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Soil Vapor Extraction Treatment Optimization

Photolytic Destruction
of
Vapor Phase Volatile Organic Compounds

Final
Work Implementation Plan

February 16, 1998

Submitted to Larry Jaramillo, Contracting Officer
SM-ALC/PKOP
McClellan AFB, Ca.

Submitted By:

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PRDA # FO4699-97-C-0107

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Soil Vapor Extraction Treatment Optimization
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for
FINAL WORK IMPLEMENTATION PLAN

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Abbreviations

AFB	Air Force Base
Amps	Amperes
ATM	Atmospheric
AWS	Air Water Separator
C3-C12	Hydrocarbons chemicals containing 3 to 12 carbon atoms per molecules
Cal	California
Can	Summa Canister
Catox	Catalytic Oxidizer
CCl_4	Carbon Tetrachloride
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
cfm	cubic feet per minute
CL	Center-Line
cm^2	Square centimeters
COE	Catox Effluent
COI	Catox Influent
CSE	Caustic Scrubber Effluent
D	Day
DAA	Days After Award
dBA	Decibles measured on the A scale
DoD	Department of Defense
DOE	Department of Energy
DRE	Destruction Removal Efficiency
ECS	Emission Control System
EL-#	Exclusion Level - 1, 2, or 3
EM	Environmental Management Directorate
EPA	Environmental Protection Agency
FBO	Filtered Blowdown

FMS	Filter Media/Solids
gph	gallons per hour
gpm	gallons per minute
H.P.	Horse Power
HSP	Health and Safety Plan
HCFC	Hydrochlorofluorocarbon
hr	hour
Hz	Hertz
IC	Investigation Cluster
ID	Induced Draft
kW	Kilowatts
lbs/hr	pounds per hour
LEL	Lower Explosive Limit
MCAWW	Methods for Chemical Analysis of Water and Wastes
MCV	Motor Controlled Valve
NETTS	National Environmental Technology Test Site
nm	Nanometers
NO_x	Oxides of Nitrogen
°F	Degrees Fahrenheit
ORD	Office of Research and Development
OSHA	Occupational Safety and Health Administration
OU	Operating Unit, OU followed by a letter, e.g. OU D is Operable Unit "D"
P	Primary Project Objective
PCE	Perchloroethylene or tetrachloroethylene
PDU	Photolytic Destruction Unit
PIC	products of incomplete combustion
PLC	Programmable Logic Control
POA	Project Objectives Statement
ppbv	parts per billion by volume

PPE	Personal Protective Equipment
ppmv	parts per million by volume
psia	pounds per square inch absolute pressure
psig	pounds per square inch gauge pressure
PTI	Process Technologies Incorporated
QA/QC	Quality Assurance /Quality Control
QAPP	Quality Assurance Project Plan
R11	Trichlorofluoromethane
R12	Dichlorodifluoromethane
R13	Trichlorotrifluoroethane
Rev	Revision
RMSF	Rocky Mountain Spotted Fever
S	Secondary Project Object
SAP	Sampling and Analytical Plan
scfm	Standard cubic feet per minute (60°F and 14.69 psia)
SFB	Scrubber Final Blowdown
SIB	Scrubber Initial Blowdown
SITE	Superfund Innovative Technology Evaluation
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TRLs	Target Reporting limits
Tetra Tech	Tetra Tech EM Inc.
TIO	Technology Innovation Office
TNMOC	Total non-methane organic compounds
TO-#	Standard Sampling or Analytical Test Method
UV	Ultraviolet Light
V	Volt
VOCs	Volatile Organic Compounds

VPNs	Vapor piezometer nests
VW	Vapor Well
WIP	Work Implementation Plan

SECTION 1

INTRODUCTION

1.1 INNOVATIVE TECHNOLOGY DEMONSTRATION PROGRAM

The McClellan AFB Innovative Technology Demonstration Program is an ongoing program established to identify and evaluate those innovative technologies that hold promise for widespread remedial applications. Each technology partner contributes to the overall process goal of generating defensible data on technology costs and performance that can be mutually shared and disseminated. The primary partners of this technology development program are:

- The Strategic Environmental Research and Development Program, which selected McClellan Air Force Base (AFB) as a National Environmental Technology Test Site (NETTS) for the demonstration of technologies designed to treat chlorinated solvents. The main goal of the test site concept is to promote rapid development and transfer of promising technologies to full-scale field implementation and commercialization.

- The California Environmental Technology Partnership (CETP), whose mission is to enhance the California economy and environment through the development of hazardous waste remediation technology.

- The Public-Private Partnership Program (Partnership Program), wherein McClellan AFB has a Memorandum of Understanding with the U.S. Environmental Protection Agency's (EPA) Technology Innovation Office (TIO); California EPA (Cal/EPA); Clean Sites, Inc.; American Telephone & Telegraph Co.; Beazer East, Inc.; Dow Chemical Co.; E.I. DuPont de Nemours Company; Monsanto Company; Southern California Edison; and Xerox Corporation.

- The U.S. EPA Superfund Innovative Technology Evaluation (SITE) Program, established by the EPA to accelerate the development of new and innovative technologies to solve hazardous waste site cleanup problems.

Process Technologies Incorporated (PTI) was selected by McClellan AFB to perform an on-site, pilot-scale demonstration of its innovative technology for the concentration and photolytic destruction of vapor phase volatile organic compounds (VOCs). The demonstration is being performed in response to a Program Research and Development Announcement F04699-95-R-0143. The PTI technology will be applied to the treatment of process vapors produced by an existing soil vapor extraction (SVE) system located at McClellan AFB, Site IC 31.

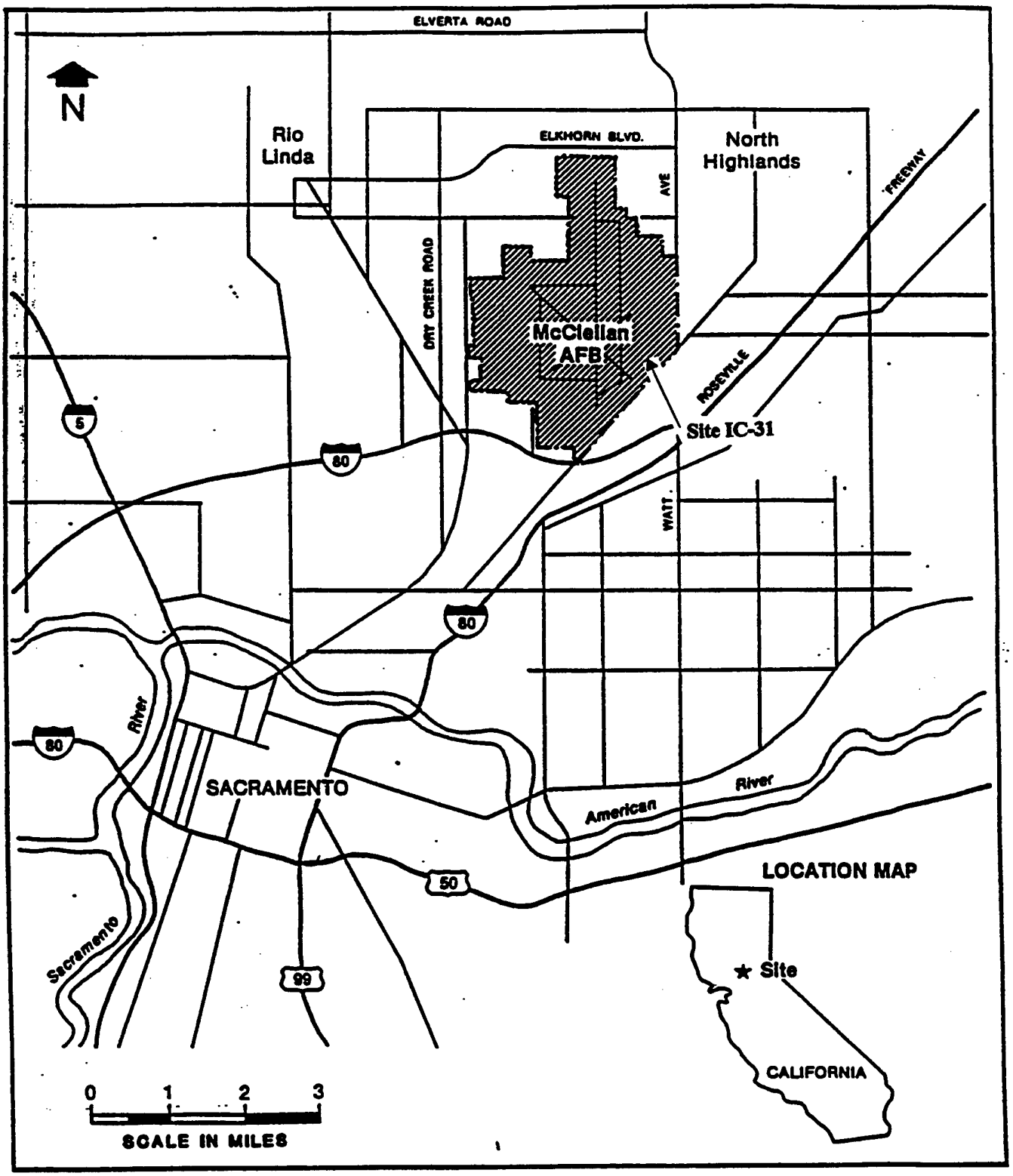
1.2 MCCLELLAN AFB SITE DESCRIPTION

McClellan AFB is located approximately six miles northeast of downtown Sacramento, California. The main base facility includes 2,949 contiguous acres. The current primary mission of the base is management, maintenance, and repair of aircraft, electronics, and communications equipment.

The base was and is engaged in a wide variety of operations involving the use, storage, and disposal of hazardous materials. These include industrial solvents, caustic cleaners, electroplating chemicals, heavy metals, polychlorinated biphenyls, low level radioactive wastes, and a variety of fuel oils and lubricants. There are approximately 250 waste sites, potential release locations, and other areas that have been identified as warranting investigation.

Soils contamination consists primarily of chlorinated hydrocarbons. The known aerial extent of soil contamination is about 370 acres. The base has a number of operational remediation systems in place, including SVE. Operable Unit (OU) A, Investigation Cluster (IC) 31 was selected for the demonstration. At IC 31 an existing Technology Test Pad will provide off-gas from an SVE system for the technology demonstration. Figure 1-1 is a location map designating the location of McClellan AFB. Figure 2-1 identifies the location of Site IC 31.

Figure 1-1: Site Map for McClellan AFB [1]



(1) Map copied from "Installation Restoration Program (IRP) - Stage 3- Basewide Remedial Investigation/Feasibility Study, Quality Assurance Project Plan Update, Revision 3, Volume III: Updates", Final Report for McClellan AFB prepared by Radian International LLC, April 1997.

1.3 PREVIOUS PTI DEMONSTRATIONS AT McClellan AFB

Prior to this demonstration, PTI completed two other demonstration projects at McClellan AFB. They were: 1) "Process Technologies, Inc. Photolytic Demonstration Project", and 2) "Photolytic Destruction Demonstration". These projects were completed as part of the on-going Innovative Technology Demonstration Program. A brief description of these demonstrations and the primary partners associated with each are described below:

- The **"Process Technologies, Inc. Photolytic Demonstration Project"** was performed in 1994, as part of the Public-Private Partnership Program and the EPA Superfund Innovative Technology Evaluation (SITE) Program. These programs are described in Sections 1.4 and 1.5, respectively. This demonstration involved bench-scale testing at PTI's laboratory in Boise, Idaho followed by on-site demonstration of the technology for the destruction of VOCs known to be in the soils at OUD Site S, McClellan AFB. The bench-scale testing was completed in June of 1994 and was implemented as part of McClellan AFB's Public/Private Partnership. The results of these bench-scale tests showed very high destruction removal efficiencies (DREs) for the target contaminants at varying concentrations.

  Following the bench-scale testing, PTI designed, installed, and operated a small-scale pilot system at OUD Site S, McClellan AFB. The testing was completed in December 1994, and again, very high DRE rates for the known contaminants of concern were achieved by the photolytic process. The system also demonstrated >99% on-line availability during the eight week period. However, several contaminants not contained in the "List of Target VOCs" were discovered to be in the soil during PTI's field demonstration. The presence of these long-chain hydrocarbons resulted in the formation of certain tar-like by-products inside the PTI reactor. Extensive testing and reactor design engineering, to eliminate or minimize these by-products, was subsequently performed at PTI's laboratory. Refer to CH2MHill's field data report, "PTI Technical Memorandum Report, Site S, Operable Unit D, Data Item No. A00E", for more information.

- PTI performed the **"Photolytic Destruction Demonstration"** program during the period September 1995 - January 1996. One of the primary objectives of this program was to develop the design basis for a full-scale, 500 cfm treatment system. The work included the demonstration of a redesigned photolytic reactor at Site S. As reported in the "Photolytic Destruction Technology (PDT) Technical Memorandum" submitted by CH2M Hill, "The PDT was successful in treating contaminated soil vapor. In its current state of development, PDT is not considered a cost-effective alternative for SVE off-gas treatment at McClellan AFB. However, if the PDT system is implemented under high-concentration, low-flow rate conditions, it has the potential to be a cost-effective alternative at McClellan AFB. Through future testing, PTI hopes to lower remediation costs with the addition of a concentrator." A detailed report of the findings can be found in the CH2MHill report "Photolytic Destruction Technology, Technical Memorandum II", Delivery Order 7036.

As a result of these previous demonstration projects, and other testing performed at Hill AFB, PTI has gained practical field experience for the next generation design of a system that will minimize maintenance for the operators. This includes the accessibility to the lamps, reagent panels, clean out ports for any tars that may deposit, and the cleaning of the reactor with minimum downtime. This knowledge has been incorporated into PTI's system that will be demonstrated under the McClellan AFB demonstration in early 1998.

1.4 OVERVIEW OF CLEAN SITES' PUBLIC-PRIVATE PARTNERSHIP AT McClellan AFB

This section describes how the Partnership Program will interact with this demonstration. The Partnership Program is coordinated by Clean Sites under a cooperative agreement with the TIO of the EPA. Its purpose is to accelerate the acceptance and implementation of innovative remediation technologies by cooperatively establishing field demonstrations that generate full-scale and real-world operating, performance and cost data. The Partnership Program involves regulators, industry, and the public in the technology demonstrations working collaboratively such that each of their individual interests may be reflected in the demonstration data collected.

The McClellan AFB Environmental Management (EM) Office and Air Force Headquarters are ultimately responsible for activities at the base. The role of the Partnership Program participants at McClellan AFB is to review and comment on the design, operation and evaluation of the demonstration. The private companies participating for this demonstration are: Dow Chemical Company; E.I. DuPont de Nemours & Co.; Monsanto Company; Beazer East, Inc.; American Telephone & Telegraph Co.; Xerox Corporation; and Southern California Edison. These comments will be provided to PTI and McClellan AFB for their discussion.

Clean Sites will assist in organizing and coordinating the exchange of information among the private and public partners. The EPA TIO will provide support to the Partnership Program, particularly in facilitating the participation of other EPA and regulatory offices. A brief description of the responsibilities of each of the participants is provided in Section 1.9, additional detail is provided in Section 2.7.

1.5 Overview of the SITE Program

A formal program has been established by the EPA to accelerate the development of new and innovative technologies to solve hazardous waste site cleanup problems. This program is called the Superfund Innovative Technology Evaluation or SITE Program. The SITE Program's goals are to identify, investigate, and evaluate technologies that will create permanent solutions to contaminated sites. The SITE Program has four objectives:

1. Identify and, where possible, remove impediments to the development and commercial use of alternative technologies.

2. Conduct demonstrations of promising technologies to establish reliable performance and cost information for site characterization and cleanup decision-making.

3. Develop procedures and policies that encourage selection of available alternative treatment remedies at Superfund sites.

4. Structure a development program that nurtures emerging technologies.

To locate the best available technologies, the EPA solicits proposals to demonstrate innovative technologies. A screening and selection process is conducted on the proposals received. The focus of the screening process is to determine the ability of the technology to treat Superfund site wastes, the treatment cost expectations, the technology's performance, the developer's approach to testing, and the applicability of the technology for full-scale demonstration. Technologies that meet the above criteria become possible candidates for demonstration.

The SITE Program is administered by the EPA's Office of Research and Development (ORD). ORD is responsible for reviewing and evaluating the proposals submitted for consideration, soliciting the EPA Regional Offices for demonstration sites, and matching the technologies with appropriate demonstration sites.

SITE demonstrations are usually conducted at Superfund sites, at EPA testing and evaluation facilities, other government facilities, sites undergoing private cleanup, the developer's test facilities, or at privately owned facilities.

1.6 DEMONSTRATION SITE DESCRIPTION

The location for this demonstration is Site IC 31. IC 31 is located in the southeast corner of McClellan AFB and covers an area of 6.7 acres. An SVE system was installed at Site IC 31 to remove VOCs from the vadose zone hot spots to reduce the potential for contaminant migration to ground water. URS Consultants, Inc. (URS) began operation of the Site IC 31 SVE system on September 3, 1996. The SVE process facility is designed to extract up to 800 scfm of soil vapor from the vapor well at vacuum levels down to -12 inches of mercury.

The SVE system installed at the site uses a catalytic oxidation (Catox) emission control system (ECS). The Catox is designed to destroy a minimum of 95 percent of the VOCs, and a caustic scrubber designed to remove greater than 99 percent of hydrochloric and hydrofluoric acid generated by the destruction of halogenated VOCs in the Catox system. Additional information on the test site and the test waste are presented in Sections 2.3 and 2.4.

Table 1-1 below, lists the critical VOCs and their approximate concentration in the SVE vapor for this demonstration. The critical VOCs were chosen based on data collected by URS at the site during the period January to March 1997. Upon review of this data, PTI chose to designate all analytes that were specifically identified by EPA Method TO-14 as having an average concentration at or above 1 ppmv as a critical VOC. All other compounds measured during the demonstration will be considered non-critical VOCs. Based on historical data collected at the site by URS Consultants, Inc., non-critical VOCs may include toluene. The quality assurance for measuring critical VOCs is more rigorous than that for non-critical VOCs, as explained in Section 3.

The data collected during the demonstration will be adequate to calculate meaningful percent removals, at least for critical VOCs, because the detection limits for the analytical methods being used (2 ppbv) is sufficiently low.

Table 1-1: Critical VOCs

Compound	Expected Concentration Level (ppmv)[1]
1,1-dichloroethane	4.30
1,1-dichloroethene	3.70
1,1,1-trichloroethane	4.20
benzene	3.90
carbon tetrachloride	1.00
cis-1,2-dichloroethene	2.70
chloroform	3.10
methylene chloride	1.10
tetrachloroethylene	1.70
trichloroethylene	32.50
trichlorotrifluoroethane	1.30

Note: (1) Average values based on data collected by URS Consultants, Inc. during the period January 16, 1997 to March 28, 1997.

1.7 PTI SYSTEM DESCRIPTION

The PTI system consists of a concentration unit and a photolytic destruction unit (PDU). VOCs typically found in SVE vapor include both halogenated organic chemicals (e.g. trichloroethylene and perchloroethylene), and non-halogenated hydrocarbons (e.g. benzene, toluene, and petroleum hydrocarbons). Based on previous experience in treating SVE vapor produced at McClellan AFB (see Section 1.3), PTI has found that it is advantageous to reduce the level of non-halogenated VOCs from the vapor stream prior to treatment in the PDU.

In order to remove the non-halogenated VOCs from the SVE vapor, PTI first concentrates the VOCs using the concentration unit. The concentration unit consists of:

- An **adsorber** that uses fluidized bed adsorbent beads to extract organic chemicals from the SVE vapor. The adsorbent beads are specifically designed to extract VOCs from high humidity gas streams. The adsorber is designed to achieve a minimum VOC removal efficiency of 95%.
- A **desorber** that evaporates the VOCs from the "loaded" adsorbent beads. High-pressure steam (125 psig) provides energy through a heat exchanger to desorb the organics from the adsorbent beads. A low pressure steam (atmospheric pressure) is used as the carrier vapor to sweep the desorbed organic vapors from the desorber. The desorbed "lean" adsorbent beads are then continuously recycled to the adsorber.
- To a **condenser** that is cooled with chilled water. Water vapor and non-halogenated organics are preferentially removed in the condenser. A portion of the halogenated chemicals are also removed in the condenser.

Non-condensable vapors from the condenser are then processed through the PDU. The PDU consists of:

- Two **Photolytic Reactors**, each capable of treating up to 5 cfm of contaminated vapor.
- A **Wet Scrubber** that uses sodium hydroxide solution to react with any acid gases that may be present in the treated gases leaving the reactors. The treated gas is then recycled to the inlet of the adsorber unit.

A general description of the technology is provided in Section 2.2, and a detailed description of the system as it is applied to this Demonstration Test is provided in Section 2.4. A description test plan is presented in Section 2.4.7.

1.8 TECHNOLOGY DEMONSTRATION OBJECTIVES

The PTI system demonstration has both primary and secondary objectives. Primary objectives are critical for the technology evaluation. Secondary objectives will provide information that is useful but not critical. There are three primary objectives and seven secondary objectives established for this Technology Demonstration. Primary objectives have been given a "P" designation, and secondary objectives have been given an "S" designation. The objectives are listed below and are more fully defined in the Project Objectives Agreement (POA) included herein as Appendix 3E.

P1 Evaluate whether the PTI system can achieve 95% overall removal of total non-methane organic compounds (TNMOC) in the feed gas stream at a 90% confidence level.

P2 Determine the percent removals achieved by the PTI system for critical VOCs in the feed gas stream at a 90% confidence level.

P3 Estimate treatment costs for the PTI system to achieve an average TNMOC removal of 95% for VOC-contaminated soil vapor at McClellan AFB, in a 1,000 scfm system.

The secondary objectives of this project are as follows:

S1 Determine the percent removals achieved by the PTI system for non-critical VOCs.

S2 Determine the concentrations of hydrochloric acid, chlorine, phosgene, ozone, carbon monoxide, NOx and dioxins exiting the PDU and PTI system.

S3 Determine the VOC percent removals achieved by the PDU.

S4 Determine the amount of VOCs which will be leached from the reagent panels when subjected to the EPA's toxicity characteristic leaching procedure (TCLP).

S5 Determine if the aqueous scrubber discharge meets the McClellan AFB wastewater treatment acceptance criteria.

S6 Characterize the condensate from the condenser for disposal purposes.

S7 Document observed operating problems and their resolutions.

The Technology Demonstration objectives are more fully developed in Section 3.1.2. Table 3-1 of the QAPP identifies sample locations and critical and non-critical parameters for the vapor streams, condensate, wastewater, and reagent panel samples. Table 3-4 identifies the number of analytical samples (including QA samples) required for the Technology Demonstration. Further explanations of how the analytical results will be used to determine if project objectives have been met are also provided in Section 3.1.2.

1.9 RESPONSIBILITIES OF THE PARTICIPANTS

This full-scale demonstration will be conducted as part of the ongoing Innovative Technology Demonstration Program described in Section 1.1. The Clean Sites Public-Private Partnership program will review and provide comments to PTI and McClellan AFB on the design, operation, and evaluation of the demonstration. Additionally, Clean Sites and TIO will promote interaction among the Partners with the objective of creating a demand among potential users of the PTI technology. TIO will also disseminate the results of the evaluation upon its completion.

McClellan AFB will provide the site and the required services and utilities, including coordinating the interface between the PTI unit to the URS SVE unit. URS reports directly to McClellan AFB and will be responsible for operating and maintaining the SVE system. McClellan AFB is also responsible for disposal/treatment of the liquid and waste streams generated by the SVE and PTI systems at McClellan.

PTI reports directly to McClellan AFB and will be responsible for the implementation of the demonstration including installation, operation, sampling, and demobilization of the demonstration facility.

The EPA SITE Program will be responsible for oversight of the field operations and laboratory analyses. Tetra Tech EM Inc. (Tetra Tech), EPA contractor for the SITE Program, will provide coordination between McClellan AFB, EPA-SITE and PTI, and will assume the lead role for the technical evaluation and quality assurance of the PTI system.

Greater detail on the responsibilities of each party is provided in Section 2.7. Figure 3-1 in the QAPP illustrates the lines of communication between the various parties.

1.10 QUALITY ASSURANCE/QUALITY CONTROL

A Quality Assurance Project Plan (QAPP) has been developed for this PTI technology demonstration project. The QAPP is tailored to conform to a Category II QAPP as specified for EPA SITE demonstrations and to meet all requirements of the McClellan AFB Base-wide QAPP. The objectives of the QAPP for this project are two-fold. First, the plan provides the mechanism for ongoing control and evaluation of measurement data quality throughout the course of the project. Second, the plan is structured so that audit results and quality control data will ultimately be used to define data quality and accuracy. The data quality estimates will, in turn, be used to define the level of the uncertainty associated with the measured parameters and process test values.

1.11 HEALTH AND SAFETY

The Health and Safety Plan (HSP) has been developed to establish specific guidelines and requirements for the protection of PTI personnel and its subcontractors. The HSP defines the risks associated with the installation, sampling and operation of the PTI system at McClellan AFB and describes how these risks will be mitigated. The HSP meets the requirements of McClellan AFB and has been prepared in accordance with the regulatory requirements of 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response. The HSP is presented in Section 4.

SECTION 2

TECHNOLOGY DEMONSTRATION PROGRAM

2.1 GENERAL PROJECT DESCRIPTION

McClellan AFB includes 2,949 contiguous acres which are bounded by the city of Sacramento to the west and southwest, the unincorporated Rio Linda to the northwest, and the North Highlands to the east. The base was and is engaged in a wide variety operations involving the use, storage, and disposal of hazardous materials. These include industrial solvents, caustic cleaners, electroplating chemicals, heavy metals, polychlorinated biphenyls, low level radioactive wastes, and a variety of fuel oils and lubricants. As a result of these operations, ground water and soil within and around the base have become contaminated with a variety of chemicals. McClellan AFB has been divided into 12 geographic OUs for the investigation of contamination. Each OU has one or more potentially contaminated sites within its boundary. Over 250 sites (locations where contaminants may have been released) have been identified at McClellan AFB.

The broad objective of this technology demonstration is to evaluate the effectiveness and economics of the PTI System to remove VOCs from soil vapor associated with the SVE well(s) at OU A, Site IC 31 (see Figure 2-1 for Site IC 31 location).

The PTI System consists of a Concentration Unit and a PDU. The application of the PTI System to the treatment of the Site IC 31 SVE soil vapor is described in the following sections:

Section 2.2 provides a general discussion of both the concentration technology and the PTI photolytic destruction technology. A variety of potential applications for the combined use of the technologies are identified.

The existing SVE ECS is described in Section 2.3 including a description of the SVE soil vapor composition. The proposed tie-in for the PTI System to the Site IC 31 SVE system is described in this section.

A detailed description of the PTI System as it will be applied to this specific project is provided in Section 2.4. This detailed description presents how the process will operate, describes the equipment that will be installed to facilitate the technology demonstration, defines the operating requirements for the demonstration (staffing, supplies, utility requirements, etc.), and defines the proposed test plan that will be implemented. The test plan identifies pre-mobilization and mobilization activities, and describes the two phases of testing (Phase 1 - Parametric Testing and Phase 2 - Preferred Operating Condition Testing). Decontamination and demobilization activities are also presented.

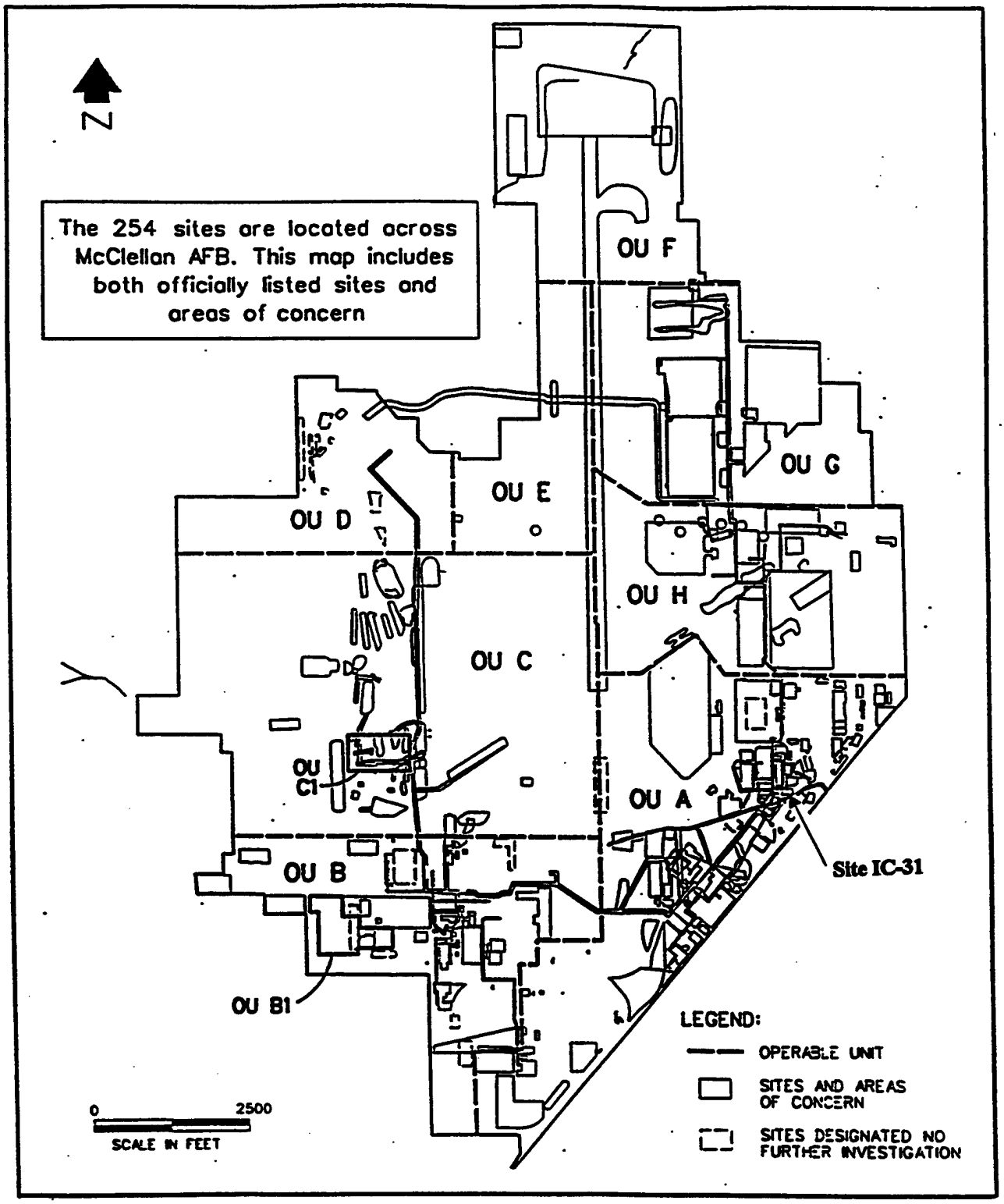
The current project schedule is to begin on-site work on February 16, 1998. The on-site operation of the PTI System, including the implementation of the sampling and analytical test plan, will commence on March 4, 1998 and will be completed on April 29, 1998. PTI will issue the final documenting report on August 31, 1998. EPA will prepare and issue an independent Innovative Technology Evaluation Report based on their assessment of the technology demonstration.

2.2 GENERAL TECHNOLOGY DESCRIPTION

PTI's VOC treatment system consists of a Concentration Unit and a PDU. The Concentration Unit is best applied to high flow, low concentration VOC vapor streams, and the PDU is best applied to low flow, high concentration VOC vapor streams.

The Concentration Unit produces a low flow, high VOC vapor that is then processed through the PDU. A fluidized bed Concentration Unit is used to effect the VOC concentration. The Concentration Unit includes a chilled-water condenser to preferentially remove non-halogenated hydrocarbons from the vent gas prior to treatment in the PDU. PTI has combined the two technologies to provide a system that can treat a variety of contaminated VOC vapor

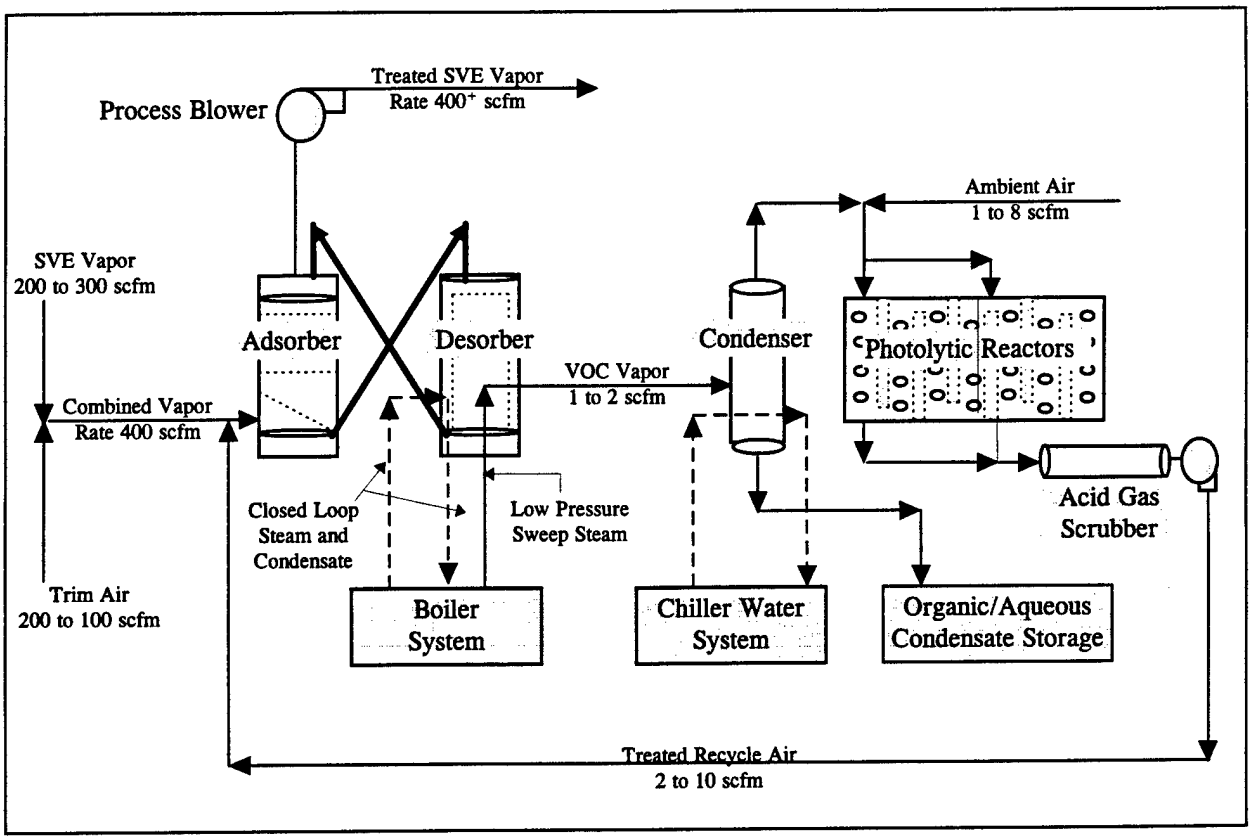
Figure 2-1 **Location Of Operable Units (OU) At McClellan AFB [1] and Investigation Cluster (IC) 31**



(1) Map copied from "Installation Restoration Program (IRP) - Stage 3- Basewide Remedial Investigation/Feasibility Study, Quality Assurance Project Plan Update, Revision 3, Volume III: Updates", Final Report for McClellan AFB prepared by Radian InternationalLLC, April 1997.

(2) streams. Both technologies are generally described below. A detailed description of the technology as it is applied to Site IC 31 is presented in Section 2.4. Figure 2-2 presents a simplified schematic diagram of the PTI System.

Figure 2-2 Simplified Schematic Diagram of PTI System



2.2.1 Concentration Unit

The fluid bed technology to be used for this demonstration was developed by Molnbacka Industri AB (MIAB) of Sweden. This fluidized bed Concentration Unit has been utilized in Europe since 1989 for the control of VOC emissions and odors. PTI licensed this technology for the U. S. Market and procured the rights to manufacture this equipment.

MIAB received the European Chemical Industry Council (CEFIC) Environmental Award to recognize their innovative concentrator. PTI draws on the experience of MIAB's engineering staff in customizing new applications.

The Concentration Unit works by first processing the SVE vapor flow through a series of trays filled with adsorbent beads. The VOCs are adsorbed onto the adsorbent beads, and the treated air is either vented through a stack to atmosphere or to an emission control system for further treatment. For this demonstration project, the treated air is processed through the emission control system for Site IC 31. Depending on the contaminants and their concentration, adsorbent media trays may be added to enhance the rate of organic capture.

2.2.1.1 Adsorber/Desorber Sections

A fluidized bed adsorber will be used for this demonstration. Fluidization of the adsorbent media enhances the kinetics and improves the VOC capture rate. In a fluidized bed adsorber, the constant movement of the media allows for all portions of the adsorbent to be utilized. In a static bed adsorber, a small break between adsorbent beads will allow the gas flow to channel through the path of least resistance, and pass through the adsorber without treatment.

The adsorbent beads are transferred into the desorber section which may be either located below, or to the side of, the adsorber section. For this demonstration, the desorber is located to the side of the adsorber. The desorber can be a fluidized bed or plug flow bed. A plug flow bed is a continuous flowing bed that is differentiated from a fluidized flow bed in that large volumes of vapor are not used to vigorously agitate the bed. For this demonstration, a plug flow bed will be used.

In the desorber unit for this project, the adsorbent beads move slowly downward through the desorber from top to bottom. The beads are in a laminar flow regime, i.e. they are not in a turbulent flow regime as occurs with the vigorous agitation associated with an active fluidized bed. The advantage of using a plug-flow bed over a fluidized bed for this application is that very high concentration ratios can be achieved for the plug flow bed since no gases (air or nitrogen) are introduced to agitate the bed, thus the desorbed vapors are not diluted with fluidization gases.

The VOCs are evaporated from the adsorbent beads by applying heat and by introducing a sweep vapor to remove the VOCs from the desorber. The bed heating media is an indirect, closed loop heat source, so it does not come into direct contact with the media or the adsorbed organics. For this Technology Demonstration, a small boiler will be used to produce up to 125 psig steam that will heat the bed up to 350°F.

The sweep vapor may be steam, air, or nitrogen. For this project, low pressure steam (atmospheric pressure) will be used for the sweep vapor. The use of air or nitrogen only as the sweep gas would significantly reduce the capacity of the condenser, or would require that the condenser be operated at temperatures below 32 °F in order to achieve the same level of VOC condensation obtained with the steam sweep system.

The use of a non-condensible gas (air or nitrogen) as the sweep gas to facilitate the removal of organic vapors from the desorber would reduce the concentration of organic vapors in the combined stream, thereby reducing the dew point of the combined stream. Colder temperatures would therefore be required to initiate condensation than if the organic vapors were not diluted. When a condensible vapor (steam) is used as the sweep gas, then as the combined stream is cooled, the steam condenses and the concentration of organics in the combined stream increases. This raises the dew point of the combined stream and allows the organics to condense at higher temperatures than would otherwise occur if a non-condensible gas is used.

Additionally, if air is used as the sweep gas, then relatively high volumes of air (20+ cfm) are needed in order to operate the unit at concentrations below 20% of the Lower Explosive Limit (LEL).

2.2.1.2 Adsorbent Media (Beads)

Depending on the application and anticipated duration of a project, PTI will suggest the optimal activated media for the adsorption process. In some situations, standard activated carbon will achieve the capture rates and other project objectives. Where there is high moisture content, difficult to adsorb organics, the necessity to reach very stringent treatment levels, and/or a multi-year installation, it may be beneficial to use a more expensive, but higher performance adsorbent.

For this demonstration, PTI will use Ambersorb® 600 carbonaceous adsorbent. This material was specifically designed for vapor phase applications. It is hydrophobic, so high levels of water vapor in the gas flow do not compete with the organics at the adsorption sites.

The spherical beads are small in size, varying between 20 and 40 mesh, and they have high strength as compared to activated carbon. Both of these characteristics are favorable to a fluidized bed design and promote better adsorption and longer media life. Rohm and Haas technical personnel have advised PTI that the Ambersorb® product has lasted over three years in one of its fluidized bed applications before replacement was required. For this demonstration, we do not expect to replace any Ambersorb® over the eight week test period.

The Ambersorb media is less prone to organic build-up with repeated regeneration. Although the adsorbent will eventually need to be replaced, as far as this eight week demonstration program is concerned, there will be little,

if any, degradation of the adsorption capacity of the media. It is also less sensitive to fluctuating operating conditions.

2.2.1.3 Condenser

Vapors released in the desorber flow through a condenser system that uses chilled water as the heat transfer media. As noted above, low pressure steam will be used as the sweep vapor to move the desorbed VOCs out of the desorber and into the condenser. The use of steam creates a sweep vapor that is primarily condensable, thereby promoting a high level of condensation in the condenser. The condenser will be operated at temperatures above 32 °F. Lower condenser temperatures require a more complex condenser unit designed to allow for freeze/thaw cycling.

2.2.2 Photolytic Destruction Unit

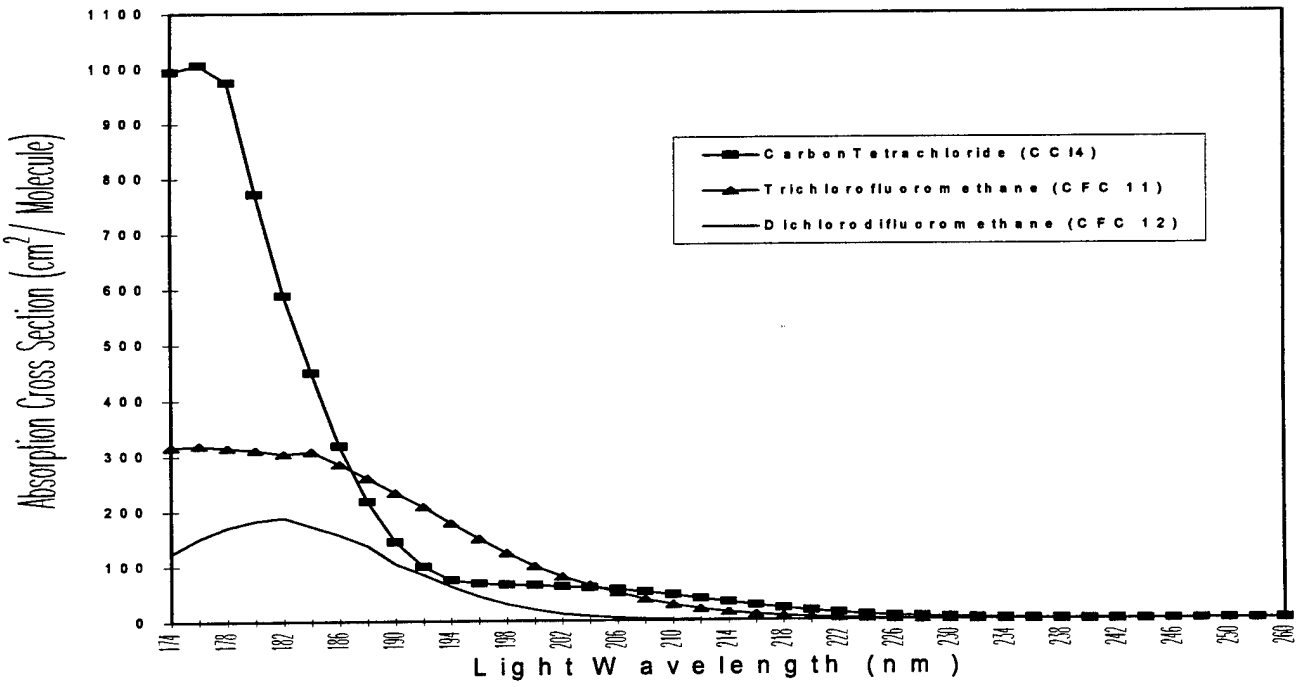
The proprietary technology developed by PTI is a method of photochemically oxidizing gaseous organic compounds within a reaction chamber. PTI's Photolytic Destruction Technology uses low pressure ultraviolet (UV) lamps located within the reaction chamber. The lamps produce UV emissions primarily at wavelengths in the 185 to 254 nanometer range. Photons emitted from these lamps break apart the chemical bonds making up the VOC molecule.

Some of the resulting by-products are chemically reacted with a solid reagent to form non-hazardous salts. The technology is ideally suited to the destruction of low-flow, high concentration gas streams. The process is capable of destroying mixtures of halogenated and non-halogenated VOCs.

2.2.2.1 Photochemical Oxidation of VOCs Using UV Light

PTI's proprietary technology mimics the natural process of breaking down ozone-depleting chemicals in the stratosphere. As the wavelength of light decreases, or becomes shorter than that of visible light, the energy level of the photons increases. These photons are capable of imparting substantial amounts of energy to the molecular bonds of compounds. For each type of molecular bond, there is a range of light energy capable of separating the molecules into a "free radical" state. Halocarbons are most efficiently destroyed by UV light in the 170 to 254 nm

Figure 2-3: Absorption Cross Section[1]



[1] DeMore, W.B., et al, eds., Chemical Kinetics and Photochemical Data for Use in Stratospheric Modeling, JPL Publication 94-26, 1994, California Institute of Technology.

range. Figure 2.3 demonstrates the ability of certain compounds to absorb deep UV light. Although the UV lamps used in the PTI reactors do not produce UV wavelengths at the peak absorption wavelengths for the chemicals shown (172 to 180 nanometers), sufficient UV energy is absorbed by the molecules at the 185 nanometer level to effectively break the molecular bonds.

2.2.2.2 Capture of Oxidation By-Products

In both nature and in the PTI reactor, the free radicals that are formed in the breakdown of halocarbons remain highly energized and extremely reactive until recombining with other radicals to form stable species. Breakdown products and acids produced in the photolytic reactor are controlled through the use of a patented reagent panel. PTI utilizes a proprietary reagent within the process chamber to react chemically with the gaseous degradation products formed during the photolytic destruction of halocarbon molecules, to form solid, stable reaction products.

The reagent panel is comprised of a PTI patented mixture of calcium oxide (CaO), calcium hydroxide ($Ca(OH)_2$) and other ingredients. As photons break apart the halocarbon chemical bonds, free radicals are formed. These extremely reactive free radicals may react with other reactive species or water, which then react with the alkaline calcium chemicals in the reagent. The resulting compounds are stable, inorganic salts such as calcium chloride, and some organic salts, and remain part of the reagent. Scanning electron microscope (SEM) analysis performed on spent reagent has shown that these compounds are retained in the reagent

Figure 2-4: Reagent Utilization

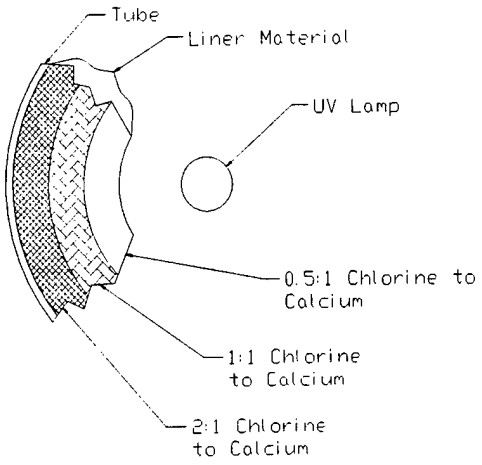


Figure 2-4 demonstrates the utilization of the reagent after reacting with the chloride radicals in the gas stream. Typically, over 50% to 70% of the active reagent is utilized. The reagent is replaced as needed when reaction products reach a level that make continued use of the reagent ineffective. Reagent life time depends on flow rate, influent concentrations, and specific chemical composition of destruction targets.

PTI has performed tests on spent reagent, using the test methodology prescribed in the U.S. EPA's hazardous waste regulations, to determine whether the material would be classified as a hazardous waste under the federal hazardous waste law and EPA regulations.

Past tests, using EPA Methods 8240 and 8270, performed on the Toxicity Characteristic Leaching procedure (TCLP) extract of spent reagent material produced at McClellan AFB have resulted in a determination that the spent reagent does not exhibit the characteristic of toxicity. The spent reagent is also not reactive, corrosive, or flammable, and thus, the company is confident that it is not a hazardous waste under federal law. The company accordingly believes that the spent reagent material can be disposed of as ordinary solid waste, or utilized as a feed-stock for cement manufacturing.

2.2.3 PTI System

2.2.3.1 Applications

The system's versatility provides for several market applications, as discussed below:

Soil Remediation. This market application involves the destruction of chemicals contained in soils at Superfund sites, federal facilities (DoD/DOE sites), and private industrial sites. PTI's system is located downstream of the soil vapor extraction unit to destroy the harmful contaminants in the air stream.

Groundwater Decontamination. VOCs contaminating groundwater sources are separated from the water with air or steam, after pumping the water to the surface. The VOC-laden gas stream is then treated using PTI's system.

Tank Vent Abatement. Chemical storage tanks are equipped with vents to displace excess and potentially harmful gases. In most cases these vented gases must be captured and treated prior to release to the atmosphere. PTI's system can be located in the vent stream to destroy any harmful gases present.

Waste Refrigerant Destruction. The bulk of refrigerants now in place are of a class of chemistry known as chlorofluorocarbons and hydrochlorofluorocarbons (CFCs and HCFCs). PTI's process is capable of destroying certain refrigerants to the required 98% destruction level.

Halon Disposal. Halons are common fire suppressant chemicals. PTI is able to destroy certain Halons with its PDU to levels of 98% or greater.

2.2.3.2 Maintenance

There are a few planned maintenance activities associated with the operation of the PTI system.

- Organic condensate must be periodically manifested and shipped to off-site treatment units.
- It is anticipated that adsorbent will require replacement every three years. Longer life may be possible depending upon the chemicals involved.
- The reagent panels must be replaced periodically to ensure that the process is efficiently capturing the free radicals formed during the oxidation process, minimizing reformation products. Site specific operational experience is used to determine when reagent panel replacement is required.
- The UV lamps will require replacement every 14 months.
- The caustic solution used in the acid gas scrubber will need to be replenished periodically as required. The solution should be replenished when the pH of the spent solution is 8.0 or lower.

2.2.3.3 Automated Operation

System start-up and shut-down procedures are fully automated with a Programmable Logic Control (PLC) system. Alarm conditions can be recorded to allow for system checks prior to starting up the system after a shut-down condition. An emergency stop button is provided.

2.2.3.4 Performance Advantages

The PTI System is a relatively low temperature process. The fluidized bed adsorber is normally operated below 120 °F, the plug flow bed desorber is normally operated at 230 °F to 300 °F, and the PDU is normally operated at 150 °F to 200 °F. By operating at relatively low temperatures, the system avoids the incidental production of highly toxic and corrosive compounds which may occur during the thermal destruction of certain halogenated organic compounds.

Most conventional thermal oxidizers, which incinerate VOCs at temperatures near 1,800 °F, experience corrosion and other difficulties, even at very low concentrations of halogenated VOCs. Thermal processes often produce as byproducts undesirable "products of incomplete combustion" (PICs) and acidic compounds. PICs are often carcinogens, and many of them are not efficiently recovered by conventional scrubbing and may therefore be discharged directly into the environment. Any acidic compounds formed in the process must be removed through expensive and often maintenance-intensive quenching and scrubbing processes.

The PDU significantly reduces harmful emissions by inhibiting the reformation process. The reformation process is inhibited by reducing the concentration of free radical in the vapor phase due to their reaction with the reagent panels. The placement of the reagent panel in the photolytic reactor transforms potentially harmful acidic radicals into inert, stable salts. The spent reagent material has proven to be non-hazardous using the Toxicity Characteristic Leaching Procedure (TCLP) analysis performed by EPA certified laboratories. This allows disposal of the spent reagent in an ordinary landfill operation. Any by-products not captured by the reagent panels are recovered in a small (10 to 20 cfm), conventional scrubber. The emissions from the scrubber system are recycled through the Concentration Unit.

PTI's technology is attractive from a regulatory standpoint because it operates at relatively low temperature as compared to catalytic oxidizers, and significantly reduces the production of secondary waste streams. Because the Concentration Unit and the PDU are relatively low temperature operations, they do not produce compounds that contribute to the creation of smog, such as nitrogen oxides (NO_x). In more populated areas of the U.S., users of incineration or catalytic oxidation processes must purchase air discharge credits when their equipment emits these compounds to the atmosphere. The use of the Concentration Unit to concentrate VOC vapors prior to destruction in the PDU significantly decreases the volume of secondary waste products. For example, a PDU scrubber may discharge only 1/8-1/4 gallons per minute (gpm) of water, whereas some thermal oxidizer scrubbers discharge from 1-2 gpm in treating the same waste stream. The lower scrubber discharge rate results in less total water to be treated, and thus, less cost to the user.

2.3 DEMONSTRATION SITE

2.3.1 Description of Site IC 31

The demonstration will be performed at the Technology Test Pad located within Site IC 31. Site IC 31 is located in the southeast corner of McClellan AFB and covers an area of 6.7 acres. There are two separate remedial treatment systems located adjacent to the Technology Test Pad. The two systems treat effluents extracted from Sites IC 31 and IC 29.

A SVE system was installed at Site IC 31 to remove VOCs from the vadose zone in order to reduce the potential for contaminant migration to ground water. The depth to groundwater at the site is approximately 100 to 110 feet below ground surface. URS began operation of the Site IC 31 SVE system on September 3, 1996. The SVE system at Site IC 31 currently consists of one operating vapor well (VW), several vapor piezometer nests (VPNs), and an ECS. The SVE process facility is designed to extract up to 800 scfm of soil vapor from the vapor well at vacuum levels down to -12 inches of mercury. During the period January through May, 1997, the SVE rates from the operating well have varied from 170 scfm to 330 scfm with VOC concentration levels of 600 to 1,000 ppmv.

Vapors from the SVE system are processed through an ECS. The ECS includes both a Catox and a caustic scrubbing system. The Catox unit is designed to destroy a minimum of 95% of the VOCs, and the caustic scrubber is designed to remove greater than 99% of hydrochloric and hydrofluoric acid generated by the destruction of halogenated VOCs in the Catox system.

URS has reported that 64,993 pounds of VOCs have been processed through the ECS as of May 31, 1997 (Refer to Soil Vapor Extraction Systems, Monthly Operations Report for May 1997, by URS Greiner, dated June 12, 1997). The VOCs present in highest concentrations include TCE, other halogenated solvents, and petroleum hydrocarbons. The SVE vapor will be the principal feed stream for the demonstration. The composition of this SVE vapor stream is shown on Table 2-1. (Note: All of the remaining tables and figures for Section 2 are located immediately behind Section 2.7.) Five separate VOC samples were analyzed during the period January 10 through March 28, 1997. An average value for each analyte is identified in the right most column. The average values have been used to represent the SVE vapor for the development of the process flow balances included herein as Appendices 2B and 2C.

A dual phase treatment system is installed adjacent to the Technology Test Pad and treats vapors from Site IC 29. A low profile air stripper is used to evaporate the VOCs from the groundwater, and generates approximately 400 scfm of process gas at 30 to 40 ppmv VOCs. The vapor effluent from the air stripper is combined with the SVE vapors

from IC 31, and the combined vapor then flows to the Catox Unit influent (COI). Vapor effluent from Site IC 29 will not be processed through the PTI System.

2.3.2 PTI Process Tie-in at Site IC 31

The technology demonstration will consist of implementing the PTI system to a slip-stream taken from the suction of the SVE blower at Site IC 31. The slip-stream will be taken upstream from the point where the IC 29 air stripper vapors combine with the IC 31 SVE vapors. Figure 2-5 presents a schematic process flow diagram that reflects the interface of the PTI system with the SVE system. The flow rate of this slip-stream is controlled by a butterfly valve provided with the PTI System. After the SVE gases have been treated by the PTI system, the treated air will be returned to a point downstream from the slip-stream take-out point. PTI will work with the McClellan AFB personnel to identify the exact interface locations. The isolation valves and all interface modifications to the existing SVE piping system are outside of PTI's scope of supply. Figure 2-6 presents a block flow diagram that identifies the major process operations associated with the PTI System. Also shown on the diagram are the proposed sampling points to be used for the sampling and analysis plan (SAP). Refer to Section 3 for detailed information related to the SAP.

2.4 TECHNOLOGY DEMONSTRATION - DETAILED DESCRIPTION

2.4.1 Basis for Process Flow Balance Development

The economics for the PTI system are most favorably impacted by the overall mass rate of organics removed by the system. As the quantity of organics removed increases, removal cost ($'s per pound of organics removed) is reduced. For this reason, the primary variable that will be evaluated during the technology demonstration will be to determine the maximum SVE vapor rate (scfm) that can be processed through the system while achieving an overall VOC removal efficiency (RE) of 95%.

Previous experience in treating SVE vapor at McClellan AFB (see Section 1.3) has demonstrated that it is advantageous to reduce the quantity of non-halogenated hydrocarbons processed through the PDU. Consequently, the PTI System utilizes a condenser to preferentially remove these compounds. Selecting the optimum condensing temperature is a secondary variable which will be evaluated during the test program.

Process flow diagrams for the PTI System are provided in Appendix 2A. Two process diagrams are included. Appendix 2A Sheet 1 identifies the major process equipment associated with the Concentration Unit and Appendix 2A Sheet 2 identifies the process equipment associated with the PDU. Process flow stream numbers are shown for the vapor phase process streams. The stream numbers correlate with the process flow balance tables included as Appendices 2B and 2C

Process flow balances were developed based on a nominal SVE vapor influent flow rate of 250 scfm from the SVE well system. Appendix 2B presents the gas-side process flow diagram and process flow balance for the PTI System when treating 250 scfm of SVE vapor with the condenser operating at 35 °F. Appendix 2C presents the process flow diagram and process balance with the condenser operating at 68 °F. The composition of the SVE vapor is based on the average composition shown on Table 2-1 (706.3 ppmv of VOCs). As shown on the process flow balance in Appendix 2B, when processing 250 scfm of SVE vapor at 95% removal efficiency, the mass rate of VOC removal is 3.061 pounds per hour (lbs/hr) [3.222 lbs/hr influent (Stream No. 1A) - 0.161 lbs/hr (Stream No. 2)].

The PTI System that will be used for this demonstration was originally designed to remove 3.6 lbs/hr of VOCs. This is equivalent to 294 scfm of SVE vapor (3.6 lbs/hr / 3.061 lbs/hr x 250 scfm). Since the PTI System is limited by the mass rate (lbs/hr) of VOCs that can be removed by system, the SVE vapor influent rate to the concentrator system will be limited to control the mass rate of VOCs processed. If higher VOC concentrations are experienced during the demonstration program, then lower SVE vapor rates will be processed. If lower concentrations are experienced, then higher SVE flow rates will be processed. Ambient air will be combined with the SVE vapor to achieve the desired total flow rate through the concentrator unit. The vapor rate through the adsorber must be maintained in the range of 400 to 500 scfm to properly fluidize the adsorbent. PTI intends to operate the unit at a flow rate of approximately 400 scfm to the inlet of the adsorber.

2.4.2 Concentration Unit Operation

In the process of removing VOCs from SVE vapors, PTI first concentrates the VOCs using a Concentrator Unit. The Concentrator Unit consists of:

- An adsorber that develops a fluidized bed of adsorbent beads to extract organic vapors from the SVE vapor. The adsorbent beads are specifically designed to extract VOCs from high humidity gas streams. Although the adsorber is designed to achieve a minimum VOC removal efficiency of 95%, the adsorber used for this demonstration includes two additional stages of adsorption than are required to meet the 95% minimum removal efficiency. For this reason, PTI expects that the VOC removal efficiencies achieved during the demonstration program will be higher than the 95% RE goal.

- A desorber that evaporates the VOCs from the "loaded" adsorbent beads. High-pressure steam (125 psig) provides energy through a heat exchanger to desorb the organics from the adsorbent beads. A low pressure steam (atmospheric pressure) is used as the carrier vapor to sweep the desorbed organic vapors from the desorber. The desorbed "lean" adsorbent beads are then continuously recycled to the adsorber.

- A condenser that is cooled with chilled water. Water vapor and non-halogenated organics are preferentially removed in the condenser. A significant quantity of the halogenated chemicals are also removed in the condenser.

The basic process operations for the PTI Concentration Unit (refer to Process Flow Sheet, Appendix 2A Sheet 1) are described below:

- A booster blower will be installed to draw SVE vapors from the suction side of the existing SVE blower unit. The discharge of the booster blower will be discharged into the Concentration Unit.
- The booster blower unit will include an air/water separator. Water that collects in the separator will be transferred to McClellan AFB for their disposal to the existing wastewater disposal system.
- The adsorber will be operated under a slight negative pressure so that SVE vapor can be drawn into the adsorber. A manually operated flow control system will be used to bring 250 scfm of SVE vapors into the unit. As noted earlier, the SVE flow rate will be adjusted based on the actual VOC concentrations that are experienced during the demonstration program.
- Additional ambient air (trim air) will be mixed with the SVE vapor before entering the adsorber. A manually operated flow control system will be used to draw 400 scfm of combined vapors into the adsorber.
- The combined 400 scfm of gas flow moves upward through multiple stages of contact with adsorbent media. For this project, Ambersorb® 600, an activated synthetic media manufactured by Rohm and Haas, will be used to adsorb VOCs from the gas stream.
- The adsorbent beads flow downward through the unit (tray-to-tray) while the gas flows upward at sufficient velocity to fluidize each stage of adsorbent. This allows intimate and thorough contact of the gas with the adsorbent.
- The treated gas passes through an internal screen prior to its return to the existing SVE piping at a point down-stream from the tie-in. The internal screen ensures that the adsorbent beads are retained within the adsorber.
- The "loaded" adsorbent beads are pneumatically transferred to the top of the desorber. The adsorbent beads flow downward in a plug flow manner. The desorber contains a steam-heated, heat exchanger that warms the adsorbent up to 350 °F. This vaporizes the adsorbed VOCs.
- Low pressure, superheated steam is used to sweep the desorbed VOCs out of the desorber and into the condenser.
- The condenser temperature can be controlled with a thermostat to achieve the desired condensing conditions. Initially, PTI will operate the condenser with chilled water at 35 °F to achieve maximum removal of the VOCs as liquid condensate. During the first few weeks of operation, an evaluation will be made to determine the preferred operating temperature for the condenser. As the temperature is

increased, higher levels of non-condensable vapors will be produced for subsequent processing through the PDU.

- Condensate will be collected in a "day" tank and then transferred to a bulk storage tank. The bulk storage tank will be sampled and analyzed prior to transfer of the condensate to McClellan AFB waste disposal systems. The day tank will be sized to hold 3 to 4 days of condensate. This will allow the bulk tank to be held inactive while awaiting the analytical results prior to transfer of the bulk storage condensate to McClellan AFB.
- A small electric-heated boiler will generate steam for the desorber and provide the low pressure, sweep steam.
- A chilled water system will be used to produce chilled water for the condenser. Heat is rejected from the refrigeration unit using an air-cooled heat exchanger.
- The "lean" adsorbent will be pneumatically recycled to the top of the adsorber for reuse. This provides for the continuous closed-loop operation of the adsorbent beads through the concentrator system.
- It is not anticipated that any additional adsorbent will be required during the test program.

2.4.3 PDU Operation

Non-condensable vapors from the condenser are then processed through the PDU. The PDU consists of:

- Two Photolytic Reactors, each capable of treating up to 5 scfm of contaminated vapor.
- A Wet Scrubber that uses sodium hydroxide solution to react with any acid gases that may be present in the treated gases leaving the reactors. The treated gas is then recycled to the inlet of the adsorber unit.

The basic unit operations for the PDU (refer to the Process Flow Sheet Appendix 2A Sheet 2) are described below:

- Non-condensable vapors from the condenser flow into the PDU. Two photolytic reactors operated in parallel are provided with the unit, and provisions have been made to allow retrofitting of a third reactor if required.
- The non-condensable vapors are mixed with ambient air prior to entering the PDU in order to control the vapors to less than 20% of the LEL for the gas mixture. This adjustment is made manually based on an LEL meter reading. The LEL meter is interlocked to automatically shut-down the system in the event that the LEL meter reading approaches 100%.
- The VOC laden vapor passes through the photolytic reactors where the vapors are exposed to high levels of photons. The VOCs break into free radicals which react with the alkaline compounds contained in the reagent panels. The reagent panels are adjacent to the UV lamps.
- In order to control the temperature inside the reactors, a closed-loop cooling water system provides cooling water to plate-type heat exchangers that are sandwiched between the reagent panels. Heat energy from the lamps, and heat of reaction from the neutralization reactions are removed via the internal heat exchangers (see Appendix 2D).
- The closed-loop cooling system circulates the water from the heat exchangers through a radiator system where air rejects the heat to atmosphere. The cooling system has two pumps, one operating and one spare.
- The treated gas then flows through a caustic scrubber to remove any trace amounts of acid gases or chlorine gas that are not reacted with the reagent panels.
- The scrubbing system operates with a 5% caustic soda solution as the reagent. Two pumps are provided with the system, one operating and one spare.
- Spent scrubber solution is batch flow pumped out of the scrubber recycle tank, through an activated carbon canister provided by PTI, and into a 55 gallon drums. Composite samples of the solution in the drums will be analyzed prior to transfer to McClellan AFB wastewater disposal systems.
- The clean, scrubbed gas then flows back to the inlet of the Concentration Unit.

- An emergency by-pass system is included so the cleaned and scrubbed gas can be processed through a canister of activated carbon prior to recycle to the adsorber outlet in the event that the Concentration Unit trips off-line.
- A single set of reagent panels will be used during the demonstration. At the completion of the demonstration, the panels will be sampled and analyzed by EPA TCLP protocol. Additional information regarding the Test Plan is provide in Section 2.4.7 and Section 3.1.3.

2.4.4 PTI System Installation on the Technology Test Pad

The PTI system will be installed adjacent to the existing environmental control system (ECS) locate at Site IC 31. Figure 2-7 identifies the proposed location of the PTI system installation on the Technology Test Pad. As shown, the existing fence will need to be temporarily relocated to provide access to the PDT set-up area during installation and operation. Overhead electrical lines are above the proposed installation area, consequently the PTI system will need to be assembled without the use of cranes. Forklifts will be used for positioning of the PTI equipment. A layout of the PTI System equipment is provided herein as Figure 2-8.

2.4.5 PTI System Modules

The PTI equipment will be brought to the site as equipment modules that are interconnected with field-run piping, and electrical/instrumentation wiring. The equipment modules are:

- Concentration Unit Trailer Module (adsorber, desorber, fan, pneumatic transfer system, condenser, refrigeration unit, boiler unit, and all associated electrical equipment and controls - see Figure 2-9).
- Solvent Storage Tank Module (skid-mounted condensate day tank and pump).
- The PDU Module (The PDU will consist of a single module that will be interconnected to the Concentration Unit and tank modules. The PDU will be housed in a cargo container that has all of the PDU equipment pre-piped, pre-wired and pre-instrumented. This module will also house the motor control center and the PLC system that is common to all of the modules. A small work office is also included in the Process Module (see Figure 2-10).
- SVE Booster Blower Module (booster blower, air/water, motor starter, and instrumentation/controls).

All of the PTI System modules will be placed on cribbing as the primary support for the units. Grounding rods will be placed as appropriate and grounding wires provided to ensure the safe operation of the unit.

2.4.6 Operating Requirements

2.4.6.1 PTI Staffing

During the installation phase, a minimum of four and a maximum of six PTI personnel will be on-site. This will include the PTI Project Manager, Field Manager, Health and Safety Officer, and Chemist. Two others may be involved during this period. They include a field technician to support the equipment installation and the Project Director. These personnel will be on-site for approximately two weeks to facilitate the installation and mechanical start-up of the facility. All of the personnel will follow McClellan AFB procedures for badging and safety orientation. Appropriate personal information required to facilitate the badging process will be submitted a minimum of two weeks prior to site work. Several of these personnel will participate in a Field Kick-off meeting prior to mobilization. In addition, MIAB, the manufacturer of the Concentration Unit, may also have one or two representatives on-site. The MIAB personnel are citizens of Sweden and their credentials required to support site access will be submitted to McClellan AFB a minimum of one month prior to their participation in site work.

Various subcontractors will also be involved during the installation, operations, and demobilization phases of the work. They include: a trucking company to first deliver and later ship the unit, an electrical subcontractor to make (and later terminate) electrical tie-ins, a piping subcontractor to install field -run piping, reagent supplier for the deionized water, and analytical sampling laboratory personnel.

During operations, the Field Manager or the Project Manager will be on-site during normal work-hours. The Field Manager will be stationed in the Sacramento area throughout the duration of the Technology Demonstration.

During the decontamination and demobilization phase at the conclusion of the project, a similar staff of personnel will be involved with decommissioning and shipment of the unit.

2.4.6.2 Operating Times

PTI intends to operate the facility 24 hours per day, seven days per week. The unit will operate unattended during normal off-hours and weekends.

2.4.6.3 Utility and Reagent Requirements

Project utility requirements, reagent consumption, and residues rates are presented in Table 2-2. The "Quantity" column reflects the total anticipated reagent use, utility consumption, and waste production that will occur during the entire demonstration. Specific power requirements are presented on Table 2-3.

2.4.7 Test Plan

2.4.7.1 System Pre-testing

Prior to initiating the on-site work, the PTI system will be tested to verify mechanical, electrical and instrumentation integrity. The Concentration Unit will be operated using air only as the feed gas and the adsorbent beads will be recycled through adsorber/desorber equipment. The steam and chilled water sub-systems will also be tested prior to shipment to the site. In addition, the PDU will be fully tested prior to shipping it to the site.

2.4.7.2 Mobilization

Prior to delivering the PTI system to the site, PTI personnel will coordinate with McClellan AFB personnel to ensure that the site is ready to receive the PTI System. Advance mobilization include:

- Preparing an area to receive the PTI system.
- Preparing an area to receive the Booster Blower.
- Installing piping connections for the SVE vapor inlet, treated vapor outlet, and potable water tie-ins. Since this is a temporary facility, piping runs will all be above grade and will be anchored onto cribbing supports. Walk-over stiles will be placed where appropriate to prevent tripping hazards.
- Preparing a 480 volt, 200 amp electrical service (a fused disconnect) to provide power to the PTI System.

The first two weeks of PTI on-site time will be used for the installation and mechanical check-out of the PTI system. The PTI demonstration site will be arranged as shown in Figure 4-1. Work Zones are defined on this figure. During normal work operations, project personnel and visitors will be required to use Level D personnel protection (see Section 4.5.2). During reagent panel change-out, an exclusion zone will be set up as shown on Figure 4-1. Personnel involved with the panel change-out will be required to wear Level C personnel protection (see Section 4.5.2). After the reagent panels have been replaced, approximately a one to two hour procedure, the exclusion zone will be terminated.

2.4.7.3 Parametric Testing

The demonstration will be performed in two phases. Phase 1 involves parametric testing to establish the preferred operating conditions for the Phase 2 test work. Two variables will be assessed during Phase 1 of the program. They are: mass flow rate of organics and condenser operating temperature. The mass flow rate of organics is the major cost impacting parameter for the Concentration Unit, and the condenser operating temperature is the major parameter that impacts the costs for the condenser and the PDU.

Table 2-4 presents the planned test program during Phase 1 of the demonstration. The first three-day period will be used to condition the adsorbent beads. During this period, the unit will be operated at approximately 200 scfm of SVE vapor and 200 cfm of ambient air. The adsorbent beads will achieve a residual loading of organics that will be typical of the VOC chemistry specific to Site IC 31 SVE vapors. A total vapor flow rate of 400 scfm or greater into the adsorber is required to maintain fluidization. After the adsorbent beads have been conditioned with organics, the PTI system will be operated continuously for a minimum of 2-1/2 days under each of the defined operating conditions. This will allow the Concentration Unit to achieve equilibrium operation for each of the conditions. After 2-1/2 days of operation, a sample will be collected to represent the run.

Samples will be taken at the adsorber unit inlet and outlet and analyzed as defined in the Technology Evaluation Sampling Schedule (Table 3-5 in Section 3). Samples will also be taken at the inlet of the PDU to determine system performance at each of the conditions. These samples will be taken at the end of each parametric test run, and approximately 4 hours will be required to collect each sample. Flow rate, temperature, and pressure measurements will be taken for each of the vapor streams analyzed. This will provide the ability to determine the mass flow rates of SVE vapor, trim gas, treated gas, and organic removal. Humidity measurements will also be taken for the vapors entering and exiting the adsorber. A three day break will follow the last parametric test run to allow for data evaluation and the reconfiguration of the PTI system to operate at the preferred operating conditions selected for the Phase 2 tests.

After completing the series of parametric tests, the analytical results will be evaluated to establish the operating conditions for the Phase 2 test. The samples from the Phase 1 test runs will be produced on a quick turn-around basis. The most favorable conditions will be the highest mass flow rate of organics achieved (minimum ambient air use) while maintaining a minimum of 95% overall VOC removal, and the highest condensate temperature that can be maintained without overloading the PDU (flow rates greater than 10 cfm or explosive limits greater than 20% of the LEL).

2.4.7.4 Preferred Operating Condition Testing

For the remainder of the demonstration, the PTI system will be operated at the preferred operating conditions determined during weeks 1-3.

Table 3-5 (Section 3) presents the proposed SAP for the project, and Appendices 3A and 3B (Section 3) identify the sample locations. Sampling protocols, data reduction/evaluation techniques, and other quality assurance requirements are also addressed in Section 3. EPA SITE will provide quality assurance oversight and audits.

2.4.7.5 Project Objectives Testing

Analytical testing will be performed to meet the Project Objectives P1, P2, S1, S2, S3, S4, S5, and S6. Section 3.1.2 identifies the number of samples and the analytical methods that will be used to gather data to meet these objectives. Operations and Maintenance Logs will be used as the basis for addressing Project Objectives P3 and S7.

2.4.7.6 Demobilization

After completion of the demonstration runs, PTI will decontaminate and decommission the system. The decontamination work will be performed in two steps. First, the Concentration Unit will be operated using ambient air only in a recycle mode to remove organics retained in the adsorbent beads. The organics will be collected and characterized to determine the quantity of residual organics in the adsorbent. Second, after the adsorbent has been regenerated, the system will be taken off-line and disassembled. Mechanical equipment that has been exposed to contamination will be cleaned in conformance with the procedures defined in the HSP (refer to Section 4). Decontamination materials will also be disposed in conformance with the HSP.

Two samples will be taken from the reagent panels. One sample will be a composite from reagent panels located near the inlet to each reactor, and the other will be a composite from reagent panels located near the outlet of each reactor. First, the inlet sample will be subjected to TCLP testing. If the sample meets TCLP requirements, then all reagent panels will be deemed non-hazardous and appropriately disposed. If the sample fails the TCLP tests, then all of the panels will be disposed in conformance with the hazardous waste disposal requirements, and the second sample will be tested for TCLP in order to provide additional information for the Final Report.

2.5 DOCUMENTATION AND REPORTING

PTI will be responsible for ensuring that all field data including measurements, activities, and sample analysis resulting from the test are properly documented and secured to meet McClellan AFB and EPA's SITE Program requirements. PTI will maintain a file on all work documentation including raw data, calculations, assumptions, and sources of information. PTI will also take 35 mm color slides of relevant field activities and will provide copies of the slides to McClellan AFB, Clean Sites, and EPA National Risk Management Research Laboratory (NRMRL). The EPA NRMRL program will arrange for a videotaped documentation of the Technology Demonstration.

PTI will also prepare monthly reports throughout the project duration. The reports will be issued to the organizations represented on the project team (see Section 2.7).

PTI's contract with McClellan AFB will be closed-out with the issuance of a Final Report which will follow the format specified in the McClellan AFB Performance Work Statement. A copy of the Table of Contents for the Final Report is included herein as Appendix 2E. The Final Report will include an economic analysis and information for a comparative evaluation against similar technologies. EPA will prepare a demonstration bulletin, technology capsules, a QA/QC data package, and a final Innovative Technology Evaluation Report, all of which will be provided to the organizations represented on the project team.

2.6 SCHEDULE FOR THE TECHNOLOGY DEMONSTRATION

Table 2-5 identifies key report, deliverables, and other important milestones as required by PTI's contract with McClellan AFB. The overall schedule for the technology demonstration is presented in Figure 2-11.

The project has been scheduled to have the on-site activities begin on February 18, 1998, immediately after the Final Work Implementation Plan has been approved and issued. Pre-operations activities will require approximately two weeks to complete. During the first week, the PTI System modules will be positioned and the PTI modules will be interconnected. Tie-ins to the existing SVE system and utility hook-ups will also be made during this period. After the installation is complete, the second week will be required to complete mechanical start-up and process start-up of the system. During mechanical start-up, the equipment, piping, electrical systems, and instrumentation systems will be checked-out for system integrity. After completing the mechanical start-up, process start-up will be initiated first using ambient air only as the feed gas to the adsorber, followed by the processing of SVE vapor.

The Phase 1 Parametric Testing activities are scheduled to begin on March 4, 1998. The activities will require approximately three weeks to complete. Analytical samples will be taken and analyzed as scheduled in the SAP. After review of the Phase 1 data, the Phase 2 Preferred Operating Conditions Testing will begin on March 25, 1998. The PTI System will be operated under steady-state conditions for a five week period that ends on April 29, 1998.

During the five week period for Phase 2 testing, a visitors day will be held (tentatively scheduled for April 1, 1998) which is hosted by McClellan AFB personnel. Presentations will be made by both McClellan AFB project team members and PTI project team members.

After completing the Phase 2 test work, approximately one week will be required to decontaminate the PTI System and secure the PTI modules for shipment off-site. It is planned that the PTI system will be shipped off-site on May 6, 1998.

PTI will initiate the preparation of the Draft Report on April 29, 1998. The Draft Report will be issued for review by the entire project team on May 25, 1998. As required by McClellan AFB, a formal comment and review period will follow the Draft Report review. Issuance of the Final Report is scheduled for August 31, 1998.

2.7 PROJECT TEAM – RESPONSIBILITIES AND PARTICIPANTS

The following sections identify the responsibilities of the participants in the demonstration of the system. An Overall Project Organization chart is presented in Section 3.2, Figure 3-1, and quality assurance personnel are identified in Section 3.2, Figure 3-2.

2.7.1 McClellan AFB

McClellan AFB has the overall project responsibility for the technology demonstration. The McClellan AFB Project Manager is responsible for ensuring the completion of the individual program tasks. McClellan AFB will assist in coordinating the involvement of Clean Sites, Public-Private Partnership, and EPA SITE in this demonstration. McClellan AFB has assigned the development of the Work Implementation Plan to PTI. Craig Burnett is the Project Manager for McClellan AFB, Jerry Vincent is the Field Team Leader, Larry Jaramillo is the Contracting Officer, and Tim Chapman (BDM Management Services) will serve as Project Coordinator for McClellan AFB.

2.7.2 EPA NRMRL

EPA NRMRL is responsible for the oversight in the preparation and implementation of the Technology Demonstration. EPA NRMRL will also be responsible for defining and implementing the quality assurance programs for the project. Both pre-operation and operational audits will be performed by EPA NRMRL at the demonstration site and at the analytical laboratories. The EPA Project Manager for this program is Paul dePercin, and Kirankumar Topudurti (Tetra Tech) will serve as consultant to EPA NRMRL throughout the program.

2.7.3 EPA Technology Innovation Office

EPA-TIO will assist the Public-Private Partnership in gathering input regarding the development and implementation of the demonstration program. The TIO will also be responsible for the dissemination of the evaluation results to the public. TIO will also assist in the resolution of technical and/or policy issues that may arise during the course of the project. TIO's Project Manager for the Public-Private Partnership is Carlos Pachon.

2.7.4 Clean Sites

Clean Sites, under a cooperative agreement with EPA TIO, will provide assistance through facilitation for the Public-Private Partnership. Clean Sites will coordinate the exchange of information between the partners, McClellan AFB, and PTI, and will alert the partners of issues that arise during the course of the project. Clean Sites will receive documents and information from PTI, McClellan AFB, or other partners involved in the demonstration, will transmit that information to the Partnership members, will facilitate the review and evaluation of that information, and will communicate the results of those reviews and evaluations to PTI and McClellan AFB for their consideration. Clean Sites' Project Manager for this demonstration is Richard Waesche.

2.7.5 PTI

PTI is responsible for the development and implementation of the demonstration. PTI will identify technical and non-technical obstacles that may interfere with the timely completion of the demonstration and will report these items to McClellan AFB personnel. PTI will perform sampling in conformance with the proposed sampling plan. Where PTI lacks the expertise to perform a particular type of sample, PTI will arrange for qualified sampling personnel to take the samples. PTI will also be responsible for packing and shipping these samples to the appropriate analytical laboratory. PTI will document the activities during the demonstration and will prepare the Final Report. PTI will also evaluate the results of the analytical tests, including evaluation the results of the quality assurance program established by the EPA SITE audits. PTI will be responsible for the safety of its personnel. PTI reports directly to the McClellan AFB. PTI's Project Manager is John Ferrell, PTI's Project Director is Mike Swan, and PTI's Operations Field Manager is Randy Cooper.

Table 2-1
IC 31 SVE Vapor Composition

Chemical	First Quarter 1997 Anaytical Data (1,2)						
	4888 TO14	5547 TO14	5638 TO14	5735 TO14	5739 TO14	5752 TO14	Average TO14
	ppmv	ppmv	ppmv	ppmv	ppmv	ppmv	ppmv
Chloromethane	-	-	-	-	-	-	-(3)
Methylene Chloride	1.800	1.200	1.100	0.610	-	0.540	1.1
Chloroform	3.400	3.300	3.200	2.600	3.100	2.800	3.1
Carbon Tetrachloride	1.400	1.300	1.000	0.640	0.680	0.590	1.0
1,1 Dichloroethane	3.600	5.600	3.800	4.100	4.400	4.200	4.3
1,2 Dichloroethane	1.300	0.840	0.830	0.420	-	0.540	0.7
1,1,1 Trichloroethane	4.100	4.100	5.000	3.800	4.100	4.300	4.2
Vinyl Chloride	-	-	-	-	-	-	-
1,1 Dichloroethene	5.100	4.100	3.700	2.900	3.200	3.000	3.7
trans-1,2 Dichloroethene	-	-	-	-	-	-	-
cis-1,2 Dichloroethene	3.200	2.900	3.200	2.200	2.400	2.500	2.7
TCE	37.000	35.000	35.000	31.000	30.000	27.000	32.5
PCE	1.700	1.600	1.800	1.900	1.800	1.600	1.7
1,2-Dichlorobenzene							-
Dichlorodifluoromenthane (R12)	-	-	-	-	-	-	-
Trichlorofluoromethane (R11)	-	-	-	-	-	-	-
Trichlorotrifluoroethane (R113)	1.500	1.700	1.600	1.100	1.100	1.000	1.3
Chlorobenzene	-	-	1.000	-	-	-	0.2
Benzene	5.900	5.100	4.300	2.900	3.100	2.300	3.9
Toluene	1.300	1.200	0.830	0.420	-	0.540	0.7
Ethylbenzene	1.300	0.840	0.830	0.420	-	0.540	0.7
Xylene, Total	1.300	0.840	0.830	0.420	-	0.540	0.7
1,2,4-Trimethylbenzene							-
Acetone							-
Other Valatile Hydocarbons C-3	Not Reported		3.400	-	4.500	5.800	3.4
Other Valatile Hydocarbons C-4	Not Reported		3.800	-	-	-	1.0
Other Volatile Hydrocarbons - C-5	Not Reported		6.800	-	-	-	1.7
Other Volatile Hydrocarbons - C-6	Not Reported		12.700	9.100	7.900	12.700	10.6
Other Volatile Hydrocarbons - C-7	Not Reported		269.170	209.580	200.000	189.460	217.1
Other Volatile Hydrocarbons - C-8	Not Reported		278.340	219.160	200.000	198.920	224.1
Other Volatile Hydrocarbons - C-9	Not Reported		110.000	100.000	100.000	120.000	107.5
Other Volatile Hydrocarbons - C-10	Not Reported		57.000	54.000	53.000	60.000	56.0
Other Volatile Hydrocarbons - C-11	Not Reported		18.000	25.000	20.000	22.000	21.3
Other Volatile Hydrocarbons - C-12	Not Reported		4.000	-	-	3.900	2.0
Total Volatile Organics (ppmv)	73.9	69.6	831.2	672.3	639.3	664.8	706.9
Critical VOCs	73.900	69.620	68.020	55.430	53.880	51.990	62.4
TNMOC's -TO-14 Reported	Not Reported		6200	5100	4700	5000	5250

1) Results are shown for only those chemicals historically known to have been on site.
2) Numbers shown in smaller size font are reported at the method detection limit. These chemicals were not detected by Method TO14, but were detected by Method 8021.
3) Dash "-" indicates that component was not detected.

Table 2-2
Utilities, Reagents, and Waste Products

Description	Condition	Units	Quantity	Provider [1]	Comments
A. Reagents					
1. Reagent Panels	PTI Patented	each	24	PTI	One Change-out per reactor at end of Demonstration Test
2. Caustic Solution [2]	20%	wt%	11	PTI	Gallons Total for Project
B. Utilities					
1. Boiler Make-Up Water	Deionized	gallons	56	PTI	Gallons total for Project
2. Scrubber Make-up Water	Deionized	gallons	55	PTI	Gallons total for Project
3. Cooling System Make-up Water	Tap Water	gallons	5	McClellan AFB	Gallons total for Project
4. Consumed Power	480 V, 3-phase	kwh	76,589	McClellan AFB	Total for Project, See Electric Load List (Table 2-3+AK98)
5. Nitrogen	Compressed	Bottles	4	PTI	
C. Waste Products & Residues					
1. Spent Reagent Panels [3]	3' X 4' X 1" thick	each	24	PTI	Reagent Panels
2. Condensate [4]					
a. Organic Phase	60 °F to 80 °F	gallons	623	McClellan AFB	Total for Project
b. Water Phase	60 °F to 80 °F	gallons	1,164	McClellan AFB	Total for Project
3. Boiler Blowdown	<130 °F	gallons	3	McClellan AFB	Gallons total for Project
4. Scrubber Blow-down [2]	100 °F to 115 °F	gallons	40	McClellan AFB	Inventory at end of Project
5. Cooling System Disposal	100 °F to 120 °F	gallons	40	McClellan AFB	Inventory at end of Project
6. Miscellaneous PPE Materials	Dry (Sacked)	drums	2	PTI	One Drum per Panel Change-out plus 1 for miscellaneous.

Notes:
1. "Provider" is the organization responsible for either providing a reagent or utility, or for final disposal of waste product
2. Caustic Solution containers and Scrubber Solution container are double contained.
3. Reagent Panels will be handled as though they are hazardous materials until notification that they pass TCLP Test.
4. The Aqueous and Organic condensate is not separated and will be double contained in conformance with environmental regulations.

Table 2-3
Electric Load List

	Volts	Phase	Hz	Amps max.	Amps normal	kW max.	kW normal	H.P. max.	H.P. normal
Concentration Unit									
Concentrator I.D. Fan	480	3	60	5.5	4.4	4.1	3.3	5.00	4.00
Steam Generator	480	3	60	58.4	29.2	48.0	24.0	65.0	32.5
Condensate Return Pump	110	1	60	3.7	2.9	0.4	0.3	0.50	0.40
Cooling Compressor	208	3	60	6.8	5.6	2.2	1.9	3.00	2.50
Chilled Water Sytem Pump	208	3	60	3.4	2.7	1.1	0.9	1.50	1.20
Chilled Water By-pass Pump	208	3	60	1.1	0.9	0.4	0.3	0.50	0.40
Chilled Water Fan	208	3	60	1.1	0.9	0.4	0.3	0.50	0.40
Subtotals =				80.0	46.7	56.6	31.0	76.0	41.4
Photolytic Destruction Unit									
Reactor - 1	110	1	60	75.0	44.0	7.8	4.6	10.5	6.2
Reactor - 2	110	1	60	75.0	44.0	7.8	4.6	10.5	6.2
Reactor - 3 (Future)	110	1	60	75.0	-	7.8	-	10.5	-
Cooling Water Fan	220	1	60	9.7	8.9	2.0	1.8	2.50	2.30
Primary Scrubber Pump	208	3	60	1.8	1.4	0.6	0.5	0.75	0.60
StandbyScrubber Pump	208	3	60	4.7	-	1.6	-	2.0	-
Primary Cooling Water Pump	110	1	60	5.8	3.9	0.6	0.4	0.75	0.50
Standby Cooling Water Pump	110	1	60	3.9	-	0.4	-	0.50	-
Chemical Feed Pump	110	1	60	1.9	1.9	0.2	0.2	0.25	0.25
Scrubber Blowdown Pump	110	1	60	2.6	-	0.3	-	0.33	-
Reactor Purge Blower	208	3	60	0.8	-	0.3	-	0.33	-
Scrubber Air Blower	208	3	60	1.3	1.3	0.4	0.4	0.50	0.50
Pneumatic transport Blower	208	3	60	2.5	1.8	0.8	0.6	1.00	0.70
Air Compressor	110	1	60	23.3	15.5	2.4	1.6	3.00	2.00
Control Panel	110	1	60	20.0	10.0	2.2	1.1	3.0	1.5
Subtotals =				303.3	132.7	35.1	15.7	46.4	20.7
Oxidizer Process Area									
Area Lightining	110	1	60	20.0	15.0	2.1	1.6	2.8	2.1
Booster Blower	480	3	60	15.4	12.3	11.8	9.4	15.00	12.00
Solvent Transfer Pump	110	1	60	2.6	2.6	0.3	0.3	0.33	0.33
Subtotals =				38.0	29.9	14.1	11.2	18.1	14.4
Office Area									
Plug-in Receptacles	110	1	60	20.0	5.0	2.1	0.5	2.8	0.7
Lighting	110	1	60	20.0	5.0	2.1	0.5	2.8	0.7
Air-conditioner	110	1	60	20.0	15.0	2.1	1.6	2.8	2.1
Subtotals =				60.0	25.0	6.3	2.6	8.4	3.5
Process Area									
Plug-in Receptacles	110	1	60	20.0	5.0	2.1	0.5	2.8	0.7
Lighting	110	1	60	20.0	5.0	2.1	0.5	2.8	0.7
Area Fan	110	1	60	20.0	15.0	2.1	1.6	2.8	2.1
Subtotals =				60.0	25.0	6.3	2.6	8.4	3.5
Summary of Electrical Loads									
110 Volt	110	1	60	44.8	19.8	44.8	19.8	59.8	26.4
208 Volt	208	3	60	23.5	14.6	6.7	3.9	10.1	6.3
220 Volt	220	1	60	9.7	8.9	2.0	1.8	2.5	2.3
480 Volt	480	3	60	79.4	46.0	63.9	36.7	85.0	48.5
480 Volt Equivalence									
Totals =	480	3	60	167.0	88.6	117.3	62.3	171.0	90.8

Table 2-4: I[illegible]nstration Program Phase 1 and Phase 2.

PARAMETER	PHASE 1 Parametric Testing						PHASE 2 Preferred Operating Conditions
Weeks →	WEEK 1		WEEK 2		WEEK 3		WEEKS 4-8
Test Runs [1] →	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	Operate for approximately five weeks
SVE Flow Rate (scfm)	200[2]	250	300	SEE NOTE 3	Highest SVE mass flow rate from Runs 1-3 that achieves >=95% TNMOC Removal	Run-4 SVE mass flow rate if >=95% TNMOC Removal achieved; if not, Run-5 SVE rate	Highest mass flow rate from Test Runs 1-6 that achieves >=95% TNMOC Removal
Ambient Air Flow Rate (scfm)	200	150	100	SEE NOTE 3	Ambient air to meet 400 scfm total flow	Ambient air to meet 400 scfm total flow	Ambient Air to achieve 400 scfm total flow through Concentrator Unit.
Total Flow Rate (scfm)	400	400	400	400	400	400	400
Condensate Temperature (°F)	35	35	35	35	68	68°F if Runs 1--4 SVE mass flow rate; 85°F if Run 5 SVE rate	Highest Temperature during Parametric Testing that achieves the goals
Description	Condition Bed @ lowest planned SVE vapor mass flow rate & lowest planned condensing temperature	Increase SVE vapor mass flow rate by additional 50 scfm @ 35°F condensing temperature	Increase SVE vapor mass flow rate by additional 50 scfm @ 35°F condensing temperature	Increase SVE vapor mass flow rate to maximum possible @ 35°F condensing temperature	Evaluate impact of Increasing the condensing temperature to 68 °F	Operate at maximum SVE vapor mass flow rate that >= 95% TNMOC removal and increase temperature	A three day break will be held between Phase 1 and Phase 2 in order to incorporate analytical data from Test Run 6 into the operating condition evaluation.
Day of Week →	w th F s s m T w th F s s m T w th F s s M t w						
Sampling Event →	1		2		3		4		5		6		**Begin Phase 2**
Sampling Date →	Mar 6		Mar 10		Mar 13		Mar 17		Mar 20		Mar 23		**March 25, 1998**

(1) Each test run will be operated for a minimum of 2-1/2 days to achieve steady state operation of the concentration unit.

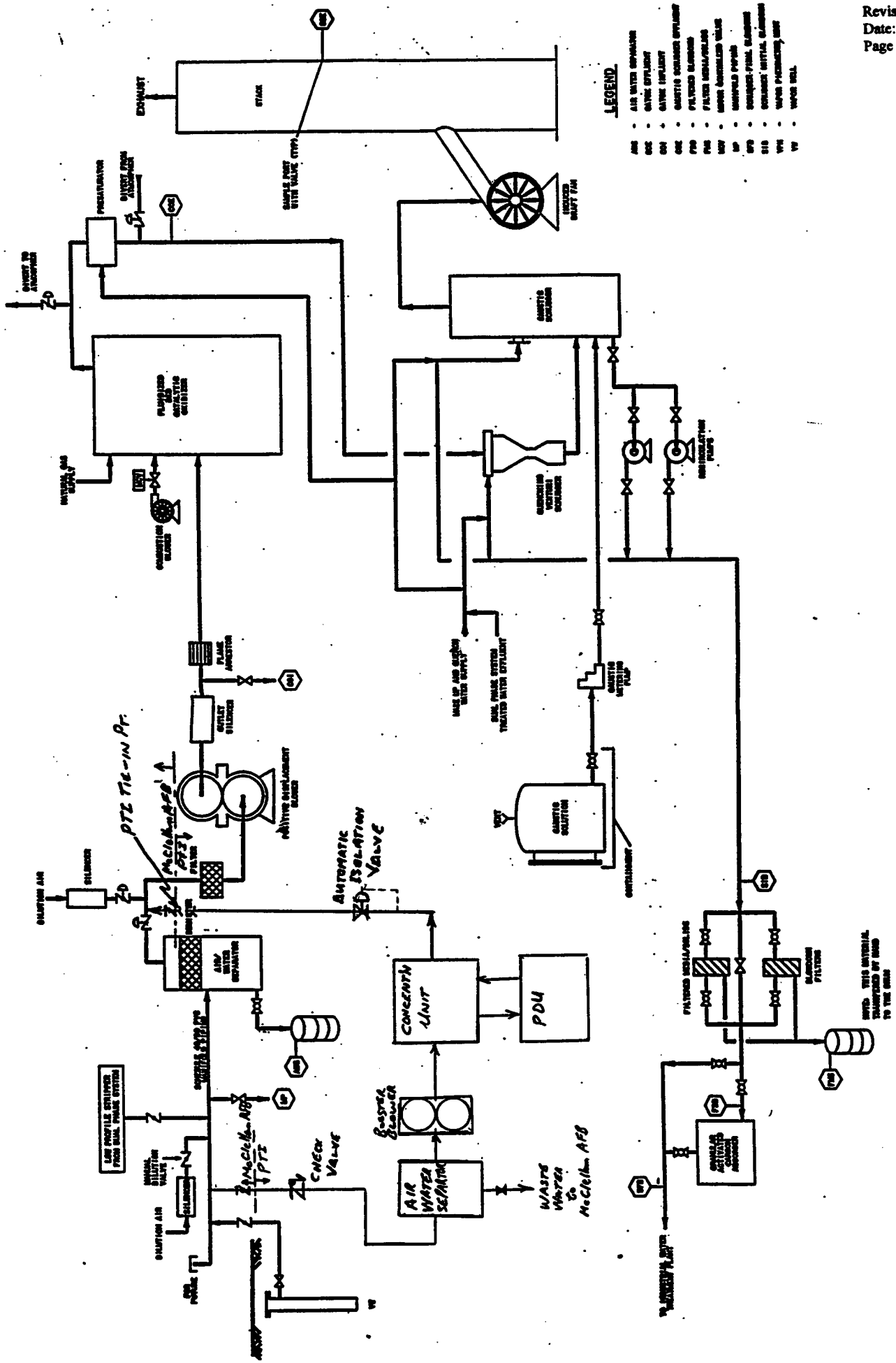
(2) Bed conditioning will begin on Monday prior to the first test run. The bed conditioning will be done at the same SVE vapor flow rate and condenser temperature conditions as Test Run-1. This will allow over four days of operation for the bed to condition and come into equilibrium prior to taking the sample for Test Run-1. Subsequent test runs will increase either SVE vapor flow rate or condenser temperature to determine the preferred operating condition for Phase 2.

(3) The adsorber will be operated at the maximum achievable SVE rate (up to 400 scfm) that can be processed through the system. Ambient air will be adjusted to achieve the total flow rate of 400 scfm through the concentrator unit.

Table 2-5: Major Deliverables and Milestones

Milestone/Event	Date/Period
• Issue Working Copy of the WIP	June 26,1997
• Issue Draft Copy of the WIP	October 6, 1997
• Issue Final Copy of WIP	February 16, 1998
• Field Kick-of Meeting	February 17, 1998
• Mobilize to Site	February 18, 1998
• Initiate Phase 1 Parametric Testing	March 4, 1998
• Initiate Phase 2 Steady-State Testing	March 25, 1998
• Complete Testing	April 29, 1998
• Visitor's Day	April 1, 1998
• Issue Draft Report for Project Review	May 25, 1998
• Issue Final Report	August 31, 1998

Figure 2-5 Site IC 31 SVE Process Diagram with PTI Interface


LEGEND
EXHAUST
STACK
SAMPLE PORT WITH VALVE (TYP.)
INDUCED DRAFT FAN
PRESATURATOR
CARBON ADSORBERS
FLAME ARRESTOR
OUTLET SILENCER
ROTARY POSITIVE DISPLACEMENT BLOWER
DILUTION AIR SILENCER
AIR/WATER SEPARATOR
AUTOMATIC ISOLATION VALVE
CONCENTR. UNIT
PDU
AIR WATER SEPARATOR
WASTE WATER TO McCLELLAN AFB
CHECK VALVE
DILUTION VALVE
AIR PROFILE STRIPPER FROM DUAL PHASE SYSTEM
PTI TIE-IN Pt.
McCLELLAN AFB PTI
McCLELLAN AFB
GRANULAR ACTIVATED CARBON ADSORBER
BAGHOUSE FILTERS
PARTICULATE FILTERS
MOISTURE SEPARATOR
CARBON SOLUTION
CONTAINMENT
MAKE UP AIR WATER SUPPLY
DUAL PHASE SYSTEM TREATED WATER EFFLUENT
CARBON SOLUTION PUMP
RECIRCULATION PUMPS
CARBON VESSELS
FLUIDIZED BED REACTOR
NATURAL GAS SUPPLY
COMBUSTION BLOWER
AIR WATER SEPARATOR
DILUTION AIR
SYSTEM VACUUM
VENT TO ATMOSPHERE
PRESATURATOR
WATER FROM AIR PROFILE STRIPPER
SYSTEM VACUUM
VENT
WATER
AIR
SAMPLE
VAPOR
VENT TO ATMOSPHERE
WATER TO CARBON ADSORBERS
WATER FROM AIR PROFILE STRIPPER
WATER TO AIR PROFILE STRIPPER
WATER FROM CARBON ADSORBERS

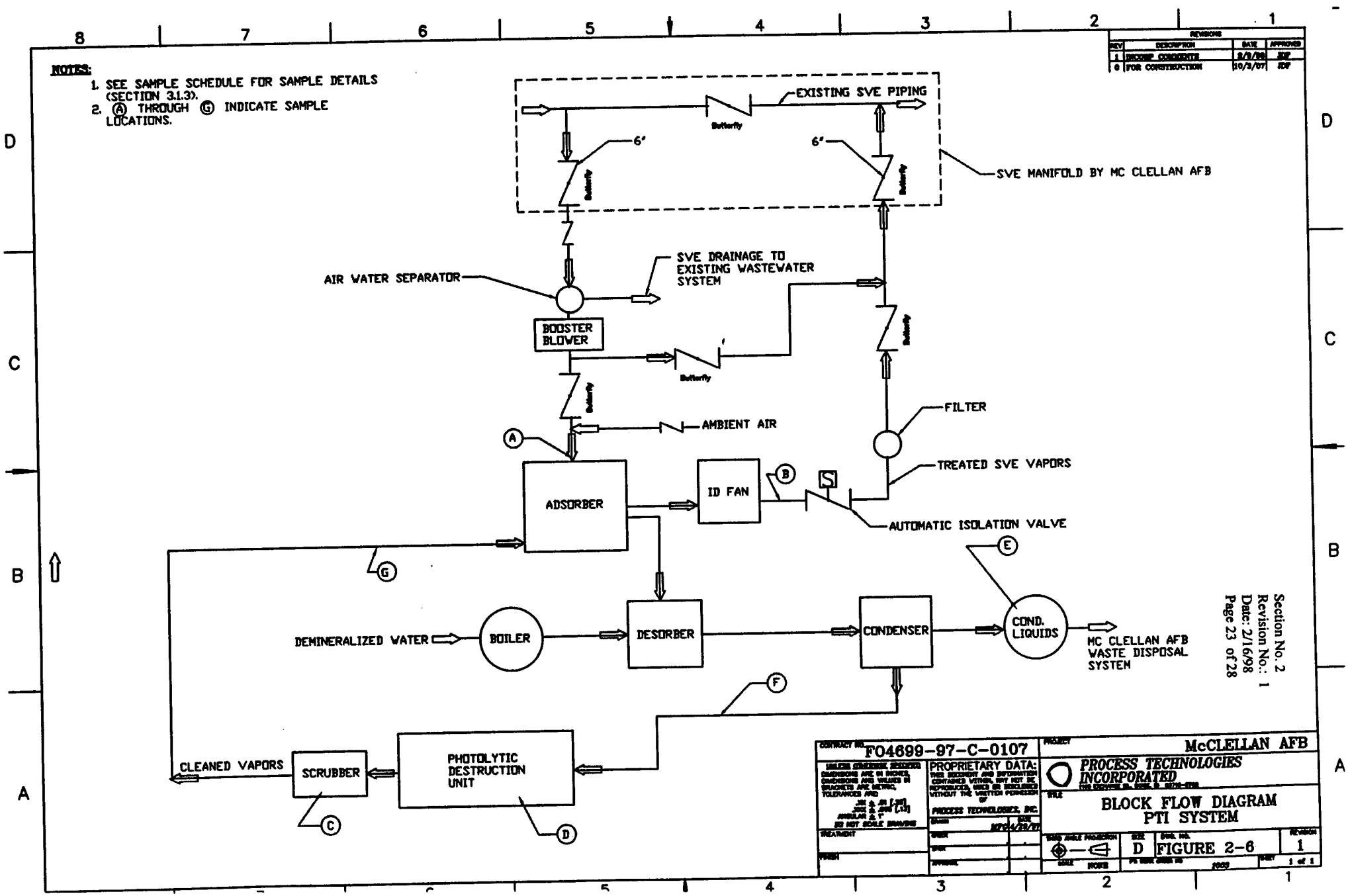
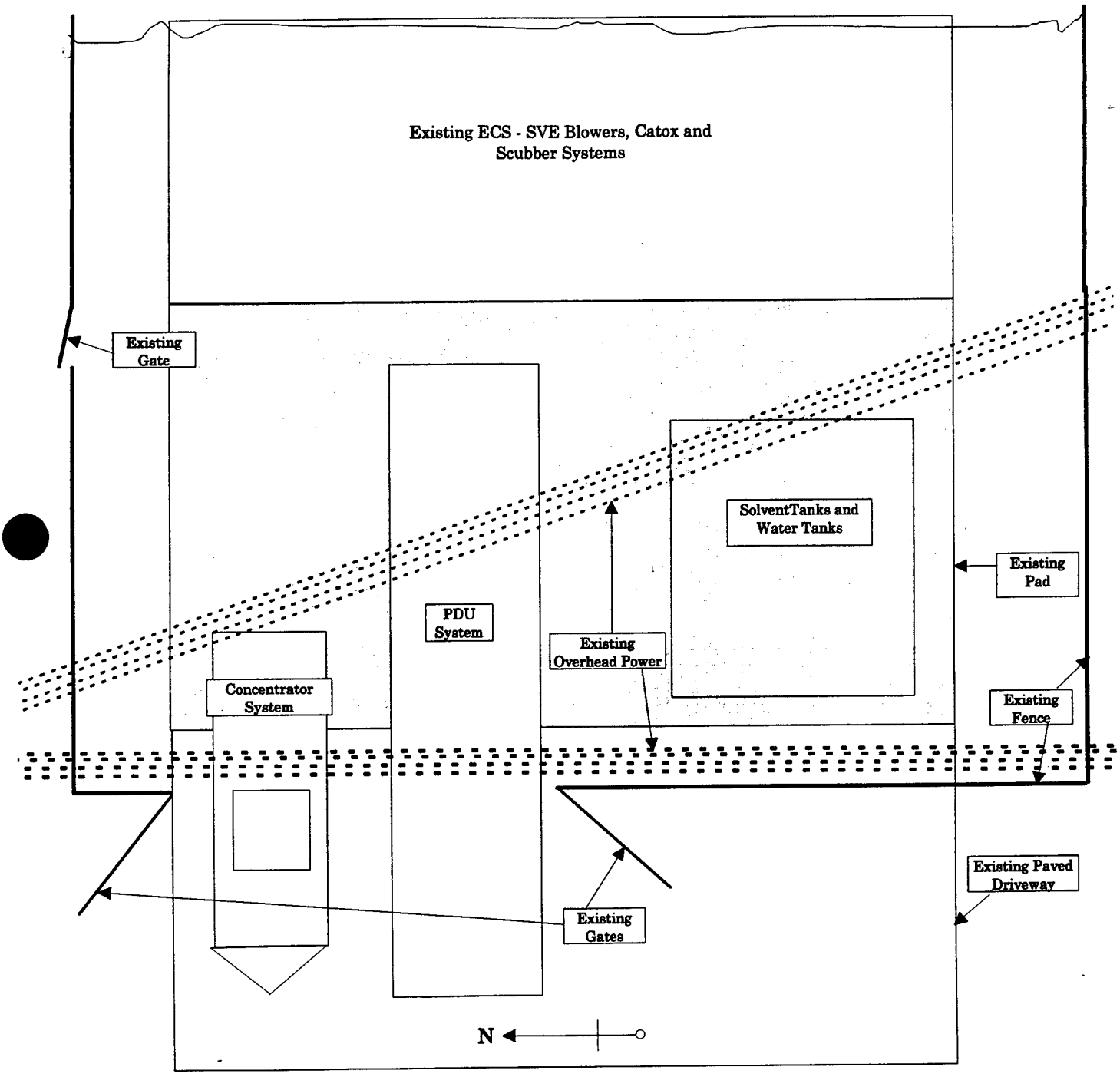
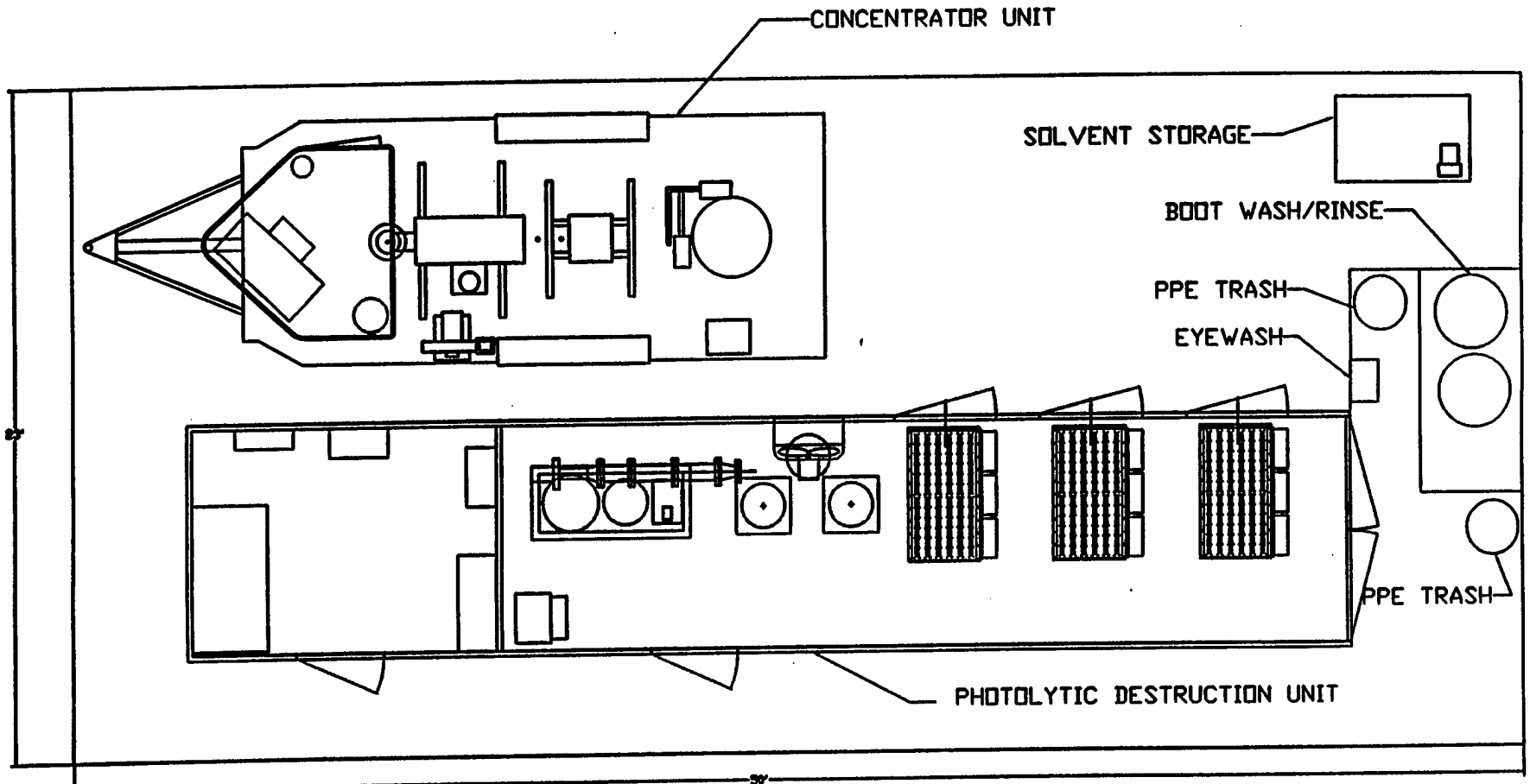

NOTES:
1. SEE SAMPLE SCHEDULE FOR SAMPLE DETAILS (SECTION 3.1.3).
2. (A) THROUGH (G) INDICATE SAMPLE LOCATIONS.
REVISIONS
REV DESCRIPTION DATE APPROVED
1 INCORP COMMENTS 8/8/98 JDF
0 FOR CONSTRUCTION 10/3/97 JDF
EXISTING SVE PIPING
Butterfly
6"
6"
SVE MANIFOLD BY MC CLELLAN AFB
AIR WATER SEPARATOR
SVE DRAINAGE TO EXISTING WASTEWATER SYSTEM
BOOSTER BLOWER
AMBIENT AIR
FILTER
TREATED SVE VAPORS
ADSORBER
ID FAN
AUTOMATIC ISOLATION VALVE
DEMINERALIZED WATER
BOILER
DESORBER
CONDENSER
COND. LIQUIDS
MC CLELLAN AFB WASTE DISPOSAL SYSTEM
CLEANED VAPORS
SCRUBBER
PHOTOLYTIC DESTRUCTION UNIT
A
B
C
D
E
F
G
CONTRACT NO. F04699-97-C-0107
PROPRIETARY DATA:
PROJECT McCLELLAN AFB
PROCESS TECHNOLOGIES INCORPORATED
TITLE BLOCK FLOW DIAGRAM PTI SYSTEM
SIZE D DWG NO. FIGURE 2-6 REVISION 1
SCALE NONE
Section No. 2
Revision No.: 1
Date: 2/16/98
Page 23 of 28

Figure 2-7: PTI Site Drawing at IC-31





NOTES:

REV	DESCRIPTION	DATE	APPROVED
A	FOR APPROVAL	9/29/97	JDP
0	FOR CONSTRUCTION	10/9/97	JDP

Figure 2-8: PTI System - General Arrangement

CONTRACT NO. F04699-97-C-0107

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PROJECT: McCLELLAN AFB

PROCESS TECHNOLOGIES INCORPORATED

TITLE: PTI SYSTEM GENERAL ARRANGEMENT

SIZE: D | DWG. NO.: FIGURE 2-8 | REVISION: 0

SCALE: NONE | SHEET: 1 of 1

Figure 2-9: Concentrator Unit General Arrangement

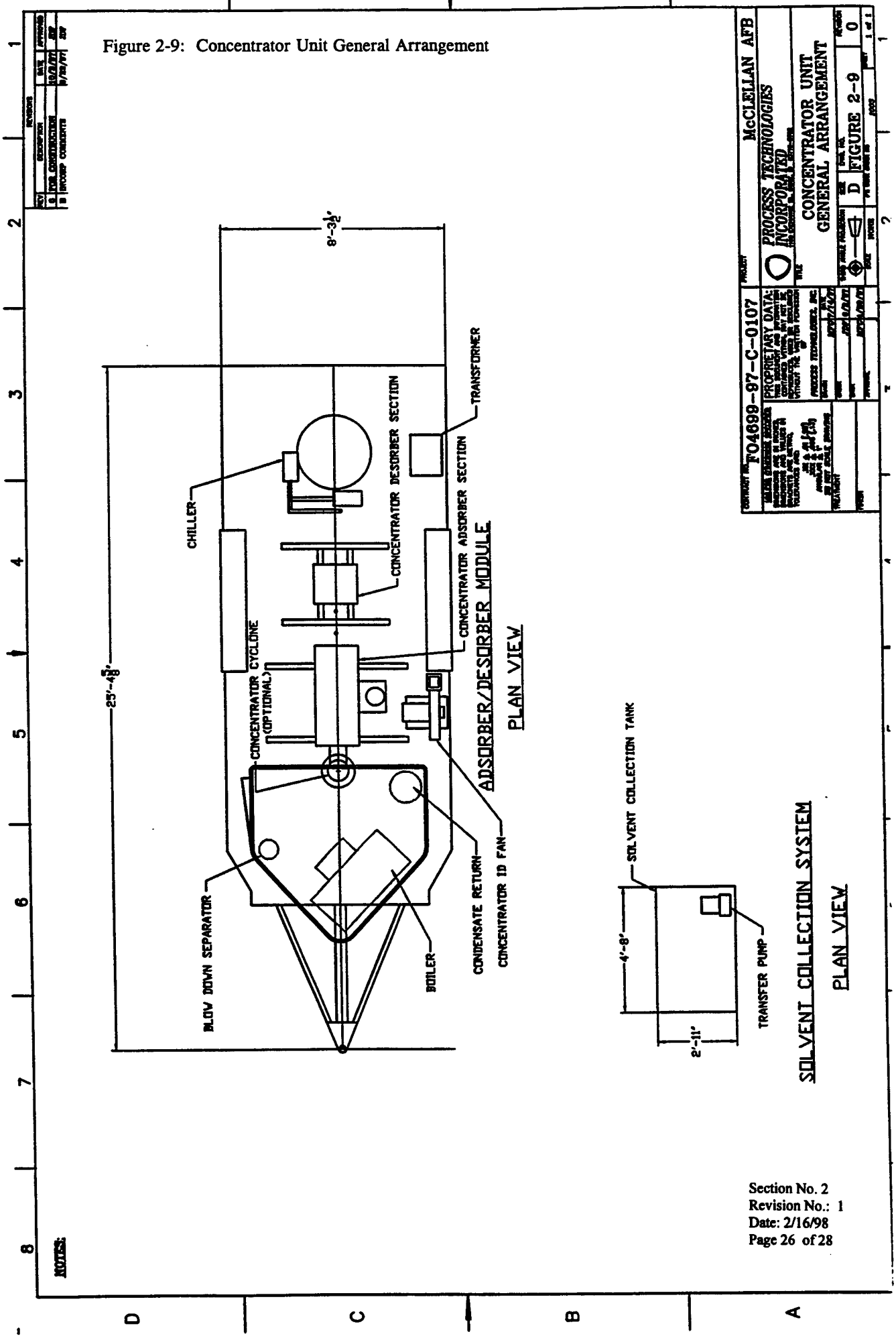


Figure 2-10: Photolytic Destruction Unit - General Arrangement

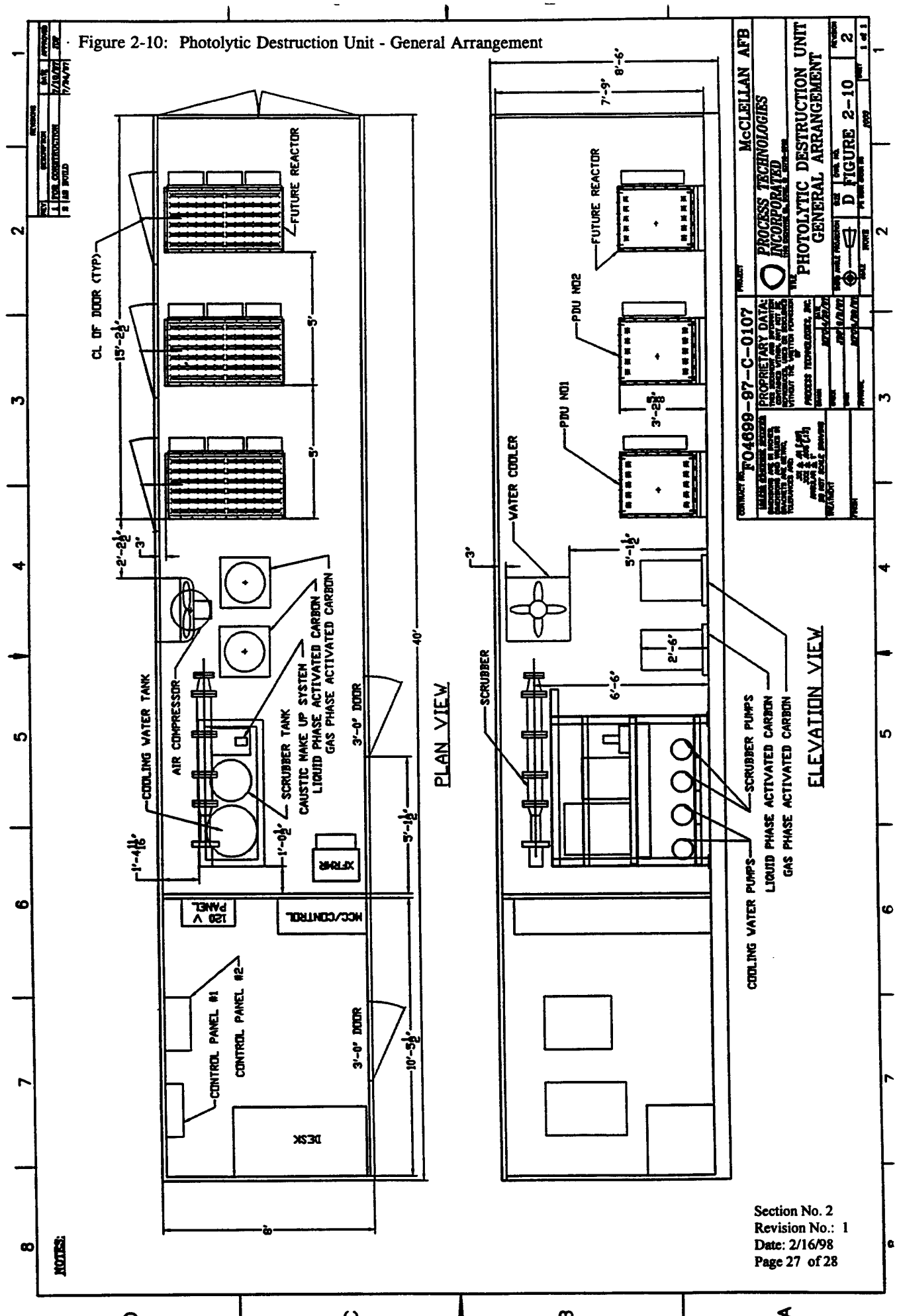
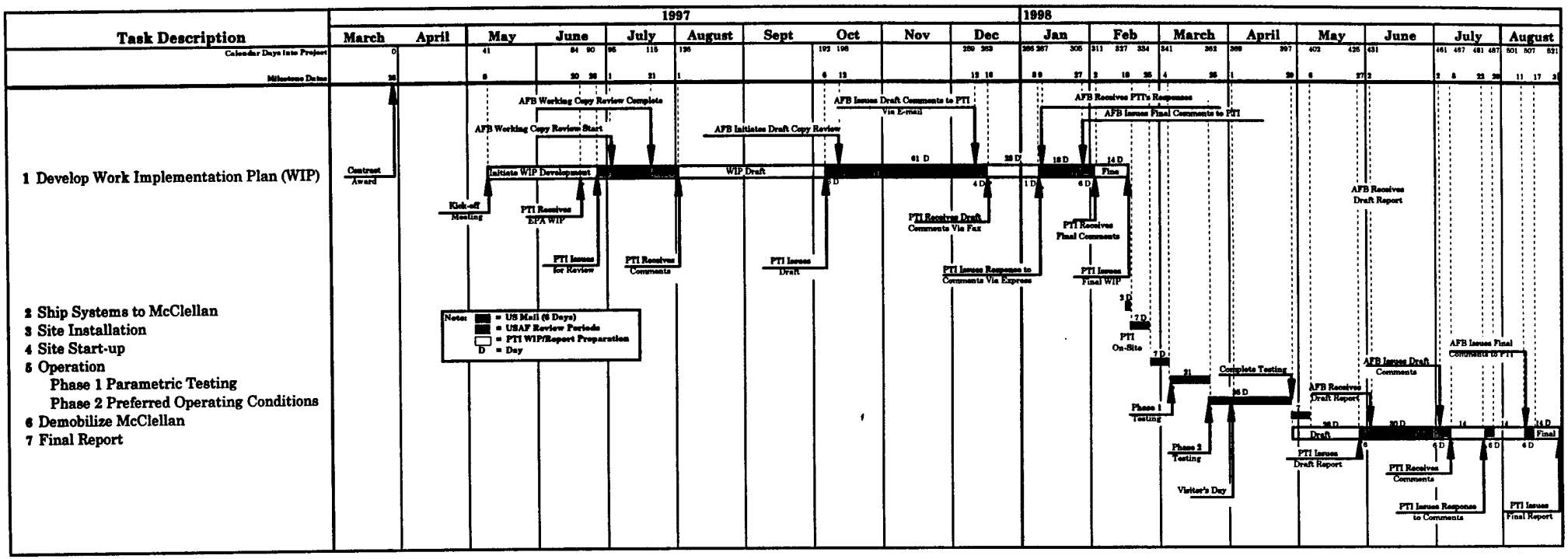


Figure 2-11

Overall Schedule for Demonstration Test



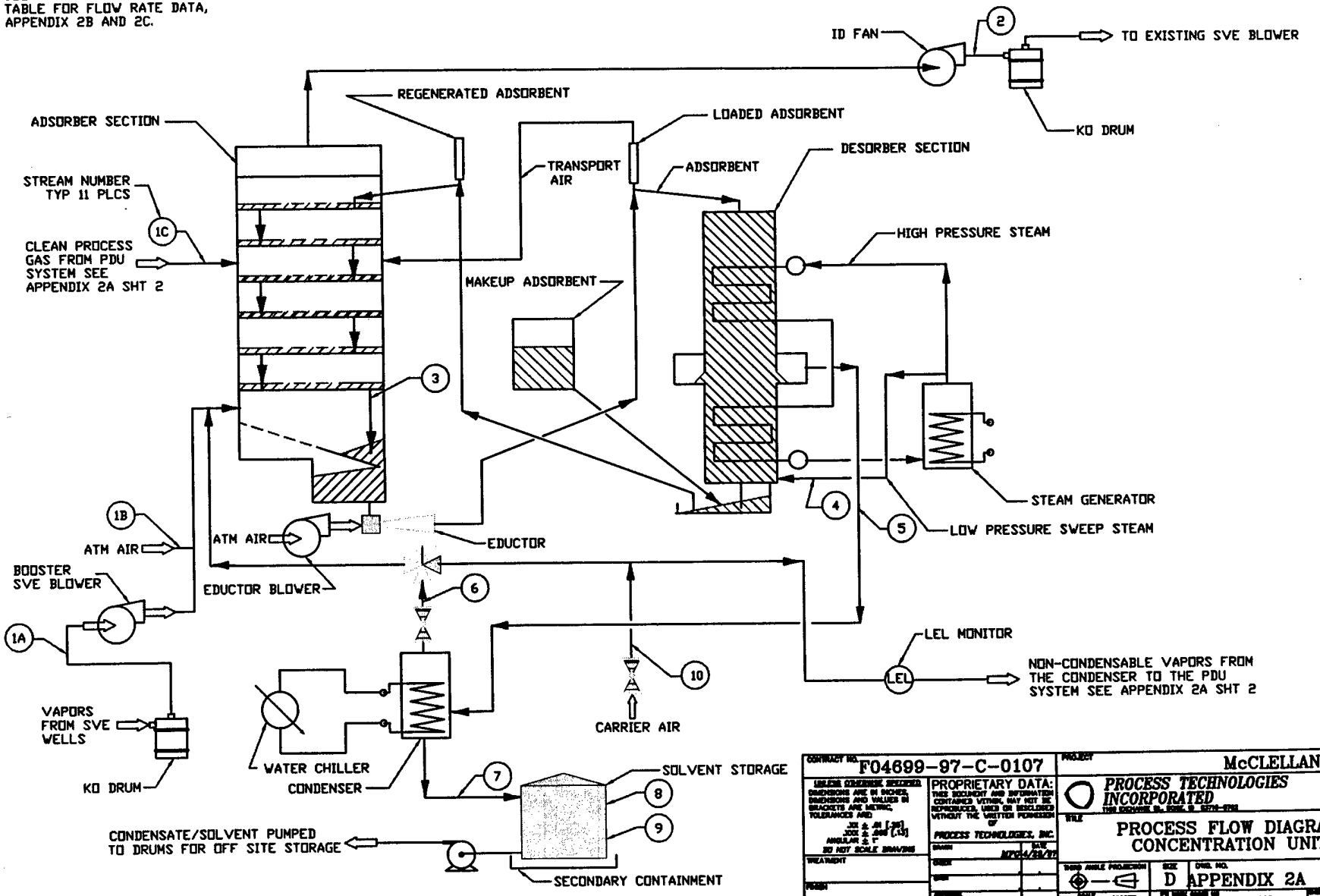
APPENDIX 2A

PROCESS FLOW DIAGRAMS

NOTES:

1. SEE PROCESS FLOW BALANCE TABLE FOR FLOW RATE DATA, APPENDIX 2B AND 2C.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
1	INCORP COMMENTS	8/8/98	JDF
0	FOR CONSTRUCTION	10/4/97	JDF



CONTRACT NO. F04699-97-C-0107

PROJECT McCLELLAN AFB

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PROCESS TECHNOLOGIES INCORPORATED

TITLE

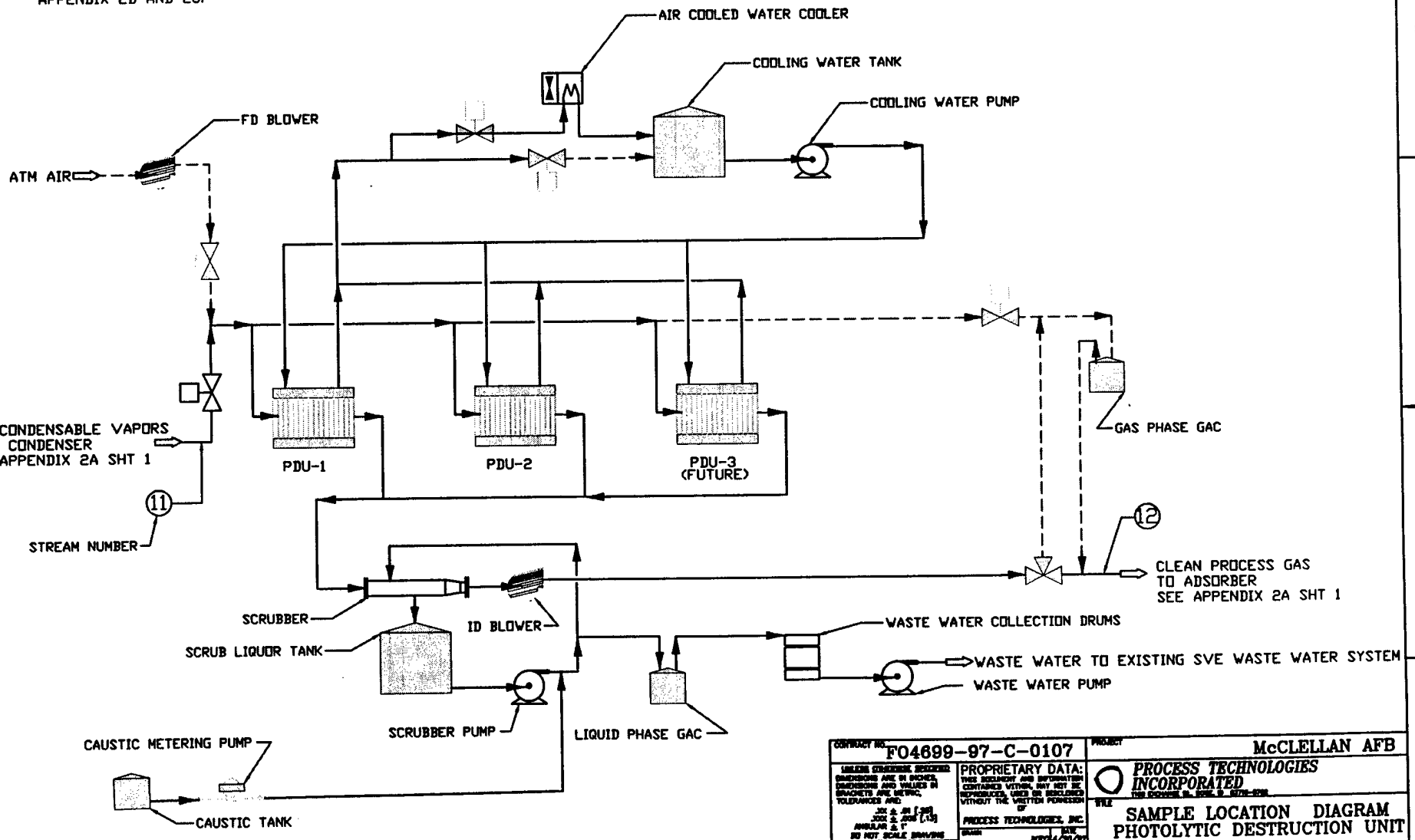
PROCESS FLOW DIAGRAM CONCENTRATION UNIT

SIZE D | DWG. NO. APPENDIX 2A | REVISION 1

SHEET 1 of 2

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
1	INCORP COMMENTS	8/10/98	JDF
0	FOR CONSTRUCTION	10/3/97	JDF

NOTES: 1. SEE PROCESS FLOW BALANCE TABLE FOR FLOW RATE DATA, APPENDIX 2B AND 2C.



CONTRACT NO. F04699-97-C-0107

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES, DIMENSIONS AND VALUES IN BRACKETS ARE METRIC, TOLERANCES ARE: .XX ± .01 [.25], .XXX ± .005 [.13], ANGULAR ± 1°. DO NOT SCALE DRAWING

TREATMENT

FINISH

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DRAWN — DATE 10/24/97

CHECK

ENG

APPROVAL

PROJECT: McCLELLAN AFB

PROCESS TECHNOLOGIES INCORPORATED

TITLE: SAMPLE LOCATION DIAGRAM PHOTOLYTIC DESTRUCTION UNIT

THIRD ANGLE PROJECTION

SIZE: D

DWG. NO.: APPENDIX 2A

REVISION: 1

SCALE: NONE

PS DWG. SHEET NO. 1009

SHEET 2 of 2

PROCESS FLOW BALANCE
(Condensing Temperature @ 35 °F

Appe[illegible]B	Stream Number		1A			1B			1C			2		
PROCESS FLO[illegible]ALANCE		Flow Rate: Acfm	289			260			3.75			50[illegible]		
Concentrator with PDU System		Scfm	250			250			2.91			501		
Site IC-31		Gpm	Not Applicable						Not Applicable			Not Applicable		
First Quarter 1997 Data		Temperature (°F)	126.0			80.0			180.00			70		
Condensing Temp = 35 F		Pressure (Psia)	14.33			14.69			14.33			14.76		
Rev. 0		Percent of LEL	6.84%						0.25%			0.17%		
Chemical	Composition:	Molecular Weight	SVE Vapor to Adsorber			Ambient Air			Recycled PDT Treated Vapors			Treated Vapor return to ECS		
			Lbs/hr	Lb-mols/hr	ppmv	Lbs/hr	Lb-mols/hr	ppmv	Lbs/hr	Lb-mols/hr	ppmv	Lbs/hr	Lb-mols/hr	ppmv
Chloromethane	CH_3Cl	50.5	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	CH_2Cl_2	85.0	3.53E-03	4.16E-05	1.05E+00				0.00E+00	0.00E+00	0.00E+00	1.77E-04	2.08E-06	2.62E-02
Chloroform	$CHCl_3$	119.5	1.45E-02	1.21E-04	3.06E+00				0.00E+00	0.00E+00	0.00E+00	7.24E-04	6.06E-06	7.63E-02
Carbon Tetrachloride	CCl_4	154.0	6.01E-03	3.90E-05	9.86E-01				5.76E-06	3.74E-08	8.11E-02	3.01E-04	1.95E-06	2.46E-02
1,1 Dichloroethane	$C_2H_4Cl_2$	99.0	1.68E-02	1.70E-04	4.28E+00				0.00E+00	0.00E+00	0.00E+00	8.40E-04	8.48E-06	1.07E-01
1,2 Dichloroethane	$C_2H_4Cl_2$	99.0	2.57E-03	2.59E-05	6.55E-01				0.00E+00	0.00E+00	0.00E+00	1.28E-04	1.30E-06	1.63E-02
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.5	2.24E-02	1.68E-04	4.23E+00				0.00E+00	0.00E+00	0.00E+00	1.12E-03	8.38E-06	1.06E-01
Vinyl Chloride	C_2H_3Cl	62.5	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,1 Dichloroethene	$C_2H_2Cl_2$	97.0	1.41E-02	1.45E-04	3.67E+00				0.00E+00	0.00E+00	0.00E+00	7.04E-04	7.26E-06	9.15E-02
trans-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
cis-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	1.05E-02	1.08E-04	2.73E+00				0.00E+00	0.00E+00	0.00E+00	5.25E-04	5.41E-06	6.82E-02
TCE	C_2HCl_3	131.5	1.69E-01	1.29E-03	3.25E+01				3.00E-04	2.28E-06	4.95E+00	8.48E-03	6.45E-05	8.12E-01
PCE	C_2Cl_4	166.0	1.14E-02	6.86E-05	1.73E+00				2.81E-06	1.69E-08	3.67E-02	5.70E-04	3.43E-06	4.33E-02
Dichlorodifluoromenthane (R12)	CCl_2F_2	121.0	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trichlorofluoromethane (R11)	CCl_3F	137.5	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trichlorotrifluoroethane (R113)	$C_2Cl_3F_3$	187.5	9.90E-03	5.28E-05	1.33E+00				7.37E-05	3.93E-07	8.52E-01	4.99E-04	2.66E-06	3.35E-02
Chlorobenzene	C_6H_5Cl	112.5	7.43E-04	6.60E-06	1.67E-01				0.00E+00	0.00E+00	0.00E+00	3.71E-05	3.30E-07	4.16E-03
Benzene	C_6H_6	78.0	1.21E-02	1.56E-04	3.93E+00				1.24E-05	1.59E-07	3.44E-01	6.08E-04	7.80E-06	9.82E-02
Toluene	$C_6H_5CH_3$	92.0	2.61E-03	2.83E-05	7.15E-01				1.63E-22	1.77E-24	3.83E-18	1.30E-04	1.42E-06	1.78E-02
Ethylbenzene	$C_6H_5CH_2CH_3$	106.0	2.75E-03	2.59E-05	6.55E-01				2.85E-07	2.69E-09	5.83E-03	1.37E-04	1.30E-06	1.63E-02
Xylene, Total	$C_6H_4(CH_3)_2$	106.0	2.75E-03	2.59E-05	6.55E-01				2.70E-07	2.55E-09	5.53E-03	1.37E-04	1.30E-06	1.63E-02
Other Volatile Hydrocarbons - C-3	C_3H_8	44.0	5.97E-03	1.36E-04	3.43E+00				0.00E+00	0.00E+00	0.00E+00	2.98E-04	6.78E-06	8.55E-02
Other Volatile Hydrocarbons - C-4	C_4H_{10}	58.0	2.18E-03	3.76E-05	9.50E-01				0.00E+00	0.00E+00	0.00E+00	1.09E-04	1.88E-06	2.37E-02
Other Volatile Hydrocarbons - C-5	C_5H_{12}	72.0	4.85E-03	6.73E-05	1.70E+00				2.10E-05	2.91E-07	6.32E-01	2.43E-04	3.38E-06	4.26E-02
Other Volatile Hydrocarbons - C-6	C_6H_{14}	86.0	3.61E-02	4.20E-04	1.06E+01				1.15E-04	1.34E-06	2.90E+00	1.81E-03	2.11E-05	2.65E-01
Other Volatile Hydrocarbons - C-7	C_7H_{16}	100.0	8.60E-01	8.60E-03	2.17E+02				7.31E-04	7.31E-06	1.59E+01	4.30E-02	4.30E-04	5.42E+00
Other Volatile Hydrocarbons - C-8	C_8H_{18}	114.0	1.01E+00	8.88E-03	2.24E+02				2.87E-04	2.51E-06	5.45E+00	5.06E-02	4.44E-04	5.59E+00
Other Volatile Hydrocarbons - C-9	C_9H_{20}	128.0	5.45E-01	4.26E-03	1.08E+02				3.09E-05	2.41E-07	5.23E-01	2.72E-02	2.13E-04	2.68E+00
Other Volatile Hydrocarbons - C-10	$C_{10}H_{22}$	142.0	3.15E-01	2.22E-03	5.60E+01				4.46E-06	3.14E-08	6.81E-02	1.57E-02	1.11E-04	1.40E+00
Other Volatile Hydrocarbons - C-11	$C_{11}H_{24}$	156.0	1.31E-01	8.42E-04	2.13E+01				4.65E-07	2.98E-09	6.46E-03	6.56E-03	4.21E-05	5.30E-01
Other Volatile Hydrocarbons - C-12	$C_{12}H_{26}$	170.0	8.86E-03	5.21E-05	1.32E+00				6.28E-09	3.69E-11	8.01E-05	4.43E-04	2.61E-06	3.29E-02
Subtotal Organics			3.22E+00	2.80E-02	7.06E+02				1.58E-03	1.46E-05	3.17E+01	1.61E-01	1.40E-03	1.76E+01
Inert Gases and Vapors														
Dry Air	N_2, O_2, Ar	28.97	9.95E+02	3.44E+01	8.67E+05	1.13E+03	3.89E+01	9.81E+05	1.32E+01	4.54E-01	9.85E+05	2.13E+03	7.36E+01	9.27E+05
Water Vapor	H_2O	18.00	9.40E+01	5.22E+00	1.32E+05	1.32E+01	7.34E-01	1.85E+04	1.23E-01	6.81E-03	1.48E+04	1.04E+02	5.77E+00	7.27E+04
Totals =			1.09E+03	3.96E+01	1.00E+06	1.14E+03	3.96E+01	1.00E+06	1.33E+01	4.61E-01	1.00E+06	2.24E+03	7.94E+01	1.00E+06
				TNMOC =	5.32E+03								TNMOC =	1.33E+02
			% of Org. that are chlorinated =		7.99%							% of Org. that are chlorinated =		7.99%

Appe[redacted]B	Stream Number		3		[redacted]4		5			6		
PROCESS FLOW [redacted]ALANCE	Flow Rate: Acfm		Not Applicable, Solid Phase Adsorbent				6.1			0.868		
Concentrator with PDU System		Scfm			1.7		3.8			0.885		
Site IC-31		Gpm			Not Applicable		Not Applicable			Not Applicable		
First Quarter 1997 Data		Temperature (°F)			212		350			35.0		
Condensing Temp = 35 F		Pressure (Psia)			14.33		14.26			14.26		
Rev. 0		Percent of LEL			Not Applicable		Not Applicable (Oxygen Deficient)			82.39%		
			Adsorbed Vapors		Sweep Vapor		Desorbed Vapors			Non-Condensables		
Chemical	Composition:	Molecular Weight	Lbs/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	ppmv	lb/hr	Lb-mols/hr	ppmv
Chloromethane	CH_3Cl	50.5	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	CH_2Cl_2	85.0	3.36E-03	3.95E-05			3.36E-03	3.95E-05	6.60E+01	0.00E+00	0.00E+00	0.00E+00
Chloroform	$CHCl_3$	119.5	1.38E-02	1.15E-04			1.38E-02	1.15E-04	1.92E+02	0.00E+00	0.00E+00	0.00E+00
Carbon Tetrachloride	CCl_4	154.0	5.72E-03	3.71E-05			5.72E-03	3.71E-05	6.20E+01	5.76E-04	3.74E-06	2.67E+01
1,1 Dichloroethane	$C_2H_4Cl_2$	99.0	1.60E-02	1.61E-04			1.60E-02	1.61E-04	2.69E+02	0.00E+00	0.00E+00	0.00E+00
1,2 Dichloroethane	$C_2H_4Cl_2$	99.0	2.44E-03	2.46E-05			2.44E-03	2.46E-05	4.12E+01	0.00E+00	0.00E+00	0.00E+00
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.5	2.13E-02	1.59E-04			2.13E-02	1.59E-04	2.66E+02	0.00E+00	0.00E+00	0.00E+00
Vinyl Chloride	C_2H_3Cl	62.5	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,1 Dichloroethene	$C_2H_2Cl_2$	97.0	1.34E-02	1.38E-04			1.34E-02	1.38E-04	2.30E+02	0.00E+00	0.00E+00	0.00E+00
trans-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
cis-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	9.97E-03	1.03E-04			9.97E-03	1.03E-04	1.72E+02	0.00E+00	0.00E+00	0.00E+00
TCE	C_2HCl_3	131.5	1.61E-01	1.22E-03			1.61E-01	1.22E-03	2.05E+03	3.00E-02	2.28E-04	1.63E+03
PCE	C_2Cl_4	166.0	1.08E-02	6.52E-05			1.08E-02	6.52E-05	1.09E+02	2.81E-04	1.69E-06	1.21E+01
Dichlorodifluoromenthane (R12)	CCl_2F_2	121.0	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trichlorofluoromethane (R11)	CCl_3F	137.5	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trichlorotrifluoroethane (R113)	$C_2Cl_3F_3$	187.5	9.48E-03	5.05E-05			9.48E-03	5.05E-05	8.44E+01	7.37E-03	3.93E-05	2.81E+02
Chlorobenzene	C_6H_5Cl	112.5	7.05E-04	6.27E-06			7.05E-04	6.27E-06	1.05E+01	0.00E+00	0.00E+00	0.00E+00
Benzene	C_6H_6	78.0	1.16E-02	1.48E-04			1.16E-02	1.48E-04	2.47E+02	1.24E-03	1.59E-05	1.13E+02
Toluene	$C_6H_5CH_3$	92.0	2.47E-03	2.69E-05			2.47E-03	2.69E-05	4.49E+01	1.63E-20	1.77E-22	1.26E-15
Ethylbenzene	$C_6H_5CH_2CH_3$	106.0	2.61E-03	2.46E-05			2.61E-03	2.46E-05	4.12E+01	2.85E-05	2.69E-07	1.92E+00
Xylene, Total	$C_6H_4(CH_3)_2$	106.0	2.61E-03	2.46E-05			2.61E-03	2.46E-05	4.12E+01	2.70E-05	2.55E-07	1.82E+00
Other Volatile Hydrocarbons - C-3	C_3H_8	44.0	5.67E-03	1.29E-04			5.67E-03	1.29E-04	2.15E+02	0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-4	C_4H_{10}	58.0	2.07E-03	3.57E-05			2.07E-03	3.57E-05	5.97E+01	0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-5	C_5H_{12}	72.0	4.62E-03	6.42E-05			4.62E-03	6.42E-05	1.07E+02	2.10E-03	2.91E-05	2.08E+02
Other Volatile Hydrocarbons - C-6	C_6H_{14}	86.0	3.44E-02	4.00E-04			3.44E-02	4.00E-04	6.68E+02	1.15E-02	1.34E-04	9.54E+02
Other Volatile Hydrocarbons - C-7	C_7H_{16}	100.0	8.17E-01	8.17E-03			8.17E-01	8.17E-03	1.37E+04	7.31E-02	7.31E-04	5.22E+03
Other Volatile Hydrocarbons - C-8	C_8H_{18}	114.0	9.61E-01	8.43E-03			9.61E-01	8.43E-03	1.41E+04	2.87E-02	2.51E-04	1.79E+03
Other Volatile Hydrocarbons - C-9	C_9H_{20}	128.0	5.18E-01	4.04E-03			5.18E-01	4.04E-03	6.76E+03	3.09E-03	2.41E-05	1.72E+02
Other Volatile Hydrocarbons - C-10	$C_{10}H_{22}$	142.0	2.99E-01	2.11E-03			2.99E-01	2.11E-03	3.52E+03	4.46E-04	3.14E-06	2.24E+01
Other Volatile Hydrocarbons - C-11	$C_{11}H_{24}$	156.0	1.25E-01	7.99E-04			1.25E-01	7.99E-04	1.34E+03	4.65E-05	2.98E-07	2.13E+00
Other Volatile Hydrocarbons - C-12	$C_{12}H_{26}$	170.0	8.42E-03	4.95E-05			8.42E-03	4.95E-05	8.27E+01	6.28E-07	3.69E-09	2.64E-02
Subtotal Organics			3.06E+00	2.66E-02			3.06E+00	2.66E-02	4.44E+04	1.58E-01	1.46E-03	1.04E+04
Inert Gases and Vapors												
Dry Air	N_2, O_2, Ar	28.97	3.44E+00	1.19E-01	5.50E-01	1.90E-02	3.99E+00	1.38E-01	2.30E+05	3.99E+00	1.38E-01	9.83E+05
Water Vapor	H_2O	18.00	3.44E+00	1.91E-01	4.38E+00	2.43E-01	7.82E+00	4.34E-01	7.26E+05	1.71E-02	9.53E-04	6.87E+03
Totals =			9.94E+00	3.36E-01	4.93E+00	2.62E-01	1.49E+01	5.99E-01	1.00E+06	4.16E+00	1.40E-01	1.00E+06
								TNMOC =	3.34E+05		TNMOC =	6.40E+04
							% of Org. that are chlorinated =		7.99%	% of Org. that are chlorinated =		18.67%

Appen[illegible]	Stream Number		7		8		9		10		11		
PROCESS FLOW BALANCE	Flow Rate: Acfm		Not Applicable		Not Applicable		Not Applicable		2.115		3.131		
Concentrator with PDU System	Scfm		Not Applicable		Not Applicable		Not Applicable		2.037		2.922		
Site IC-31	Gpm		1.2		0.8		0.4		Not Applicable		Not Applicable		
First Quarter 1997 Data	Temperature (°F)		35.0		35.0		35.0		80.00		78.00		
Condensing Temp = 35 F	Pressure (Psia)		14.26		14.26		14.26		14.69		14.18		
Rev. 0	Percent of LEL		Not Applicable		Not Applicable		Not Applicable				25.0%		
Chemical	Composition:	Molecular Weight	Condensate		Aqueous Phase		Solvent Phase		Carrier Air to PDT		PDT - Feed Gas		
			Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	ppmv
Chloromethane	CH_3Cl	50.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	CH_2Cl_2	85.0	3.36E-03	3.95E-05	3.36E-03	3.95E-05	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Chloroform	$CHCl_3$	119.5	1.38E-02	1.15E-04	1.38E-02	1.15E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Carbon Tetrachloride	CCl_4	154.0	5.14E-03	3.34E-05	3.51E-03	2.28E-05	1.63E-03	1.06E-05			5.76E-04	3.74E-06	8.08E+00
1,1 Dichloroethane	$C_2H_4Cl_2$	99.0	1.60E-02	1.61E-04	1.60E-02	1.61E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
1,2 Dichloroethane	$C_2H_4Cl_2$	99.0	2.44E-03	2.46E-05	2.44E-03	2.46E-05	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.5	2.13E-02	1.59E-04	2.13E-02	1.59E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Vinyl Chloride	C_2H_3Cl	62.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
1,1 Dichloroethene	$C_2H_2Cl_2$	97.0	1.34E-02	1.38E-04	1.34E-02	1.38E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
trans-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
cis-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	9.97E-03	1.03E-04	9.97E-03	1.03E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
TCE	C_2HCl_3	131.5	1.31E-01	9.97E-04	7.02E-06	5.34E-08	1.31E-01	9.97E-04			3.00E-02	2.28E-04	4.93E+02
PCE	C_2Cl_4	166.0	1.05E-02	6.35E-05	1.40E-03	8.46E-06	9.14E-03	5.51E-05			2.81E-04	1.69E-06	3.66E+00
Dichlorodifluoromenthane (R12)	CCl_2F_2	121.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Trichlorofluoromethane (R11)	CCl_3F	137.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Trichlorotrifluoroethane (R113)	$C_2Cl_3F_3$	187.5	2.11E-03	1.12E-05	2.11E-03	1.12E-05	0.00E+00	0.00E+00			7.37E-03	3.93E-05	8.50E+01
Chlorobenzene	C_6H_5Cl	112.5	7.05E-04	6.27E-06	7.05E-04	6.27E-06	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Benzene	C_6H_6	78.0	1.03E-02	1.32E-04	4.92E-03	6.30E-05	5.40E-03	6.93E-05			1.24E-03	1.59E-05	3.43E+01
Toluene	$C_6H_5CH_3$	92.0	2.47E-03	2.69E-05	2.47E-03	2.69E-05	0.00E+00	0.00E+00			1.63E-20	1.77E-22	3.82E-16
Ethylbenzene	$C_6H_5CH_2CH_3$	106.0	2.58E-03	2.44E-05	7.02E-04	6.62E-06	1.88E-03	1.78E-05			2.85E-05	2.69E-07	5.81E-01
Xylene, Total	$C_6H_4(CH_3)_2$	106.0	2.59E-03	2.44E-05	1.40E-03	1.32E-05	1.18E-03	1.11E-05			2.70E-05	2.55E-07	5.51E-01
Other Volatile Hydrocarbons - C-3	C_3H_8	44.0	5.67E-03	1.29E-04	5.67E-03	1.29E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-4	C_4H_{10}	58.0	2.07E-03	3.57E-05	2.07E-03	3.57E-05	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-5	C_5H_{12}	72.0	2.53E-03	3.51E-05	2.53E-03	3.51E-05	4.34E-19	6.02E-21			2.10E-03	2.91E-05	6.30E+01
Other Volatile Hydrocarbons - C-6	C_6H_{14}	86.0	2.29E-02	2.66E-04	1.40E-04	1.63E-06	2.28E-02	2.65E-04			1.15E-02	1.34E-04	2.89E+02
Other Volatile Hydrocarbons - C-7	C_7H_{16}	100.0	7.44E-01	7.44E-03	2.11E-05	2.11E-07	7.44E-01	7.44E-03			7.31E-02	7.31E-04	1.58E+03
Other Volatile Hydrocarbons - C-8	C_8H_{18}	114.0	9.33E-01	8.18E-03	4.92E-06	4.31E-08	9.33E-01	8.18E-03			2.87E-02	2.51E-04	5.44E+02
Other Volatile Hydrocarbons - C-9	C_9H_{20}	128.0	5.15E-01	4.02E-03	0.00E+00	0.00E+00	5.15E-01	4.02E-03			3.09E-03	2.41E-05	5.21E+01
Other Volatile Hydrocarbons - C-10	$C_{10}H_{22}$	142.0	2.99E-01	2.10E-03	0.00E+00	0.00E+00	2.99E-01	2.10E-03			4.46E-04	3.14E-06	6.79E+00
Other Volatile Hydrocarbons - C-11	$C_{11}H_{24}$	156.0	1.25E-01	7.99E-04	0.00E+00	0.00E+00	1.25E-01	7.99E-04			4.65E-05	2.98E-07	6.44E-01
Other Volatile Hydrocarbons - C-12	$C_{12}H_{26}$	170.0	8.42E-03	4.95E-05	0.00E+00	0.00E+00	8.42E-03	4.95E-05			6.28E-07	3.69E-09	7.98E-03
Subtotal Organics			2.90E+00	2.51E-02	1.08E-01	1.10E-03	2.80E+00	2.40E-02	0.00E+00	0.00E+00	1.58E-01	1.46E-03	3.16E+03
Inert Gases and Vapors									9.17E+00	3.17E-01	1.32E+01	4.54E-01	9.82E+05
Dry Air	N_2, O_2, Ar	28.97							1.05E-01	5.86E-03	1.23E-01	6.81E-03	1.47E+04
Water Vapor	H_2O	18.00	7.80E+00	4.33E-01	6.63E+00	3.68E-01	1.17E+00	6.50E-02					
Totals =			1.07E+01	4.59E-01	6.74E+00	3.70E-01	3.97E+00	8.90E-02	9.28E+00	3.22E-01	1.34E+01	4.63E-01	1.00E+06
												TNMOC =	1.94E+04
											% of Org. that are chlorinated =		18.67%

Appe[redacted]B	Stream Number		12		
PROCESS FLOW BALANCE	Flow Rate: Acfm		3.751		
Concentrator with PDU System	Scfm		2.913		
Site IC-31	Gpm		Not Applicable		
First Quarter 1997 Data	Temperature (°F)		180.0		
Condensing Temp = 35 F	Pressure (Psia)		14.04		
Rev. 0	Percent of LEL		0.25%		
Chemical	Composition:	Molecular Weight	Treated Vapors from PDU's		
			Lb/hr	Lb-mols/hr	ppmv
Chloromethane	CH_3Cl	50.5	0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	CH_2Cl_2	85.0	0.00E+00	0.00E+00	0.00E+00
Chloroform	$CHCl_3$	119.5	0.00E+00	0.00E+00	0.00E+00
Carbon Tetrachloride	CCl_4	154.0	5.76E-06	3.74E-08	8.11E-02
1,1 Dichloroethane	$C_2H_4Cl_2$	99.0	0.00E+00	0.00E+00	0.00E+00
1,2 Dichloroethane	$C_2H_4Cl_2$	99.0	0.00E+00	0.00E+00	0.00E+00
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.5	0.00E+00	0.00E+00	0.00E+00
Vinyl Chloride	C_2H_3Cl	62.5	0.00E+00	0.00E+00	0.00E+00
1,1 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00
trans-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00
cis-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00
TCE	C_2HCl_3	131.5	3.00E-04	2.28E-06	4.95E+00
PCE	C_2Cl_4	166.0	2.81E-06	1.69E-08	3.67E-02
Dichlorodifluoromenthane (R12)	CCl_2F_2	121.0	0.00E+00	0.00E+00	0.00E+00
Trichlorofluoromethane (R11)	CCl_3F	137.5	0.00E+00	0.00E+00	0.00E+00
Trichlorotrifluoroethane (R113)	$C_2Cl_3F_3$	187.5	7.37E-05	3.93E-07	8.52E-01
Chlorobenzene	C_6H_5Cl	112.5	0.00E+00	0.00E+00	0.00E+00
Benzene	C_6H_6	78.0	1.24E-05	1.59E-07	3.44E-01
Toluene	$C_6H_5CH_3$	92.0	1.63E-22	1.77E-24	3.83E-18
Ethylbenzene	$C_6H_5CH_2CH_3$	106.0	2.85E-07	2.69E-09	5.83E-03
Xylene, Total	$C_6H_4(CH_3)_2$	106.0	2.70E-07	2.55E-09	5.53E-03
Other Volatile Hydrocarbons - C-3	C_3H_8	44.0	0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-4	C_4H_{10}	58.0	0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-5	C_5H_{12}	72.0	2.10E-05	2.91E-07	6.32E-01
Other Volatile Hydrocarbons - C-6	C_6H_{14}	86.0	1.15E-04	1.34E-06	2.90E+00
Other Volatile Hydrocarbons - C-7	C_7H_{16}	100.0	7.31E-04	7.31E-06	1.59E+01
Other Volatile Hydrocarbons - C-8	C_8H_{18}	114.0	2.87E-04	2.51E-06	5.45E+00
Other Volatile Hydrocarbons - C-9	C_9H_{20}	128.0	3.09E-05	2.41E-07	5.23E-01
Other Volatile Hydrocarbons - C-10	$C_{10}H_{22}$	142.0	4.46E-06	3.14E-08	6.81E-02
Other Volatile Hydrocarbons - C-11	$C_{11}H_{24}$	156.0	4.65E-07	2.98E-09	6.46E-03
Other Volatile Hydrocarbons - C-12	$C_{12}H_{26}$	170.0	6.28E-09	3.69E-11	8.01E-05
Subtotal Organics			1.58E-03	1.46E-05	3.17E+01
Inert Gases and Vapors					
Dry Air	N_2, O_2, Ar	28.97	1.32E+01	4.54E-01	9.85E+05
Water Vapor	H_2O	18.00	1.23E-01	6.81E-03	1.48E+04
Totals =			1.33E+01	4.61E-01	1.00E+06
				TNMOC =	1.94E+02
			% of Org. that are chlorinated =		18.67%

APPENDIX 2C

PROCESS FLOW BALANCE
(Condensing Temperature @ 68 °F

Appe[illegible]C	Stream Number		1A			1B			1C			2		
PROCESS FLOW BALANCE	Flow Rate:	Acfm	289			260			13.14			516		
Concentrator with PDU System		Scfm	250			250			10.20			509		
Site IC-31		Gpm	Not Applicable						Not Applicable			Not Applicable		
First Quarter 1997 Data		Temperature (°F)	126.0			80.0			180.00			70		
Condensing Temp = 68 F		Pressure (Psia)	14.33			14.69			14.33			14.76		
Rev. 0		Percent of LEL	6.84%						0.25%			0.17%		
Chemical	**Composition:**	**Molecular Weight**	**SVE Vapor to Adsorber**			**Ambient Air**			**Recycled PDT Treated Vapors**			**Treated Vapor return to ECS**		
			Lbs/hr	**Lb-mols/hr**	**ppmv**	**Lbs/hr**	**Lb-mols/hr**	**ppmv**	**Lbs/hr**	**Lb-mols/hr**	**ppmv**	**Lbs/hr**	**Lb-mols/hr**	**ppmv**
Chloromethane	CH_3Cl	50.5	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	CH_2Cl_2	85.0	3.53E-03	4.16E-05	1.05E+00				0.00E+00	0.00E+00	0.00E+00	1.77E-04	2.08E-06	2.58E-02
Chloroform	$CHCl_3$	119.5	1.45E-02	1.21E-04	3.06E+00				0.00E+00	0.00E+00	0.00E+00	7.24E-04	6.06E-06	7.53E-02
Carbon Tetrachloride	CCl_4	154.0	6.01E-03	3.90E-05	9.86E-01				1.83E-05	1.19E-07	7.34E-02	3.02E-04	1.96E-06	2.43E-02
1,1 Dichloroethane	$C_2H_4Cl_2$	99.0	1.68E-02	1.70E-04	4.28E+00				0.00E+00	0.00E+00	0.00E+00	8.40E-04	8.48E-06	1.05E-01
1,2 Dichloroethane	$C_2H_4Cl_2$	99.0	2.57E-03	2.59E-05	6.55E-01				0.00E+00	0.00E+00	0.00E+00	1.28E-04	1.30E-06	1.61E-02
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.5	2.24E-02	1.68E-04	4.23E+00				0.00E+00	0.00E+00	0.00E+00	1.12E-03	8.38E-06	1.04E-01
Vinyl Chloride	C_2H_3Cl	62.5	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,1 Dichloroethene	$C_2H_2Cl_2$	97.0	1.41E-02	1.45E-04	3.67E+00				0.00E+00	0.00E+00	0.00E+00	7.04E-04	7.26E-06	9.02E-02
trans-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
cis-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	1.05E-02	1.08E-04	2.73E+00				0.00E+00	0.00E+00	0.00E+00	5.25E-04	5.41E-06	6.72E-02
TCE	C_2HCl_3	131.5	1.69E-01	1.29E-03	3.25E+01				8.42E-04	6.41E-06	3.97E+00	8.50E-03	6.47E-05	8.03E-01
PCE	C_2Cl_4	166.0	1.14E-02	6.86E-05	1.73E+00				1.19E-05	7.15E-08	4.43E-02	5.70E-04	3.44E-06	4.27E-02
Dichlorodifluoromenthane (R12)	CCl_2F_2	121.0	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trichlorofluoromethane (R11)	CCl_3F	137.5	0.00E+00	0.00E+00	0.00E+00				0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trichlorotrifluoroethane (R113)	$C_2Cl_3F_3$	187.5	9.90E-03	5.28E-05	1.33E+00				7.38E-05	3.93E-07	2.44E-01	4.99E-04	2.66E-06	3.30E-02
Chlorobenzene	C_6H_5Cl	112.5	7.43E-04	6.60E-06	1.67E-01				0.00E+00	0.00E+00	0.00E+00	3.71E-05	3.30E-07	4.10E-03
Benzene	C_6H_6	78.0	1.21E-02	1.56E-04	3.93E+00				4.51E-05	5.78E-07	3.58E-01	6.10E-04	7.82E-06	9.71E-02
Toluene	$C_6H_5CH_3$	92.0	2.61E-03	2.83E-05	7.15E-01				5.88E-22	6.39E-24	3.96E-18	1.30E-04	1.42E-06	1.76E-02
Ethylbenzene	$C_6H_5CH_2CH_3$	106.0	2.75E-03	2.59E-05	6.55E-01				1.20E-06	1.14E-08	7.03E-03	1.38E-04	1.30E-06	1.61E-02
Xylene, Total	$C_6H_4(CH_3)_2$	106.0	2.75E-03	2.59E-05	6.55E-01				9.82E-07	9.27E-09	5.74E-03	1.38E-04	1.30E-06	1.61E-02
Other Volatile Hydrocarbons - C-3	C_3H_8	44.0	5.97E-03	1.36E-04	3.43E+00				0.00E+00	0.00E+00	0.00E+00	2.98E-04	6.78E-06	8.42E-02
Other Volatile Hydrocarbons - C-4	C_4H_{10}	58.0	2.18E-03	3.76E-05	9.50E-01				0.00E+00	0.00E+00	0.00E+00	1.09E-04	1.88E-06	2.34E-02
Other Volatile Hydrocarbons - C-5	C_5H_{12}	72.0	4.85E-03	6.73E-05	1.70E+00				2.11E-05	2.93E-07	1.81E-01	2.43E-04	3.38E-06	4.20E-02
Other Volatile Hydrocarbons - C-6	C_6H_{14}	86.0	3.61E-02	4.20E-04	1.06E+01				3.45E-04	4.01E-06	2.48E+00	1.82E-03	2.12E-05	2.63E-01
Other Volatile Hydrocarbons - C-7	C_7H_{16}	100.0	8.60E-01	8.60E-03	2.17E+02				2.95E-03	2.95E-05	1.82E+01	4.31E-02	4.31E-04	5.36E+00
Other Volatile Hydrocarbons - C-8	C_8H_{18}	114.0	1.01E+00	8.88E-03	2.24E+02				6.92E-04	6.07E-06	3.76E+00	5.06E-02	4.44E-04	5.51E+00
Other Volatile Hydrocarbons - C-9	C_9H_{20}	128.0	5.45E-01	4.26E-03	1.08E+02				1.40E-04	1.09E-06	6.75E-01	2.73E-02	2.13E-04	2.64E+00
Other Volatile Hydrocarbons - C-10	$C_{10}H_{22}$	142.0	3.15E-01	2.22E-03	5.60E+01				2.69E-05	1.89E-07	1.17E-01	1.57E-02	1.11E-04	1.38E+00
Other Volatile Hydrocarbons - C-11	$C_{11}H_{24}$	156.0	1.31E-01	8.42E-04	2.13E+01				2.24E-06	1.44E-08	8.90E-03	6.56E-03	4.21E-05	5.23E-01
Other Volatile Hydrocarbons - C-12	$C_{12}H_{26}$	170.0	8.86E-03	5.21E-05	1.32E+00				3.78E-08	2.23E-10	1.38E-04	4.43E-04	2.61E-06	3.24E-02
Subtotal Organics			3.22E+00	2.80E-02	7.06E+02				5.17E-03	4.87E-05	3.02E+01	1.61E-01	1.40E-03	1.74E+01
Inert Gases and Vapors														
Dry Air	N_2, O_2, Ar	28.97	9.95E+02	3.44E+01	8.67E+05	1.13E+03	3.89E+01	9.81E+05	4.59E+01	1.59E+00	9.81E+05	2.16E+03	7.47E+01	9.28E+05
Water Vapor	H_2O	18.00	9.40E+01	5.22E+00	1.32E+05	1.32E+01	7.34E-01	1.85E+04	5.37E-01	2.98E-02	1.85E+04	1.04E+02	5.79E+00	7.19E+04
Totals =			1.09E+03	3.96E+01	1.00E+06	1.14E+03	3.96E+01	1.00E+06	4.65E+01	1.62E+00	1.00E+06	2.27E+03	8.05E+01	1.00E+06
				TNMOC =	5.32E+03								TNMOC =	1.31E+02
			% of Org. that are chlorinated =		7.99%							% of Org. that are chlorinated =		8.00%

Appe[redacted]C	Stream Number	3	[redacted]4	5	6
PROCESS FLOW BALANCE	Flow Rate: Acfm	Not Applicable, Solid Phase Adsorbent	[redacted]	6.3	1.118
Concentrator with PDU System	Scfm		1.8	3.9	1.069
Site IC-31	Gpm		Not Applicable	Not Applicable	Not Applicable
First Quarter 1997 Data	Temperature (°F)		212	350	68.0
Condensing Temp = 68 F	Pressure (Psia)		14.33	14.26	14.26
Rev. 0	Percent of LEL		Not Applicable	414.38%	239.39%

Chemical	Composition:	Molecular Weight	Adsorbed Vapors		Sweep Vapor		Desorbed Vapors			Non-Condensables		
			Lbs/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	ppmv	lb/hr	Lb-mols/hr	ppmv
Chloromethane	CH_3Cl	50.5	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	CH_2Cl_2	85.0	3.36E-03	3.95E-05			3.36E-03	3.95E-05	6.35E+01	0.00E+00	0.00E+00	0.00E+00
Chloroform	$CHCl_3$	119.5	1.38E-02	1.15E-04			1.38E-02	1.15E-04	1.85E+02	0.00E+00	0.00E+00	0.00E+00
Carbon Tetrachloride	CCl_4	154.0	5.73E-03	3.72E-05			5.73E-03	3.72E-05	5.98E+01	1.83E-03	1.19E-05	7.01E+01
1,1 Dichloroethane	$C_2H_4Cl_2$	99.0	1.60E-02	1.61E-04			1.60E-02	1.61E-04	2.59E+02	0.00E+00	0.00E+00	0.00E+00
1,2 Dichloroethane	$C_2H_4Cl_2$	99.0	2.44E-03	2.46E-05			2.44E-03	2.46E-05	3.96E+01	0.00E+00	0.00E+00	0.00E+00
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.5	2.13E-02	1.59E-04			2.13E-02	1.59E-04	2.56E+02	0.00E+00	0.00E+00	0.00E+00
Vinyl Chloride	C_2H_3Cl	62.5	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,1 Dichloroethene	$C_2H_2Cl_2$	97.0	1.34E-02	1.38E-04			1.34E-02	1.38E-04	2.22E+02	0.00E+00	0.00E+00	0.00E+00
trans-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
cis-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	9.97E-03	1.03E-04			9.97E-03	1.03E-04	1.65E+02	0.00E+00	0.00E+00	0.00E+00
TCE	C_2HCl_3	131.5	1.62E-01	1.23E-03			1.62E-01	1.23E-03	1.97E+03	8.42E-02	6.41E-04	3.79E+03
PCE	C_2Cl_4	166.0	1.08E-02	6.53E-05			1.08E-02	6.53E-05	1.05E+02	1.19E-03	7.15E-06	4.23E+01
Dichlorodifluoromenthane (R12)	CCl_2F_2	121.0	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trichlorofluoromethane (R11)	CCl_3F	137.5	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trichlorotrifluoroethane (R113)	$C_2Cl_3F_3$	187.5	9.48E-03	5.05E-05			9.48E-03	5.05E-05	8.12E+01	7.38E-03	3.93E-05	2.33E+02
Chlorobenzene	C_6H_5Cl	112.5	7.05E-04	6.27E-06			7.05E-04	6.27E-06	1.01E+01	0.00E+00	0.00E+00	0.00E+00
Benzene	C_6H_6	78.0	1.16E-02	1.49E-04			1.16E-02	1.49E-04	2.39E+02	4.51E-03	5.78E-05	3.42E+02
Toluene	$C_6H_5CH_3$	92.0	2.47E-03	2.69E-05			2.47E-03	2.69E-05	4.32E+01	5.88E-20	6.39E-22	3.78E-15
Ethylbenzene	$C_6H_5CH_2CH_3$	106.0	2.61E-03	2.47E-05			2.61E-03	2.47E-05	3.96E+01	1.20E-04	1.14E-06	6.72E+00
Xylene, Total	$C_6H_4(CH_3)_2$	106.0	2.61E-03	2.47E-05			2.61E-03	2.47E-05	3.96E+01	9.82E-05	9.27E-07	5.48E+00
Other Volatile Hydrocarbons - C-3	C_3H_8	44.0	5.67E-03	1.29E-04			5.67E-03	1.29E-04	2.07E+02	0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-4	C_4H_{10}	58.0	2.07E-03	3.57E-05			2.07E-03	3.57E-05	5.74E+01	0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-5	C_5H_{12}	72.0	4.62E-03	6.42E-05			4.62E-03	6.42E-05	1.03E+02	2.11E-03	2.93E-05	1.73E+02
Other Volatile Hydrocarbons - C-6	C_6H_{14}	86.0	3.46E-02	4.03E-04			3.46E-02	4.03E-04	6.47E+02	3.45E-02	4.01E-04	2.37E+03
Other Volatile Hydrocarbons - C-7	C_7H_{16}	100.0	8.19E-01	8.19E-03			8.19E-01	8.19E-03	1.32E+04	2.95E-01	2.95E-03	1.74E+04
Other Volatile Hydrocarbons - C-8	C_8H_{18}	114.0	9.62E-01	8.44E-03			9.62E-01	8.44E-03	1.36E+04	6.92E-02	6.07E-04	3.59E+03
Other Volatile Hydrocarbons - C-9	C_9H_{20}	128.0	5.18E-01	4.05E-03			5.18E-01	4.05E-03	6.50E+03	1.40E-02	1.09E-04	6.45E+02
Other Volatile Hydrocarbons - C-10	$C_{10}H_{22}$	142.0	2.99E-01	2.11E-03			2.99E-01	2.11E-03	3.39E+03	2.69E-03	1.89E-05	1.12E+02
Other Volatile Hydrocarbons - C-11	$C_{11}H_{24}$	156.0	1.25E-01	7.99E-04			1.25E-01	7.99E-04	1.28E+03	2.24E-04	1.44E-06	8.50E+00
Other Volatile Hydrocarbons - C-12	$C_{12}H_{26}$	170.0	8.42E-03	4.95E-05			8.42E-03	4.95E-05	7.96E+01	3.78E-06	2.23E-08	1.32E-01
Subtotal Organics			3.07E+00	2.66E-02			3.07E+00	2.66E-02	4.28E+04	5.17E-01	4.87E-03	2.88E+04
Inert Gases and Vapors												
Dry Air	N_2, O_2, Ar	28.97	3.44E+00	1.19E-01	1.22E+00	4.20E-02	4.65E+00	1.61E-01	2.58E+05	4.65E+00	1.61E-01	9.50E+05
Water Vapor	H_2O	18.00	3.44E+00	1.91E-01	4.39E+00	2.44E-01	7.83E+00	4.35E-01	6.99E+05	6.23E-02	3.46E-03	2.11E+04
Totals =			9.94E+00	3.36E-01	5.61E+00	2.86E-01	1.56E+01	6.22E-01	1.00E+06	5.23E+00	1.69E-01	1.00E+06
								TNMOC =	3.22E+05		TNMOC =	1.83E+05
							% of Org. that are chlorinated =		8.00%	% of Org. that are chlorinated =		14.35%

Appe[redacted]C	Stream Number	7	8	9	10	11
PROCESS FLOW [redacted]ALANCE	Flow Rate: Acfm	Not Applicable	Not Applicable	Not Applicable	9.519	10.965
Concentrator with PDU System	Scfm	Not Applicable	Not Applicable	Not Applicable	9.167	10.234
Site IC-31	Gpm	1.1	0.8	0.3	Not Applicable	Not Applicable
First Quarter 1997 Data	Temperature (°F)	68.0	68.0	68.0	80.00	78.00
Condensing Temp = 68 F	Pressure (Psia)	14.26	14.26	14.26	14.69	14.18
Rev. 0	Percent of LEL	Not Applicable	Not Applicable	Not Applicable		25.0%

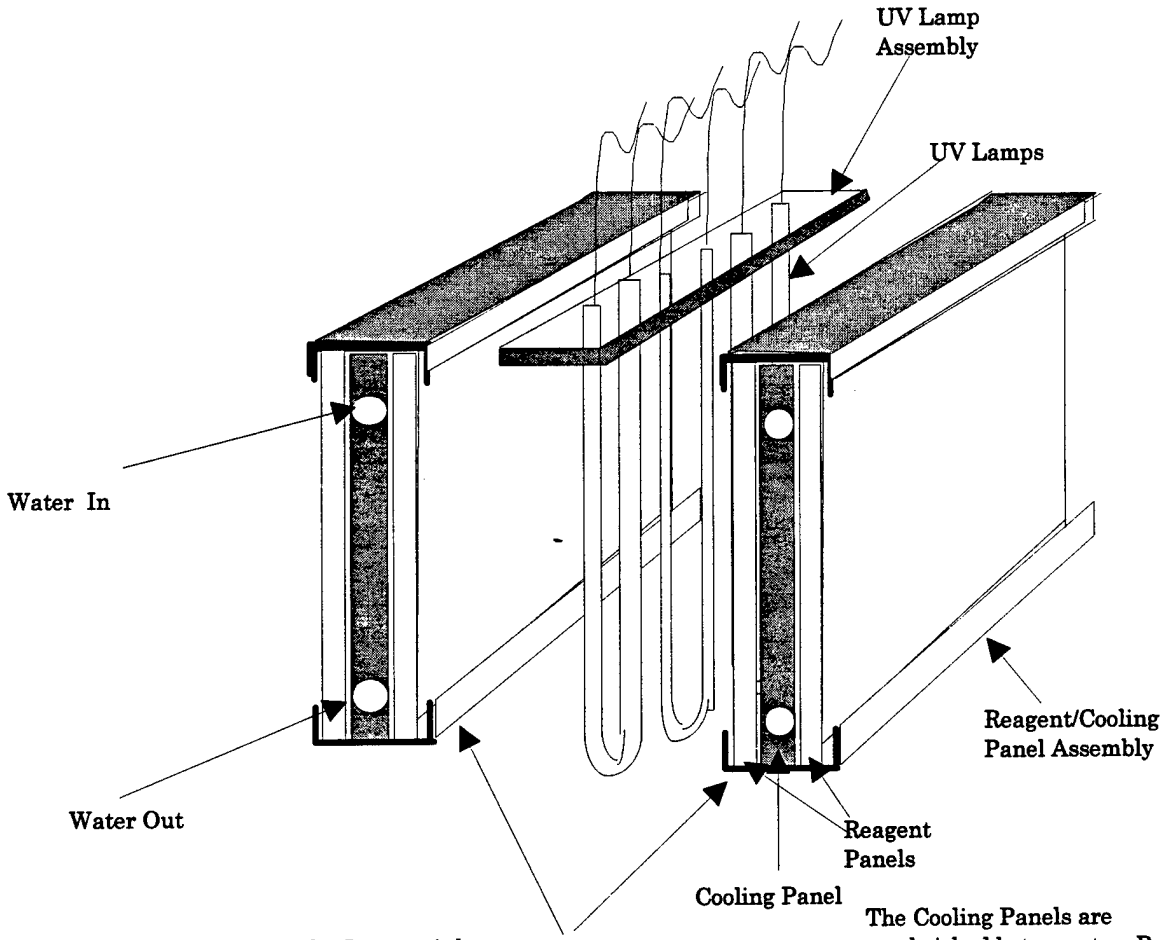
Chemical	Composition:	Molecular Weight	Condensate		Aqueous Phase		Solvent Phase		Carrier Air to PDT		PDT - Feed Gas		
			Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	Lb/hr	Lb-mols/hr	ppmv
Chloromethane	CH_3Cl	50.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	CH_2Cl_2	85.0	3.36E-03	3.95E-05	3.36E-03	3.95E-05	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Chloroform	$CHCl_3$	119.5	1.38E-02	1.15E-04	1.38E-02	1.15E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Carbon Tetrachloride	CCl_4	154.0	3.90E-03	2.53E-05	3.50E-03	2.27E-05	4.07E-04	2.64E-06			1.83E-03	1.19E-05	7.32E+00
1,1 Dichloroethane	$C_2H_4Cl_2$	99.0	1.60E-02	1.61E-04	1.60E-02	1.61E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
1,2 Dichloroethane	$C_2H_4Cl_2$	99.0	2.44E-03	2.46E-05	2.44E-03	2.46E-05	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.5	2.13E-02	1.59E-04	2.13E-02	1.59E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Vinyl Chloride	C_2H_3Cl	62.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
1,1 Dichloroethene	$C_2H_2Cl_2$	97.0	1.34E-02	1.38E-04	1.34E-02	1.38E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
trans-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
cis-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	9.97E-03	1.03E-04	9.97E-03	1.03E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
TCE	C_2HCl_3	131.5	7.74E-02	5.88E-04	6.99E-06	5.32E-08	7.74E-02	5.88E-04			8.42E-02	6.41E-04	3.95E+02
PCE	C_2Cl_4	166.0	9.65E-03	5.81E-05	1.40E-03	8.42E-06	8.25E-03	4.97E-05			1.19E-03	7.15E-06	4.42E+00
Dichlorodifluoromenthane (R12)	CCl_2F_2	121.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Trichlorofluoromethane (R11)	CCl_3F	137.5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Trichlorotrifluoroethane (R113)	$C_2Cl_3F_3$	187.5	2.10E-03	1.12E-05	2.10E-03	1.12E-05	8.67E-19	4.63E-21			7.38E-03	3.93E-05	2.43E+01
Chlorobenzene	C_6H_5Cl	112.5	7.05E-04	6.27E-06	7.05E-04	6.27E-06	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Benzene	C_6H_6	78.0	7.08E-03	9.07E-05	4.89E-03	6.28E-05	2.18E-03	2.80E-05			4.51E-03	5.78E-05	3.57E+01
Toluene	$C_6H_5CH_3$	92.0	2.47E-03	2.69E-05	2.47E-03	2.69E-05	0.00E+00	0.00E+00			5.88E-20	6.39E-22	3.95E-16
Ethylbenzene	$C_6H_5CH_2CH_3$	106.0	2.49E-03	2.35E-05	6.99E-04	6.60E-06	1.79E-03	1.69E-05			1.20E-04	1.14E-06	7.01E-01
Xylene, Total	$C_6H_4(CH_3)_2$	106.0	2.51E-03	2.37E-05	1.40E-03	1.32E-05	1.12E-03	1.05E-05			9.82E-05	9.27E-07	5.72E-01
Other Volatile Hydrocarbons - C-3	C_3H_8	44.0	5.67E-03	1.29E-04	5.67E-03	1.29E-04	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-4	C_4H_{10}	58.0	2.07E-03	3.57E-05	2.07E-03	3.57E-05	0.00E+00	0.00E+00			0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-5	C_5H_{12}	72.0	2.52E-03	3.50E-05	2.52E-03	3.50E-05	-4.34E-19	-6.02E-21			2.11E-03	2.93E-05	1.81E+01
Other Volatile Hydrocarbons - C-6	C_6H_{14}	86.0	1.40E-04	1.63E-06	1.40E-04	1.63E-06	-5.50E-18	-6.40E-20			3.45E-02	4.01E-04	2.47E+02
Other Volatile Hydrocarbons - C-7	C_7H_{16}	100.0	5.25E-01	5.25E-03	2.10E-05	2.10E-07	5.25E-01	5.25E-03			2.95E-01	2.95E-03	1.82E+03
Other Volatile Hydrocarbons - C-8	C_8H_{18}	114.0	8.93E-01	7.83E-03	4.89E-06	4.29E-08	8.93E-01	7.83E-03			6.92E-02	6.07E-04	3.74E+02
Other Volatile Hydrocarbons - C-9	C_9H_{20}	128.0	5.04E-01	3.94E-03	0.00E+00	0.00E+00	5.04E-01	3.94E-03			1.40E-02	1.09E-04	6.73E+01
Other Volatile Hydrocarbons - C-10	$C_{10}H_{22}$	142.0	2.97E-01	2.09E-03	0.00E+00	0.00E+00	2.97E-01	2.09E-03			2.69E-03	1.89E-05	1.17E+01
Other Volatile Hydrocarbons - C-11	$C_{11}H_{24}$	156.0	1.24E-01	7.98E-04	0.00E+00	0.00E+00	1.24E-01	7.98E-04			2.24E-04	1.44E-06	8.87E-01
Other Volatile Hydrocarbons - C-12	$C_{12}H_{26}$	170.0	8.42E-03	4.95E-05	0.00E+00	0.00E+00	8.42E-03	4.95E-05			3.78E-06	2.23E-08	1.37E-02
Subtotal Organics			2.55E+00	2.17E-02	1.08E-01	1.10E-03	2.44E+00	2.06E-02	0.00E+00	0.00E+00	5.17E-01	4.87E-03	3.01E+03
Inert Gases and Vapors									4.13E+01	1.42E+00	4.59E+01	1.59E+00	9.79E+05
Dry Air	N_2, O_2, Ar	28.97							4.75E-01	2.64E-02	5.37E-01	2.98E-02	1.84E+04
Water Vapor	H_2O	18.00	7.77E+00	4.32E-01	6.60E+00	3.67E-01	1.17E+00	6.47E-02					
Totals =			1.03E+01	4.53E-01	6.71E+00	3.68E-01	3.61E+00	8.54E-02	4.18E+01	#######	4.70E+01	1.62E+00	1.00E+06
												TNMOC =	1.91E+04
											% of Org. that are chlorinated =		14.35%

Appe C	Stream Number		12		
PROCESS FLOW BALANCE	Flow Rate: Acfm		13.139		
Concentrator with PDU System	Scfm		10.203		
Site IC-31	Gpm		Not Applicable		
First Quarter 1997 Data	Temperature (°F)		180.0		
Condensing Temp = 68 F	Pressure (Psia)		14.04		
Rev. 0	Percent of LEL		0.25%		
Chemical	Composition:	Molecular Weight	Treated Vapors from PDU's		
			Lb/hr	Lb-mols/hr	ppmv
Chloromethane	CH_3Cl	50.5	0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	CH_2Cl_2	85.0	0.00E+00	0.00E+00	0.00E+00
Chloroform	$CHCl_3$	119.5	0.00E+00	0.00E+00	0.00E+00
Carbon Tetrachloride	CCl_4	154.0	1.83E-05	1.19E-07	7.34E-02
1,1 Dichloroethane	$C_2H_4Cl_2$	99.0	0.00E+00	0.00E+00	0.00E+00
1,2 Dichloroethane	$C_2H_4Cl_2$	99.0	0.00E+00	0.00E+00	0.00E+00
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.5	0.00E+00	0.00E+00	0.00E+00
Vinyl Chloride	C_2H_3Cl	62.5	0.00E+00	0.00E+00	0.00E+00
1,1 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00
trans-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00
cis-1,2 Dichloroethene	$C_2H_2Cl_2$	97.0	0.00E+00	0.00E+00	0.00E+00
TCE	C_2HCl_3	131.5	8.42E-04	6.41E-06	3.97E+00
PCE	C_2Cl_4	166.0	1.19E-05	7.15E-08	4.43E-02
Dichlorodifluoromenthane (R12)	CCl_2F_2	121.0	0.00E+00	0.00E+00	0.00E+00
Trichlorofluoromethane (R11)	CCl_3F	137.5	0.00E+00	0.00E+00	0.00E+00
Trichlorotrifluoroethane (R113)	$C_2Cl_3F_3$	187.5	7.38E-05	3.93E-07	2.44E-01
Chlorobenzene	C_6H_5Cl	112.5	0.00E+00	0.00E+00	0.00E+00
Benzene	C_6H_6	78.0	4.51E-05	5.78E-07	3.58E-01
Toluene	$C_6H_5CH_3$	92.0	5.88E-22	6.39E-24	3.96E-18
Ethylbenzene	$C_6H_5CH_2CH_3$	106.0	1.20E-06	1.14E-08	7.03E-03
Xylene, Total	$C_6H_4(CH_3)_2$	106.0	9.82E-07	9.27E-09	5.74E-03
Other Volatile Hydrocarbons - C-3	C_3H_8	44.0	0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-4	C_4H_{10}	58.0	0.00E+00	0.00E+00	0.00E+00
Other Volatile Hydrocarbons - C-5	C_5H_{12}	72.0	2.11E-05	2.93E-07	1.81E-01
Other Volatile Hydrocarbons - C-6	C_6H_{14}	86.0	3.45E-04	4.01E-06	2.48E+00
Other Volatile Hydrocarbons - C-7	C_7H_{16}	100.0	2.95E-03	2.95E-05	1.82E+01
Other Volatile Hydrocarbons - C-8	C_8H_{18}	114.0	6.92E-04	6.07E-06	3.76E+00
Other Volatile Hydrocarbons - C-9	C_9H_{20}	128.0	1.40E-04	1.09E-06	6.75E-01
Other Volatile Hydrocarbons - C-10	$C_{10}H_{22}$	142.0	2.69E-05	1.89E-07	1.17E-01
Other Volatile Hydrocarbons - C-11	$C_{11}H_{24}$	156.0	2.24E-06	1.44E-08	8.90E-03
Other Volatile Hydrocarbons - C-12	$C_{12}H_{26}$	170.0	3.78E-08	2.23E-10	1.38E-04
Subtotal Organics			5.17E-03	4.87E-05	3.02E+01
Inert Gases and Vapors					
Dry Air	N_2, O_2, Ar	28.97	4.59E+01	1.59E+00	9.81E+05
Water Vapor	H_2O	18.00	5.37E-01	2.98E-02	1.85E+04
Totals =			4.65E+01	1.62E+00	1.00E+06
				TNMOC =	1.92E+02
			% of Org. that are chlorinated =		14.35%

APPENDIX 2D

Commercial Reactor Design

Schematic of Commercial Reactor Interior Components



Five Reagent/Cooling Panel Assemblies are mounted in each Reactor
Six rows of UV Lamp Assemblies are mounted in each Reactor

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APPLICATION ANALYSIS REPORT

AUTHOR INSTRUCTION

(See detailed description at right.)

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PROCESS TECHNOLOGIES, INC. CONCENTRATION AND PHOTOLYTIC DESTRUCTION OF VAPOR PHASE VOLATILE ORGANIC COMPOUNDS QUALITY ASSURANCE PROJECT PLAN

FINAL

February 16, 1998

Submitted to:

Paul dePercin, Work Assignment Manager
U.S. Environmental Protection Agency
26 West Martin Luther King Drive
Cincinnati, Ohio 45268

Submitted by:

Process Technologies, Inc.
1160 Exchange Street
Boise, Idaho 83715

PRDA # F04699-R-0143

Soil Vapor Extraction Treatment Optimization
Photolytic Destruction
of
Vapor Phase Volatile Organic Compounds

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QAPP Distribution List.

Organization	Name	Title	Copies
McClellan AFB	Craig Burnett	Project Manager	1
	Philip Mook	Team Leader	1
	Jerry Vincent	Field Team Leader	1
	Larry Jaramillo	Contracting Officer	1
	Merianne Sawyer	Contracting Office	1
EPA NRMRL	Paul dePercin	Work Assignment Manager	1
	Ann Kern	QA Officer	2
EPA-TIO	Carlos Pachan	Partnership Project Manager	1
BDM	Tim Chapman	Project Coordinator	1
Tetra Tech EM Inc.	Kirankumar Topudurti	Project Manager	4
	Kenneth Partymiller	QA Manager	1
	Stanley Labunski	QC Coordinator	1
Clean Sites	Richard Waesche	Project Manager	1
PTI	John Ferrell	Project Manager	1
	Mike Swan	Project Director	1
	Mike Gray	H&S Officer	1
	Randy Cooper	Field Manager/ Site Safety Coordinator	1
California EPA	John Wesnousky	Project Manager	1
Quanterra	Maria Jones	Project Manager	3
Best Environmental	Craig Thiry	Operations Manager	2

QAPP Approval Form

Organization	Name	Title	Approve/Disapprove	Signature/Date
McClellan AFB	Craig Burnett	Project Manager		
	Philip Mook	Team Leader		
	Jerry Vincent	Field Team Leader		
	Merianne Sawyer	Contracting Office		
EPA NRMRL	Paul dePercin	Work Assignment Manager		
	Ann Kern	QA Officer		
EPA-TIO	Carlos Pachan	Partnership Project Manager		
BDM	Tim Chapman	Project Coordinator		
Tetra Tech EM Inc.	Kirankumar Topudurti	Project Manager		
	Kenneth Partymiller	QA Manager		
	Stanley Labunski	QC Coordinator		
Clean Sites	Richard Waesche	Project Manager		
PTI	John Ferrell	Project Manager		
	Mike Swan	Project Director		
	Mike Gray	H&S Officer		
	Randy Cooper	Field Manager/ Site Safety Coordinator		
California EPA	John Wesnousky	Project Manager		
Quanterra	Maria Jones	Project Manager		
Best Environmental	Craig Thiry	Operations Manager		

SECTION 3.0

QUALITY ASSURANCE PROJECT PLAN

The Superfund Innovative Technology Evaluation (SITE) Program is intended to enhance the development and demonstration and, thereby, establish the commercial availability of innovative technologies for hazardous waste treatment.

The objective of the SITE Demonstration Program is to develop reliable engineering performance and cost data on innovative alternative technologies so that potential users can evaluate each technology's applicability for a specific site compared to other alternatives. Demonstrations are conducted at hazardous waste sites or under conditions that closely simulate actual wastes and conditions, to assure the accuracy and reliability of information collected.

Data collected during a demonstration are used to assess the performance of the technology, the potential need for pre- and post-processing of the waste, applicable types of wastes and media, the potential operating problems, and approximate capital and operating costs. Demonstration data can also provide insight into long-term operating and maintenance costs and long-term risks. Sampling and analysis procedures are, therefore, very critical. Approved quality control procedures must be stringently followed throughout the demonstration program.

Process Technologies, Inc. (PTI) has prepared this Quality Assurance Project Plan (QAPP) to include the following key elements required for a Category II QAPP.

- Project description, including the intended use of the data.
- Organizational chart and a delineation of QA/QC responsibilities.
- Data quality objectives for critical measurements, in terms of precision, accuracy, completeness, target reporting limits, representativeness, and comparability.
- Site selection and sampling procedures.
- Analytical and calibration procedures.
- Data reduction, validation, and reporting, including the handling of invalid/missing data.
- Internal quality control checks and audits.
- Systems and performance audits.
- Calculation of data quality indicators (precision, accuracy, completeness, and target reporting limits).
- Corrective actions (criteria and procedures).
- Quality control reports to management.

This QAPP follows the guidelines presented in the category II QAPP of the U.S. Environmental Protection Agency's (EPA) National Risk Management Research Laboratory (NRMRL) , formerly known as the Risk Reduction Engineering Laboratory (RREL). The QAPP also meets the requirements of the base-wide QAPP for McClellan Air Force Base (AFB). It describes the methods that PTI and its subcontractor Best Environmental and Quanterra will use to (1) handle and analyze samples and (2) perform other relevant data gathering activities in order to evaluate PTI's system at McClellan AFB. Section 1 of the WIP includes a brief overview of the project, the participants and their responsibilities. Section 2 of the WIP discusses the site selection and a detailed process description.

3.1 PROJECT DESCRIPTION

3.1.1 McClellan AFB: Site Location and History

The site for the PTI demonstration is located at Operable Unit A, Site IC 31, located near the southeast boundary of McClellan AFB, California. A description of the test site is provided in Section 2.2 of the Work Implementation Plan. A description of the Process Technologies, Inc. (PTI) technology is provided in Section 2.3. Figure 2-4 illustrates the basic configuration for the soil vapor extraction (SVE) and PTI systems for the demonstration.

3.1.2 Public-Private Partnership Goals and Project Objectives for the Demonstration

Table 3-1 summarizes project measurements to include critical and noncritical parameters for the gas streams, condensate, scrubber blowdown, and reagent panel samples. The VOCs previously detected at Site IC 31are listed in Table 3-2. The primary objectives for this test, and a brief description of how each objective will be evaluated are listed below:

P1 Evaluate whether the PTI system can achieve 95% overall removal of total non-methane organic compounds (TNMOC) in the feed gas stream at a 90% confidence level.

The determination of the TNMOC percent removal for the PTI system will be accomplished by collecting matched pairs of samples during Phase 2 of the demonstration using SUMMA® canisters and a grab sampling technique from the PTI system inlet and outlet, (Appendices 3A, sampling points A and B). These will be analyzed by EPA Method TO-12, with the data used to calculate the TNMOC removal for each sampling event, as well as an average and 90% confidence interval for Phase 2 demonstration period.

P2 Determine the percent removals achieved by the PTI system for critical VOCs in the feed gas stream at a 90% confidence level.

Percent removal for the critical VOCs will also be determined during Phase 2 of the demonstration. The critical VOCs were selected from a composite list of chemicals from six sampling events at site IC 31 (January through March of 1997) as determined by TO-14 analysis. Critical VOCs are defined as those which were present at average levels $\geq$ 1 ppmv. A list of critical and non-critical VOC can be found in Table 3-2. The percent removals will be determined by matched pairs of samples, collected in the same manner described above, from the inlet (A) and outlet (B) of the PTI system. The sample will be analyzed by EPA Method TO-14, the percent removal calculated for each sampling event, as well as an average and 90% confidence interval for Phase 2 demonstration period.

P3 Estimate treatment costs for the PTI system to achieve an average TNMOC removal of 95% for VOC-contaminated soil vapor at McClellan AFB, in a 1000 scfm system.

Cost estimates will be developed from data collected form the demonstration. Standard engineering principles will be used to scale-up costs for a 1000 scfm system. Cost estimates will be representative of charges typically assessed by the vendor and do not include profit. Costs such as preliminary site preparation, permits and regulatory requirements, initiation of monitoring and sampling programs, waste disposal and site cleanup and restoration are considered to be the responsible party's (or site owner's) obligation and will not be included in the estimate. These costs tend to be very site-specific, and calculations are left to the responsible party so that relevant information may be obtained for specific cases. The cost analysis will be included in the Innovative Technology Evaluation Report (ITER).

Table 3-1: Critical And Noncritical Project Measurements

Measurement	Stream	Classification	Sample Point[a]
Phase 1			
VOCs	Influent and Effluent Gas	C[b]	A, B
TNMOC	Influent and Effluent Gas, PDU Inlet	C	A, B,F
Phase 2			
VOCs	Condensate, Scrubber discharge, PDU Influent and Effluent	NC	C, E-1, E-2, F, G,
TNMOC	Influent and Effluent Gas	C	A, B
NO_X, O_3, CO, Phosgene	Effluent Gas, PDU Effluent	NC	B, G
Dioxins	Effluent Gas, PDU Effluent	NC	B, G
HCl, Chlorine	Effluent Gas and PDU Effluent	NC	B, G
TCLP VOCs	Reagent Panels	NC[c]	D
pH, TDS,TSS, Corrosivity	Scrubber Discharge	NC	C
Phase 1 and Phase 2[d]			
Temperature, Pressure, Flow Rate	Influent and Effluent Gas, Dilution Air	C	A, B
Temperature, Pressure	PDU Inlet and Outlet	NC	F, G
Humidity	Influent Gas, PDU Effluent	NC	A, G
Volume	Caustic, Condensate	NC	C, E-1, E-2

C = Critical
NC = Noncritical
a See Appendices 3A and 3B.
b See Tables 3-2 and 3-3.
c See Table 3-3
d See Appendix 3C - PTI Field Data Sheet

Table 3-2: Target Volatile Organic Compounds , Gas Samples

Compounds	Target Reporting Limits[a]	Classification
Benzene	2 ppbv	C
Toluene	2 ppbv	NC
Carbon Tetrachloride	2 ppbv	C
1,1-Dichloroethane	2 ppbv	C
1,2-Dichloroethane	2 ppbv	NC
1,1-Dichloroethene	2 ppbv	C
cis-1,2-Dichloroethene	2 ppbv	C
Ethylbenzene	2 ppbv	NC
Trichlorotrifluoroethane	2 ppbv	C
Methylene chloride	2 ppbv	C
Tetrachloroethene	2 ppbv	C
1,1,1-Trichloroethane	2 ppbv	C
Trichloroethene	2 ppbv	C
Chloroform	2 ppbv	C
Vinyl chloride	2 ppbv	NC
m,p-Xylenes	2 ppbv	NC
o-Xylene	2 ppbv	NC
TNMOC	0.5 ppm-C	C

a These limits may not be achievable for PDU Influent samples due to high concentrations.

There are also seven secondary objectives for this test. A brief descriptions of each objective and of how it will be evaluated is listed below.

S1. Determine the percent removals achieved by the PTI system for the non-critical VOCs.

The non-critical VOCs are listed in Table 3-2, and are defined as those which were present in the IC 31 soil vapor at average levels < 1 ppmv during the January through March 1997 sampling events. The percent removal will be calculated in the same manner as for the critical VOCs.

S2 Determine the concentrations of hydrochloric acid, phosgene, chlorine, ozone, carbon monoxide, NO_X, and dioxins exiting the PDU and PTI system.

The concentrations of HCl, chlorine, ozone, carbon monoxide, NO_X, and dioxins will be determined at the PDU outlet (G) and the PTI system outlet (B). Sampling and analysis will be performed using Method 26 for HCl and chlorine. Phosgene will be determined by Method TO-6. Ozone, carbon monoxide, and NO_X will be determined using continuous emission monitors, sampling three times for forty minutes each, during week 7 (see Table 3-5). Dioxins will be collected and analyzed by Method 23. Sampling for these contaminants will take place during week 7 of the demonstration. Sampling methods are discussed in Section 3.4.

S3. Determine the VOC percent removals achieved by the PDU.

The percent removals for VOCs will be determined by collecting samples at the inlet (F) and outlet (G) of the PDU in SUMMA canisters for analysis by Method TO-14. These will be collected during Phase 2 of the demonstration.

S4. Determine the amount of VOCs which will be leached from the reagent panels when subjected to the EPA's Toxic Characteristic Leaching Procedure (TCLP, SW-846 Methods 1311 and 8260A).

Samples of the reagent panels (sample point D) will be collected at the end of the demonstration, and analyzed for the VOCs listed in Table 3-3.

S5. Determine if the aqueous scrubber discharge meets the McClellan AFB wastewater treatment acceptance criteria.

The scrubber discharge (sample point C) will be analyzed for VOCs by EPA SW-846 Method 8260A. Total dissolved solids (TDS) and total suspended solids (TSS) will be determined by EPA MCAWW SW-846 Methods 160.1 and 160.2, respectively. Corrosivity will be determined by SW-846 method 1110 only if the pH is less than 3 or greater than 11.5 (per McClellan AFB). The pH will be determined with the pH probe installed in the scrubber unit.

S6. Characterize the condensate from the condenser for disposal purposes.

The condensate will be characterized using EPA SW-846 Method 8260A for VOCs, and SW-846 Method 1110 for corrosivity (only if pH is outside of the range 3-11.5 as per McClellan AFB). It is unclear at this time whether or not the condensate will be two distinct phases or an emulsion, therefore appropriate sample(s) (E-1, E-2) will be collected at the conclusion of the demonstration.

S7. Document observed operating problems and their resolutions

Process operating parameters will be monitored by PTI personnel throughout the test period on an hourly basis during normal work hours and will include:

1) Adsorber influent-- pressure, temperature, SVE vapor flow, total inlet gas flow, SVE vapor humidity, total inlet gas humidity.
2) Desorber – pressure, temperature, steam pressure, strip steam flow.
3) Condenser – condensate volume, dilution air rate.
4) PDU – inlet and outlet pressure and temperature, cooling water pressure and temperature, run time, and flow rate.
5) Scrubber – pressure drop, scrubber liquor pH, pressure to spray nozzles.
6) Adsorber effluent – pressure, temperature, flow rate, humidity.

Table 3-4 summarizes the total number of measurements (including QA samples) for the Demonstration Test. The average percent removal for the total VOCs will be determined by collecting grab samples in matched pairs from the influent (sample point A) and effluent (sample point B) stream of the PTI system. Percent removal obtained using EPA Method TO-12 (TNMOC) will represent the total VOC removal. This data will be treated as follows:

The average removal efficiency will be calculated by adding the total removal efficiencies and dividing by the total number of sample pairs. The data will be tested for normality and evaluated using the using the following equations. If the data is not normally distributed, it will be tested for other distributions, and evaluated using the appropriate equations from "Statistical Methods for Environmental Pollution Monitoring " by Richard Gilbert, Van Nostrand Reinhold Company, New York 1987.

Each matched pair of inlet and outlet concentration data (TNMOC) is denoted by X_i and Y_i respectively, $i = 1, \ldots, n_i$ where n is the number of matched pair samples. The ratio of outlet to inlet concentration, $R_i = Y_i / X_i$, and the average fraction remaining $R_{ave} = \sum R_i / n$, and s is the standard deviation of R_{ave}.

The upper confidence limit (UCL) will be calculated using the following equations:

$$UCL_{1-\alpha} = R_{ave} + t_{1-\alpha, n-1} (s/n^{1/2})$$

where the significance level (α) = 0.1, and $t_{1-\alpha, n-1}$ = Student t value at Significance level of α and n-1 degrees of freedom.

For the objective to be met (95% removal at 90% confidence level) $UCL_{1-\alpha}$ should be less than or equal to 0.05.

A similar procedure will be followed for the critical and noncritical VOCs, with matched pairs of samples collected at the influent and effluent (sample points A and B, respectively) and analyzed for VOCs by EPA method TO-14. The average removal efficiency for each VOC will be determined by collecting and analyzing matched pairs of samples from the influent and effluent stream of the PTI system. The average removal efficiency for each VOC will be calculated by adding the removal efficiencies for each VOC and dividing by the number of sample pairs. Each matched pair of inlet and outlet concentration data (TO-14) is denoted by X_i and Y_i respectively, $i = 1, \ldots, n_i$ where n is the number of matched pair samples. The ratio of outlet to inlet concentration, $R_i = Y_i / X_i$, and the

average fraction remaining $R_{ave} = \sum R_i / n$, and s is the standard deviation of R_{ave}. The upper confidence limit (UCL) and lower confidence limits (LCL) will be calculated using the following equations:

$$UCL_{1-\alpha/2} = R_{ave} + t_{1-\alpha/2,\, n-1}\ (s/n^{1/2})$$

$$LCL_{1-\alpha/2} = R_{ave} - t_{1-\alpha/2,\, n-1}\ (s/n^{1/2})$$

where the significance level (α) = 0.1, and $t_{1-\alpha,\, n-1}$ = Student t value at Significance level of α and n-1 degrees of freedom.

The 90% confidence limits for percent removal will be calculated by first multiplying the UCL (and LCL) values by 100 and then subtracting from 100.

PTI claims that the system is capable of removing >95% of the VOCs entering the PTI system. This claim will be evaluated by determining the average percent removal for total VOCs, as well as critical and noncritical VOCs. The gas stream flow rates and temperatures will be measured to calculate mass removal. The influent and effluent streams will be collected in SUMMA ® polished stainless steel canisters using grab sampling technique. The effluent stream will be diverted back into the SVE gas stream. Gas stream pressures, temperatures, and flow rates will be measured by PTI to document operating conditions and are critical measurements.

Table 3-3: Target Volatile Organic Compounds, TCLP Leachate Samples

Compounds	Classification
Benzene [a]	NC
Carbon tetrachloride[a]	NC
Chlorobenzene[a]	NC
Chloroform[a]	NC
1,4-Dichlorobenzene[a]	NC
1,1-Dichloroethane	NC
1,1-Dichloroethene[a]	NC
cis-1,2-Dichloroethene	NC
1,2-Dichloroethane[a]	NC
Ethylbenzene	NC
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	NC
Methylene chloride	NC
Methyl ethyl ketone[a]	NC
Tetrachloroethene[a]	NC
1,1,1-Trichloroethane	NC
Trichloroethene[a]	NC
Toluene	NC
Vinyl chloride [a]	NC
m, p-Xylenes	NC
o-Xylene	NC

a TCLP regulated

Table 3-4: Summary of Number of Measurements Required for the PTI Test

Measurement	Sample Point	No. of Samples	Field Duplicates	Field Blanks	Blinds	Total
Phase 1						
Influent Gas Stream	**A**					
TNMOC[a]		6	NA	NA	NA	6
Effluent Gas Stream	**B**					
TNMOC[a]		6	NA	NA	NA	6
PDU Inlet	**F**					
VOCs (TO-14)[a]		6	NA	NA	1	7
Phase 2						
Influent Gas Stream	**A**					
VOCs (TO-14)		10	1	1	2	14
TNMOC		10	1	1	NA	12
Effluent Gas Stream	**B**					
VOCs (TO-14)		10	1	1	2	14
TNMOC		10	1	1	NA	12
Dioxins		3	NA	1	1	5
NO_X, O_3, CO		3	NA	NA	NA	3
Phosgene		3	NA	NA	NA	3
HCl, Chlorine		3	NA	NA	NA	3
Scrubber Discharge	**C**					
VOCs		1	NA	NA	NA	1
TDS, TSS, Corrosivity, pH		1	NA	NA	NA	1

Table 3-4: Summary of Number of Measurements Required for the PTI Test (Cont.)

Measurement	Sample Point	No. of Samples	Field Duplicates	Field Blanks	Blinds	Total
Reagent Panels	**D**					
TCLP VOCs[c]		2	NA	NA	NA	2
Condensate Storage	**E-1, E-2**					
VOCs (8260A)		1[c]	NA	NA	NA	1
Corrosivity		1	NA	NA	NA	1
PDU Inlet	**F**					
VOCs (TO-14)		5	NA	NA	NA	5
PDU Outlet	**G**					
VOCs (TO-14)		5	NA	NA	NA	5
Dioxins		3	NA	NA	NA	3
NO_X, O_3, CO		3	NA	NA	NA	3
Phosgene		3	NA	NA	NA	3
HCl, Chlorine		3	NA	1	NA	4

a See Table 3-2.
b See Table 3-3.
c It is an anticipated that there will be two distinct phases, aqueous and organic, present in the condensate. Therefore each phase will be analyzed for VOCs for waste characterization purposes.

3.1.3 Experimental Design

The demonstration will cover an 8 week period and will be broken into two parts, Phase 1 and Phase 2. Phase 1 will consist of parametric testing. Feed gas flow rate from the SVE and the condenser temperature will be varied. For each set of operating conditions, a set of TNMOC and TO-14 samples will be collected at the inlet and outlet, of the PTI system and PDU inlet - sample points A, B, and F, respectively. Since only one measurement will be obtained for each set of conditions, the samples will be collected over a 4 hour period of time, using a flow regulator supplied with the SUMMA canisters. From this data, optimal conditions for operation of the PTI system will be determined. The planned operating conditions for Phase 1 can be found in Table 2.4. At the conclusion of Phase 1, the system will be shut down for 3 days for an inspection prior to the beginning of Phase 2.

Phase 2 or "Preferred Operating Condition" testing, will begin during week 4 of the demonstration and will last for 5 weeks. Gas samples will be collected in matched pairs at the inlet (sample point A) and outlet (sample point B) of the PTI system and analyzed for total non-methane organic carbon (TO-12) and for VOCs by method TO-14. Samples will be collected two days per week, one sample pair per day, for the remainder of the demonstration. Sample location points can be found in Appendices 3A and 3B.

Table 3-5: Sampling And Analysis Plan

Matrix	Parameter	Analytical Method	[A][1] PTI System Inlet Samples (gaseous) Week Number								[B] PTI System Outlet Samples (gaseous) Week Number								Sample Total
			Phase 1			Phase 2					Phase 1			Phase 2					
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	
Gas																			
	VOCs	TO-14				2	2	4**	2	2				2	2	4**	2	2	24
	TNMOC	TO-12	2	2	2	2	2	4**	2	2	2	2	2	2	2	4**	2	2	36
	[2] CO	10															3		3
	[2] Ozone	CEM															3		3
	[2] NOx	7E															3		3
	[2] Dioxins	23															3		3
	[2] HCl, chlorine	26															3		3
	[2] Phosgene	TO-6															3		3

Matrix	Parameter	Analytical Method	[C] Scrubber Discharge Samples (aqueous) Week Number								[D] Reagent Panels (solid) Week Number								Sample Total
			Phase 1			Phase 2					Phase 1			Phase 2					
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	
Solid																			
	TCLP	1311, 8260A																2	2
Liquid:																			
	VOCs	8260A								1									1
	TDS	160.1								1									1
	TSS	160.2								1									1
	Corrosivity	SW-846 Method 1110								1									1
	pH	probe																	

Matrix	Parameter	Analytical Method	[E-1, E-2] Condensate Storage Sample (liquid) Week Number								Sample Total
			Phase 1			Phase 2					
			1	2	3	4	5	6	7	8	
Liquid											
	VOCs	8260A								1	1
	Corrosivity	SW-846 Method 1110								1	1

Matrix	Parameter	Analytical Method	[F] PDU Inlet Week Number								[G] PDU Outlet Week Number								Sample Total
			Phase 1			Phase 2					Phase 1			Phase 2					
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	
Gas																			
	VOCs	TO-14	2	2	2	1	1	1	1	1				1	1	1	1	1	16
	TMNOC	TO-12	2	2	2														6
	[2] CO	10															3		3
	[2] Ozone	CEM															3		3
	[2] NOx	7E															3		3
	[2] Dioxins	23															3		3
	[2] HCl, chlorine	26															3		3
	[2] Phosgene	TO-6															3		3

Notes: ** Denotes one field duplicate and field blank.

1. Letter designates sampling point, refer to Appendices 3A, 3B.
2. NO_x, CO, O_3- 40 min.; HCl, Chlorine -60 min.; Dioxins - 180 min.; Phosgene - 60 min. sample times.

3.1.4 Schedule

Table 2-5 identifies all of the major technology demonstration activities from the planning phase to the completion of the Demonstration test. The field Demonstration test work is expected to begin on March 4, 1998 and to be completed by April 29, 1998. The PTI Final Report will be issued on August 31, 1998. Technical reports prepared by EPA and others are scheduled for completion within one year from the date of completion of the demonstration.

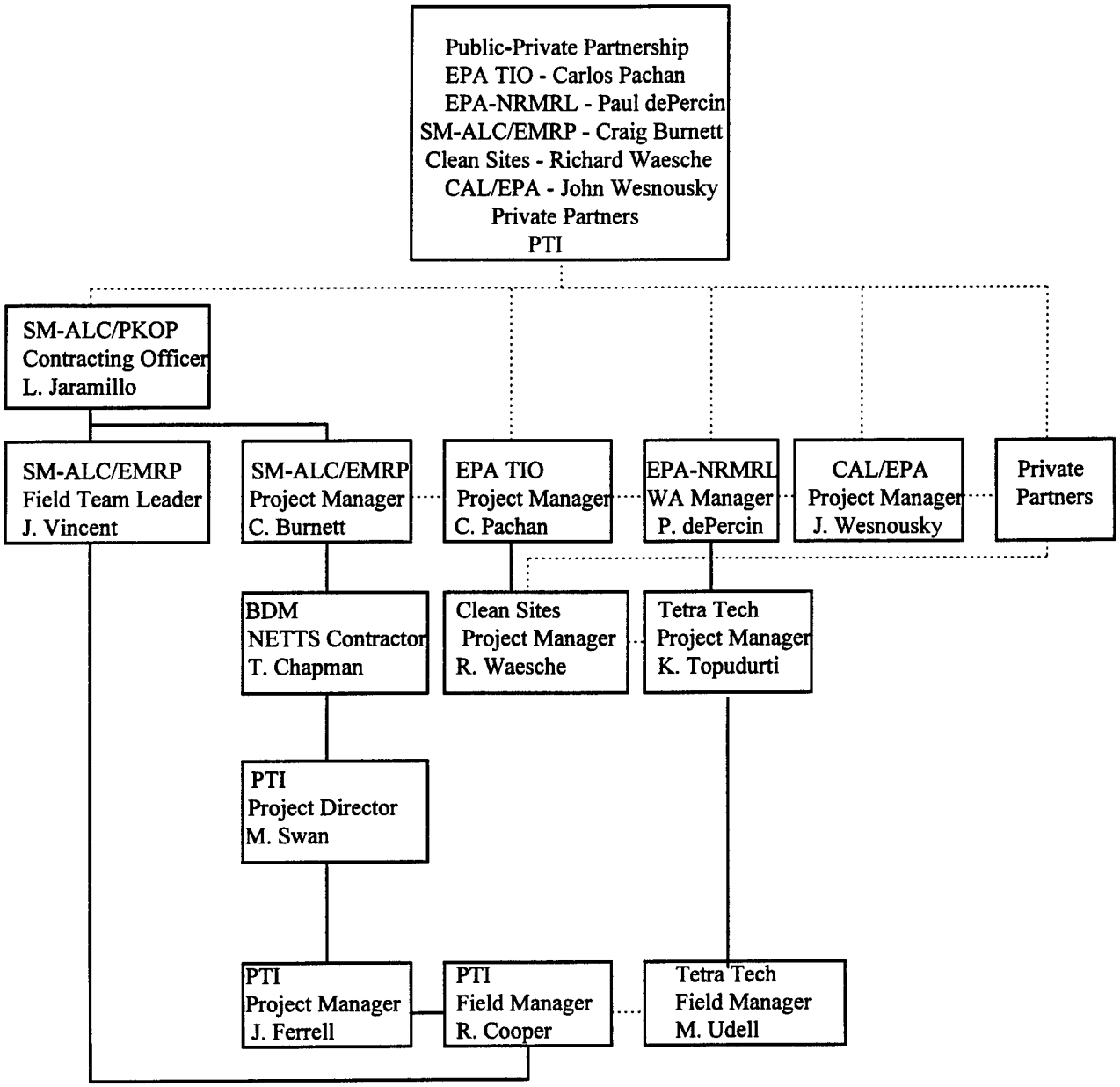
3.2 PROJECT ORGANIZATION

In developing the Work Implementation Plan for the demonstration of PTI System, the parties involved have different responsibilities. For this Demonstration, responsibilities are divided between various members of the Public-Private Partnership, including PTI; McClellan AFB and its contractor BDM; EPA-TIO and its contractor Clean Sites; and EPA-NRMRL and its contractor Tetra Tech EM Inc.. Those responsibilities were described in Sections 1.9 and 2.7. Overall project and quality assurance organizational charts of all the involved parties are presented in Figures 3-1 and 3-2, respectively. The QA organizational chart for those responsible for sampling and analysis is presented in Figure 3-3. The quality assurance and quality control functions have been organized to allow independent review of project activities, while providing ready access to QC coordination with the person most knowledgeable of the sampling/analysis activities.

EPA-NRMRL has overall project responsibility for performing the evaluation of the PTI System. The EPA-NRMRL Work Assignment Manager (WAM) is responsible for overseeing the technology testing and for ensuring the completion of the individual program tasks for the Public-Private Partnership by McClellan AFB under the SITE Program. PTI has been contracted to develop the Work Implementation Plan (WIP). EPA will review and approve the WIP. Paul dePercin is EPA-NRMRL's WAM. He has overall responsibility for data quality, data compilation, and preparation of the final reports being prepared by the EPA SITE program. The EPA QA Officer, Ann Kern, is responsible for reviewing and approving this Quality Assurance Project Plan. Tetra Tech will assist EPA-NRMRL in most of the tasks.

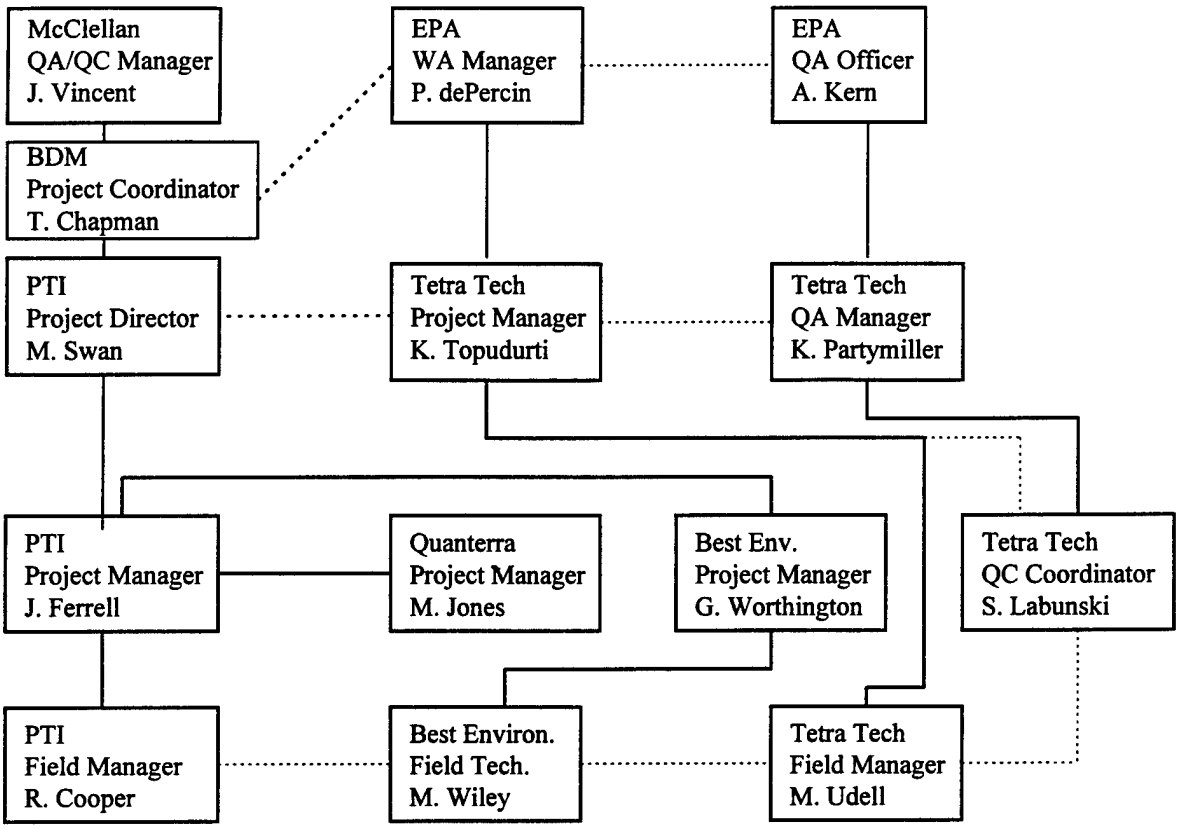
John Ferrell, the PTI Project Manager, has the overall responsibility for the PTI technical effort, including data gathering/compilation and preparation of the final report for the PTI technology demonstration. This includes the timely, cost-effective execution of all project activities. Mike Swan, the PTI Project Director, has the ultimate responsibility for completing these and all other SITE work assignments in accordance with the program objectives and within schedule and budget constraints. Randy Cooper is the PTI Field Manager/Site Safety Coordinator.

Figure 3-1: Overall Project Organization For The PTI Technology Demonstration.



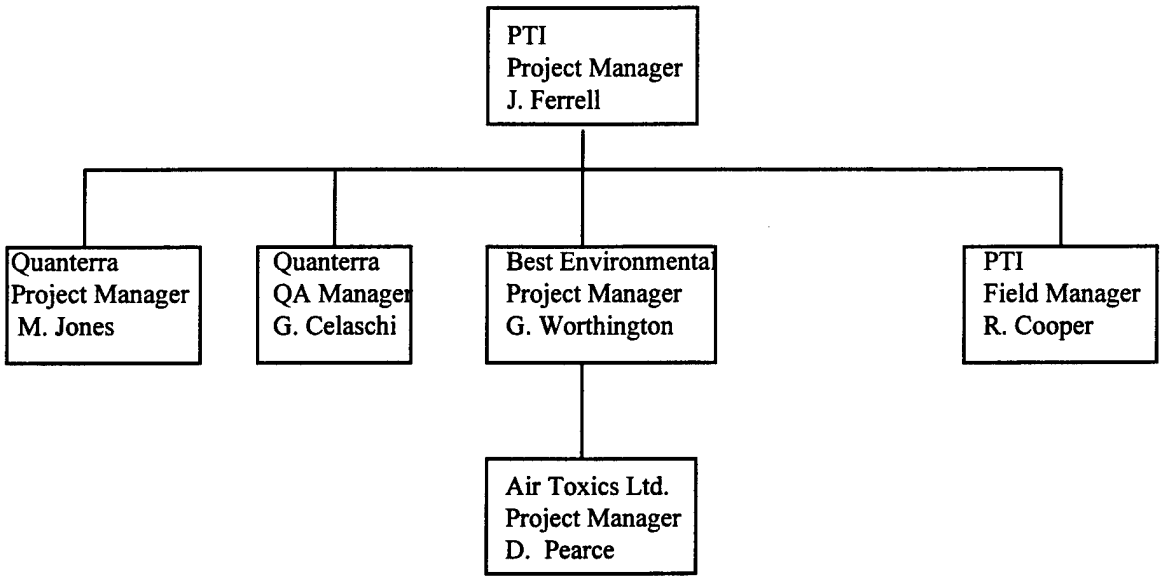
Notes: ····· Line of Communication
—— Line of Authority

Figure 3-2: Overall Project Quality Assurance Organization For The PTI Technology Demonstration.



Notes: ····· Line of Communication
—— Line of Authority

Figure 3-3: PTI Project Organization For The Demonstration.



Notes: ····· Line of Communication
—— Line of Authority

The Tetra Tech QA Manager, Kenneth Partymiller or his designee, is responsible for the overall Tetra Tech SITE QA activities. He will direct the review of the QA Project Plan, evaluate the QC programs for Tetra Tech, and assure that the results of all QA/QC activities are properly documented. The Tetra Tech QA/QC Coordinator, Stanley Labunski, will assist Dr. Partymiller to fulfill his responsibilities, which may include coordinating field and laboratory QA activities including sample tracking and reviewing of laboratory analytical data. He will inform Dr. Partymiller nonconformance of field and/or laboratory activities with reference to the QA/QC protocols set forth in this QAPP and to summarize ongoing field and laboratory QA activities.

As Tetra Tech's field manager for the sampling effort, Matt Udell or his designee, will be responsible for implementing the project -specific field quality control activities. Matt Udell will participate in Tetra Tech's on-site QC activities, document that on-site sampling protocols (specified in this QAPP) are followed, and coordinate record keeping and data review and validation for Tetra Tech. Dr. Topudurti's responsibilities include: QAPP implementation, SITE reports preparation, and monthly communication with Paul dePercin and other key participants

PTI's Field manager, Randy Cooper, will perform the PTI influent and effluent gas stream sampling according to EPA Method TO-14 and TO-12. Mr. Cooper or his designee, will also perform all measurements for noncritical parameters. Maria Jones will be responsible for the overall technical effort of the analytical laboratory. These responsibilities include the timely, cost-effective execution of all analytical activities (performed by Quanterra) in accordance with this QAPP. Ms. Jones will make weekly phone calls to John Ferrell, the PTI Project Manager, with updates on the progress of the project. PTI's contractor, Best Environmental, will be responsible for collection of samples during week 7 of the test. Guy Worthington, Project Manager for Best Environmental, will coordinate the sampling and analysis for the following analytes: ozone, NO_x, CO, HCl, chlorine, dioxins, and phosgene. The phosgene analysis will be performed by Air Toxics Ltd. All other analyses will be done by Quanterra.

The Cleans Sites Public Private Partnership program will review and provide McClellan AFB and PTI comments on the operation and evaluation of the demonstration. Additionally, Clean Sites and EPA TIO will promote interaction among the partners with the objective of creating demand for the PTI technology. TIO will also disseminate the results of the evaluation upon its completion.

McClellan AFB and its contractor BDM will provide the site and required services and utilities, including coordination of the interface between the PTI system and the URS SVE system. McClellan AFB is also responsible for the disposal/treatment of the liquid and waste streams generated by the SVE and PTI systems at McClellan. Greater detail of responsibilities can be found in Section 2.7 of the WIP.

The phone numbers of key personnel are listed in Table 3-6.

Table 3-6: Key Project Personnel For The PTI Demonstration Test

Name	Organization	Location	Title	Phone Number
Paul dePercin	EPA NRMRL	Cincinnati, OH	WA Manager	(513) 569-7797
Carlos Pachan	EPA TIO	Washington, DC	Project Manager	(703) 603-9904
Craig Burnett	SM-ALC/EMRP	McClellan AFB, CA	Project Manager	(916) 643-0830
Jerry Vincent	SM-ALC/EMRP	McClellan AFB, CA	Field Team Leader	(916) 643-0830
Tim Chapman	BDM	Sacramento, CA	Project Manager	(916) 643-1739
Larry Jaramillo	SM-ALC/PKOP	McClellan AFB, CA	Contracting Officer	(916) 643-0830
Kumar Topudurti	Tetra Tech	Chicago, IL	Project Manager	(312) 856-8742
Matt Udell	Tetra Tech	Sacramento, CA	Field Manager	(916) 852-8300
Richard Waesche	Clean Sites	Alexandria, VA	Project Manager	(703) 739-1225
Mike Swan	PTI	Boise, ID	Project Director	(208) 385-0900
John Ferrell	PTI	Boise, ID	Project Manager	(208) 385-0900
Randy Cooper	PTI	Boise, ID	Field Manager	(208) 385-0900
Maria Jones	Quanterra	City of Industry, CA	Project Manager	(626) 965-1006
Guy Worthington	Best Environmental	San Leandro, CA	Project Manager	(510) 278-4011

3.3 QUALITY ASSURANCE OBJECTIVES

The data quality objectives established for the demonstration of the PTI system are based on project requirements and are designed to ensure that the data generated during the demonstration are of known and acceptable quality to achieve the project's technical objectives. This section of the QAPP delineates the QA objectives for each of the critical measurements in terms of the data quality indicators: precision, accuracy, completeness, target reporting limits (TRLs), representativeness, and comparability. In Section 3.7 of this document, a summary of all internal QC checks associated with each method (critical and non-critical) will be presented. Objectives are outlined below, and summarized in Table 3-6, as they apply to overall project analyses for critical parameters. In addition, the calculation of data quality indicators is discussed in Section 3.9.

3.3.1 Data Quality Indicators

Precision: Precision objectives for the critical TO-14 measurements are given in Table 3-7 as the relative percent difference (RPD) between laboratory control samples and laboratory control sample duplicates (LCS/LCSD). The TO-12 analyses precision objective (Table 3-7) are given as the RPD between laboratory duplicates.

Precision objectives for field sampling activities are more difficult to define quantitatively. Analysis of duplicate samples collected in the field (field duplicates) have inherent in the measurement combined variation due to field sampling precision and laboratory analytical precision. If, overall, the analysis performed for field duplicates meets the analytical precision objectives, then the sample collection activities are considered representative and precise. Guidelines for evaluating the precision of field duplicates will be set based on the analytical precision criterion ≤ 20 percent. (e.g., As given in Table 3-7, the analytical precision criterion for VOCs analyses is an RPD of ≤ 20 percent. Therefore the guideline for field duplicates analyzed for VOC and TO-12 analyses will be an RPD of ≤ 30 percent). This is only a guideline; actual values will be determined from the results of field duplicate samples and analyses.

Accuracy: Objectives for accuracy as percent recovery of a laboratory control sample (LCS) are given in Table 3-7. This LCS will contain all critical VOCs identified in Table 3-2. The LCS will be obtained from a source independent of the calibration standard. There are no LCS/LCSD for the TO-12 analysis, however, the samples will be analyzed twice, with the acceptance criterion being an RPD of $\leq 5\%$, and the average value reported.

Completeness: Objectives for data capture, expressed as completeness, are 100 percent for the critical parameters during Phase 1 and 90 percent during Phase 2. Completeness is defined as the ratio of the number of valid measurements to the total number of measurements planned.

Target Reporting Limits: TRLs objectives are presented in Table 3-2. These TRLs are based on expected influent gas concentrations and primary objectives. These are the target reporting limits have been set lower than what is needed in order to meet primary objectives. Due to high concentrations of VOCs present, these limits may not be achievable in the PDU influent sample stream. The TRLs listed in Table 3-2 are set as low as possible in order to provide a safety factor of 25. For example, in order to demonstrate 95% removal for a VOC at an influent level of 1 ppmv, the required detection level would be 50 ppbv. By setting the TRL at 2 ppbv a safety factor of 25 is achieved, allowing the primary objectives to be met if the influent concentrations are lower than anticipated. The TRL for TNMOC is set at 0.5 ppm-C. This allows a similar safety factor (as described above for the individual VOCs) so that lower than anticipated influent concentrations would not impact the ability to meet the primary objective of 95% removal. The current TNMOC of the SVE vapor at IC 31 is approximately 5000 ppm-C.

Representativeness: A well-defined sampling strategy ensures that the samples collected are representative (i.e., exhibit average properties) of the influent and effluent streams; this strategy is presented in detail in Section 3.4.

The method of sampling described and the number of samples to be collected will help to ensure the representativeness of the contaminant concentrations determined.

Comparability: The use of standard, validated EPA methods achieves comparability of measurement data. Reporting the data in standard units of measure as specified in the methods, adhering to the method defined calibration procedures, and when possible, meeting the TRLs, all contribute to the comparability of the data. The use of EPA methods is discussed in Section 3.5.

Table 3-7: QA Objectives For Accuracy, Precision, Target Reporting Limits (TRLs), and Completeness

Parameter	Classification	Matrix (Sample Point)	Units	Method[a]	Accuracy[b], % Recovery	Precision RPD[c]	TRL[d]	Completeness[e], %
VOCs	Critical	Influent gas stream (A)	ppmv	TO-14	70-120	≤20	1 ppmv	90
VOCs	Critical	Effluent gas stream (B)	ppbv	TO-14	70-120	≤20	2 ppbv[f]	90
TNMOC	Critical	Influent, effluent gas stream (A,B)	ppm-C	TO-12		≤5	0.5 ppm-C	90

a Method references are provided in Section 3.5.
b Determined using laboratory control samples of known composition.
c Relative Percent Difference. Determined by LCS/LCSD for TO-14, duplicate sample analysis for TO-12.
d Target Reporting Limits.
e Phase 2 only, Phase 1 completeness objective is 100%.
f Some ketones have higher limits.

3.3.2 Impact of Not Meeting QA Objectives

The QA objectives presented in Table 3-7 represent the data quality necessary to establish the characteristics of the inlet and outlet vapor sample to demonstrate the technology efficiency and meet the project's technical objectives. The QA/QC efforts discussed in this QAPP focus on controlling measurement error within the precision, accuracy, and completeness limits listed, and ultimately provide a database for estimating the actual uncertainty in the measurement data for the project. QA objectives for precision and accuracy for critical measurements will be evaluated to see if the overall, averaged results for the project meet the stated primary objectives. If these objectives are not met, the precision and/or accuracy of the derived removal are decreased. If this occurs, corrective action will be taken as documented in Section 3.7. However, if the data quality achieved is well-documented and known, then the project's technical objectives can still be met although with decreased certainty depending upon the variability of the data. Similarly, if the completeness objectives are not met, then the confidence level of the determined process efficiency will be decreased.

3.4 SAMPLING PROGRAM

3.4.1 Sampling Procedures

The primary objective of a sampling strategy is to collect samples in a manner which accurately and precisely characterizes the properties of the contaminated gas stream. Samples of the influent and effluent of the PTI system, influent and effluent of the PDU, reagent panels, scrubber discharge, and condensate will be collected. Appendices 3A, and 3B illustrate the SVE and the PTI system along with the location of each sampling points.

The purpose of the influent (sample point A) gas stream samples is to determine the initial concentration of VOCs and TNMOC in the contaminated gas stream entering the PTI system. The purpose of the effluent (sample point B) gas stream samples is to determine the effectiveness of the PTI system in removing VOCs and TNMOC and determine the respective percent removals.

Samples will also be collected from the PDU outlet (sample point G) and the effluent of the PTI system (B) to determine any HCl, chlorine, O_3, NO_x, CO, phosgene, and dioxin emissions. The reagent panel samples will be collected (sample point D) at the end of the 8-week demonstration and will be analyzed for leachable VOCs using EPA's TCLP Method to verify that the panels can be disposed of in an ordinary landfill.

The purpose of the scrubber discharge sample (C) will be to determine if this meets McClellan AFB wastewater treatment acceptance criteria. This sample will be analyzed for VOCs, TDS, TSS, pH, and corrosivity only if pH <3 or > 11.5. Condensate samples (E-1, E-2) will be collected and analyzed for VOCs for disposal purposes. The corrosivity will be determined for the aqueous phase if the pH is <3 or >11.5.

The demonstration has been broken down into Phase 1 and Phase 2. During Phase 1, parametric testing will take place in order to optimize the operation of the PTI system, by varying the flow rate of contaminated feed gas entering the adsorber, and by operating the condenser at two different temperatures. As these tests are being performed, TNMOC (A, B, F) and VOC (F) samples will be collected using flow regulated 6 L SUMMA® canisters over a 4 hour period, since only 1 set of samples will be obtained per set of operating conditions. A total of 6 different sets of conditions will be investigated during this phase of the demonstration.

During Phase 2 (preferred operating conditions), the optimum operating conditions will be determined from the Phase 1 test program and will be used for the remainder of the demonstration. Grab sampling techniques will be used to collect VOC (F) and TNMOC (A, B, F) samples over a short time period (30-60 seconds) using 6 L SUMMA canisters. Since the composition of the gas should remain constant, a grab sampling technique is an appropriate sampling method for these sample streams. Field duplicates will be collected at a frequency of 10 percent during this time for both influent (A) and effluent (B) samples.

TNMOC and VOC Sampling

Canister samples will be collected from the outlet of the auxiliary blower from the SVE system after mixing with trim air, which is the influent to the PTI system (A). Each canister will be sent to the field under a hard vacuum (approximately - 29 inches Hg). Although the PTI system is under approximately -10 inches H_2O, the vacuum in the canister will still allow for collection of sufficient sample. Since the vacuum in the canister is used to collect the sample, pumps or other apparatus, which are potential sources of contamination, are not needed during sample collection. The pressure of each canister will be checked in the field prior to use. If there is evidence of leakage (the pressure of a canister differs from the others in a shipment by more than 2.0 inches Hg), that canister will not be used. The sample streams are expected to have high moisture levels and may also have extremely small particulate matter. Since high moisture and any particulate matter will cause problems with sampling, measures will be needed to alleviate these problems. To mitigate any potential problems with water, the canister sampling will be stopped

before the canister vacuum reaches atmospheric pressure. This will be achieved by monitoring the canister vacuum with an in-line vacuum gauge during canister filling. This will eliminate the potential for water to condense inside the canisters and potentially bias the sample results. Additionally, when the canisters are received in the laboratory, they will be pressurized with ultra high purity (UHP) nitrogen (see Section 3.5.1.1) which will further reduce the dew point of the vapor stream and ensure a dry sample. The particulate matter will be removed by an in-line 7-micron filter located between the sample stream and the canister.

HCl and Chlorine

The emissions of HCl and chlorine will be sampled using EPA Method 26. The sampling apparatus consist of a probe, heated filter box, six midget impingers, and a meter control module. The probe is a Modified Method 5 arrangement with a borosilicate glass liner and Teflon/quartz (dependent on temperature) filter, followed by a Teflon line which reaches the impingers. The first impinger is empty, the second and third contain 0.1 N H_2SO_4, and the fourth and fifth impingers are filled with 0.1 N NaOH, and the sixth is a drying impinger. Leak checks are performed before and after each test run.

CO Sampling

Measurement of CO will be conducted using a Gas Filter Correlation (GFC) CO Ambient Analyzer (Thermo Electron Model 48) or equivalent nondispersive infrared analyzer, at sample points B and G. These analyses will be conducted according to EPA Method 10, entitled "Determination of Carbon Monoxide Emissions for Stationary Sources."

Phosgene Sampling

Phosgene will be determined using Method TO-6, which is an ambient method. The sample is drawn through a series of midget impingers, with the volume recorded by special low flow dry gas meters. The impinger solution is an aniline/toluene solution. Phosgene reacts with the aniline to form carbanilide which is quantified by reverse phase HPLC with UV detection.

NO_X Measurement

Measurement of NO_X will be conducted according to the specifications of EPA Method 7E, entitled "Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrument Analyzer Procedure)." The NO_X analysis instrument will be a TECO Model 10 or equivalent to measure concentrations of nitric oxide (NO) and total NO_x present in the PTI effluent streams (sample points B and G).

Ozone Measurement

There are no known referenced source methods for monitoring O_3, only ambient methods. The ozone concentrations will be monitored during week 7 using a Dasibi Model 1003-AH ozone analyzer. This instrument operates by ultra-violet (UV) photometry, with UV radiation being absorbed by ozone in the sample cell. The instrument can compensate for differences in O_3 absorption due to variations in instrument zero readings and temperature. The analyzer's microprocessor continuously monitors temperature and atmospheric pressure to correct concentrations for gas law effects and eliminate drift from these sources. The system will be leak checked, and a bias check will be performed at the beginning and end of the test series.

Dioxin Measurement

Dioxin formation during the process operation is unlikely. To confirm whether dioxin formation will occur, effluent (B) and PDU effluent (G) gas samples will be collected and analyzed for dioxins. Dioxin samples will be collected and analyzed using the procedures specified in EPA Method 23. Gaseous and particulate pollutants are withdrawn from the source and drawn through a XAD sorbent trap and condenser before entering the five impingers. Filterable particulate is captured in the front half (before the filter) and condensable gaseous emissions

are collected and recovered from the XAD/sample line/impingers. The first impinger is empty, the second and third impingers both contain H_2O; a fourth impinger is left empty and the fifth impinger contains silica gel (desiccant). Sampling system leak checks are performed before and after each test run. The analysis is performed using high resolution gas chromatography / mass spectrometry.

TCLP VOC Measurement of Reagent Panels

The purpose of collecting reagent panel samples is to determine whether the panel can be disposed of in a ordinary landfill following the treatment process. It is anticipated that the reagent panels will not require removal or replacement during the 8-week demonstration period and will be sampled at the end of the demonstration. The PDU is made up of two photolytic reactors in parallel, each containing twelve-7/8" thick reagent panels, and a scrubber component. At the end of the demonstration the photolytic reactors will be opened in order to sample the reagent panels. Reagent panels 1, 2, 11, and 12 will be sampled which corresponds to gas flow in the influent and effluent sections of each photolytic reactor. Each panel will have one 3 inch x 3 inch section removed from the center of the reagent panel. Sections from reagent panels 1 and 2 from each of the photolytic reactors will be placed in a 32 oz. sample jar with minimal headspace. Samples from reagent panels 11 and 12 will be collected in a like manner, resulting in total of two samples; the inlet consisting of reagent panels 1 and 2, and the outlet comprised of reagent panels 11 and 12, from both reactors. These samples will be composited in the laboratory using equal amounts of each panel and physically broken into small pieces by crushing with a spatula or other suitable device prior to extraction.

EPA's TCLP will be implemented to determine whether the reagent panel is non-hazardous and suitable for disposal in a ordinary landfill. The composited inlet reagent panel sample will be analyzed first, and if the results are less than the allowable limits for VOCs, the outlet sample will not be analyzed, since the inlet sample would have the greatest probability of being contaminated with VOCs. However, if the inlet sample does not meet the TCLP criteria, the outlet sample will be analyzed. Table 3-4 summarizes the total number of samples required for the reagent panels.

Scrubber Discharge and Condensate Sampling

At the end of the demonstration samples of the scrubber discharge, and the condensate will be sampled. The purpose of analyzing the condensate is for disposal purposes. The scrubber discharge is being analyzed to determine if it meets the acceptance criteria of McClellan AFB's waste water treatment facility. The scrubber discharge sample will be collected from a drain valve near the bottom of the scrubber solution storage tank. The condensate sample will be collected using a drum thief (a large glass pipet) from the top of the condensate storage tank.

Table 3-8 indicates the sampling method, analysis parameter, container size, and sample quantity required for analysis for the samples to be collected by Best Environmental and PTI during the demonstration.

Field Blanks and Field Duplicates

Field blanks for TO-12 and TO-14 by opening valve on the SUMMA canister near the PTI equipment trailer and collecting a grab sample over a time period of 30-60 seconds. Field duplicates (TO-12, TO-14) will be collected by sequentially filling one canister after another. The SOP for collection of SUMMA canister samples can be found in Appendix D. Field blanks will be collected to the same vacuum level as the samples.

Table 3-9 summarizes the preservation and holding times for the gas, liquid, and reagent panel samples.

3.4.2 Sample Preservation and Holding Times

Table 3-8: Summary Of Laboratory Analyses And Sample Quantity Requirements

Sample Type	Sampling Method	Analysis Parameter	Sample Quantity Required for Analysis	Container Size
Gas Stream	Composite[a], Grab	VOCs[b]	850 mL	SUMMA Canister
Gas Stream	Composite[a], Grab	TNMOC	400 mL	SUMMA Canister
Gas Stream	Grab	CO, NO_x, O_3	NA	CEM
Gas Stream	Method 26	HCl, chlorine	100 mL	Impinger catches
Gas Stream	Method 23	Dioxins	NA	XAD cartridge, probe and nozzle rinses with acetone, dichloromethane, and toluene
Gas Stream	TO-6	Phosgene	10 mL	Impinger catches
Reagent Panels	Grab	VOC TCLP	200 g	2 - 32 oz. glass jars
Scrubber Discharge	Grab	VOCs[c]	5 mL	2 - 16 oz. glass jar
		TDS, TSS, corrosivity	8 oz.	2-16oz Polyethylene bottles
Condensate	Grab	VOCs[c]	5 mL	2 - 8 oz. glass jars

a Composite samples (4 hour) will be taken during Phase 1, grab samples during Phase 2.
b One SUMMA canister will provide enough sample for VOCs by TO-14 and TO-12 (TNMOC) analysis.
c Headspace should be minimized for all samples requiring VOC analysis.

Table 3-9: Required Preservation Techniques And Holding Times

Analysis Parameter	Sample Type	Preservation	Maximum Holding Time (days)
VOCs, TNMOC	Canister	None	30 days
HCl, Chlorine	Impingers	None	28 days
Dioxins	XAD-2 cartridge	$4^0 \pm 2$ C	30 days to extraction; 45 days to analysis from collection
TCLP VOCs	Leachate/Extract	$4^0 \pm 2$ C, minimal headspace	14 days to extraction; 14 days from extraction to analysis
Phosgene	Impingers	None	30 days
VOCs (Condensate, Scrubber discharge)	Liquid	$4^0 \pm 2$ C, minimal headspace	14 days
TDS, TSS,	Liquid	None	7 days

3.4.3 Process Monitoring

PTI will be responsible for monitoring the operational parameters of its system, including:

- Adsorber Inlet and Outlet effluent- pressure, temperature, humidity, vapor flows.
- Desorber - pressure, temperature, steam pressure, strip steam flow.
- Condenser - condensate accumulation, dilution air rate.
- PDU - inlet and outlet pressure and temperature, cooling water pressure and temperature, run time, and flow.
- Scrubber - pressure (ΔP), scrubber liquor pH, pressure to spray nozzles.

A standard pitot tube and direct read thermometer will be used to monitor the flow rate and temperature of gas entering and exiting the PTI system. A separate standard pitot tube will be installed in the centroid of the inlet and outlet ducts. The pitot tube will be used to measure the differential head pressure produced by the flow of gas across the head of the pitot tube. The differential pressure will be measured with a magnehelic differential pressure gauge. The pitot tube will be visually inspected periodically to ensure the holes are not blocked or plugged. Humidity will be determined using a thermohygrometer.

For purposes of determining flow rate, the molecular weight of the gas will be assumed to be the same as ambient air (e.g., 28.84 lb/lb-mole). It is not expected for the concentration and flow rates to vary significantly during this program. A separate J-type thermocouple will be installed at both the inlet and outlet locations of the photolytic reactors. A digital temperature read out will be used to convert the thermocouple voltages into temperature readings. The pitot tube and manometer will not require any calibration, as they both are reference devices. The J-type thermocouples and magnehelics were calibrated at the factory.

Caustic volumes will be recorded in the field log book when each batch of scrubber solution is prepared. The total volume of the scrubber solution is a known volume, and will be recorded prior to discharge as wastewater. The condensate level will be determined by measuring the levels in the holding tank and the day tank and recorded on the field data sheet (Appendix 3C).

A summary of all measurements to be recorded by PTI is shown in Appendix 3C.

3.4.4 Sample Identification

All samples will be given a unique sample identification number, which will identify its sample media type, the date and sample point, and the sample type (regular, blank, duplicate). This information will facilitate data manipulation should the analytical data be loaded into a data base. Each sample number will have five distinct parts. An example sample number is shown below.

Example Number: PT-A-090197-R-001

The first two letters designate the sample as being from the PTI monitoring program, the second part designates the sample point (as identified in the PTI Sampling and Analysis Program, Attachment 3A and 3B). The third part designates the date the sample was collected (MMDDYY). The following letter indicates sample type: R for Regular, D for Field Duplicate, and B for blank sample. The last three digits are the sequential sample number for that sample point. Each value will start with 001 and continue until the program is complete. The blind samples will also be designated as R, and have unique numbers in the field for sample identification. The field log book will note the blind samples. The blind samples will be prepared using the same containers (canisters) provided by the lab for investigative samples. Dioxin and HCl samples, which have more than one component, will be labeled with

one sample number for each sample train. Individual components will be labeled with appropriate additional information, such as "second impinger catch" or "toluene rinse".

The example number would be read as: PTI monitoring program, Adsorber influent sample - gaseous, September 9, 1997, regular sample, first sample collected during the program. At the time of sample collection the temperature, pressure, and flow rate (where applicable) at that sample point will be recorded.

Section 3.4.5

Field Documentation

All handwritten documentation must be legible and completed in permanent ink. Corrections must be marked with a single line, dated, and initialed. All documentation, including voided entries, must be maintained within project files. Field documentation shall consist of a project logbook, one or more site-specific field logbooks, field forms, sample logs/labels, and an equipment calibration log (where applicable). All logbooks must be permanently bound with hard covers and have sequentially numbered pages. In addition, each logbook will be uniquely identified and sequentially numbered. Logbooks will be maintained on-site until complete, then stored in the project files.

Project Logbooks

The project logbook chronicles all field investigation activities, but does not have the same level of detail as the field logbook. It delineates conditions and activities occurring on a given day and references the appropriate field logbooks and forms for specific information. The project logbook is also used to record all field changes along with supporting rationale.

The senior person responsible for the field effort (Field Manager) is also responsible for completing the project logbook, usually at the end of each work day. This individual must sign and date the logbook at the end of each day's entry. All partially used pages must be lined out to prevent data entry at a later date. The front cover or first page of the project logbook must list the project name, the project number, and dates of use. The following items are to be included, as appropriate to the work scope, in the project logbook:

- Date.
- Weather conditions.
- List of all project personnel, by name, title, organization, and purpose, who entered the project area during the day.
- Reference to all field logbooks used during the day, by logbook number and pages.
- Brief descriptions of sampling activities.
- Field changes or variances with references to the appropriate documentation of these changes.
- Record of equipment decontamination, with references to any specific documentation information.
- Chain-of-custody (COC) details, including COC identification number, shipping receipt (air bill) numbers, sample identification numbers, and any pertinent information relative to any specific calibration logs.
- Specific comments relative to peculiar problems that occurred during the day, if any, and their resolution.
- A record of telephone calls (incoming and outgoing) pertaining directly to the decision-making process of the Demonstration and a brief description of the content of these conversations.

Field Logbooks

All information required on the cover or first page of the project logbook must also be provided on the cover of each field logbook. Entries in the field logbook must be made in real time and must be signed by the responsible person at the end of each day. Unused pages and portions of pages must be lined out to prevent entry of additional information at a later date. Field logbook pages as well as the logbooks themselves will be sequentially numbered. The following are to be included in field logbooks:

- Date and time of specific activities.
- Weather conditions.
- Names, titles, and organization of personnel on site, names of visitors, and times of visits.
- Field observations to include, for example, specific details regarding sampling activities, (including type of sample, time of sample, and sample numbers), a description of any field tests and their results, and references to any field forms used.
- A description, in specific detail, of samples collected and duplicates or blanks that were prepared. A list of all sample identification numbers, packaging, and COC form numbers, pertinent to each sample or a reference to the appropriate documentation should be noted.
- Initial and final canister pressures.
- Specific problems, including equipment malfunctions, and their resolutions.
- A list of the time, equipment type and decontamination procedure followed (if different from the project work implementation plan) or a referenced to the appropriate documentation.

Additional information may be recorded on field and laboratory data sheets at the discretion of the logbook user. The entries should be initialed and dated by the individuals maintaining the log book.

3.4.6 Equipment Decontamination

Canisters must be clean and free of contaminants prior to sample collection. The canisters are cleaned using a combination of heated purge and evacuation cycles. The cleaning cycle consists of canister evacuation, dry N_2 purges, and humid N_2 purges while being held at 100°C (this will be done at the laboratory). The canisters are left under vacuum until used. Five percent of the canisters are analyzed by Method TO-14; individual contaminant concentrations must be < 2 ppbv.

3.4.7 Sample Custody

Table 3-9 provides a list of the sample custodians in the PTI demonstration project.

Table 3-10: Sample Custodians In The PTI Demonstration Project

Name	Organization	Title
Mike Wiley	Best Environmental	Field Technician
Randy Cooper	PTI	Field Manager
Jan Dalman	Quanterra (City of Industry)	Sample Control
Donna Christmon	Quanterra (West Sacramento)	Sample Control
Debbie Pearce	Air Toxics Ltd.	Sample Control

The possession of samples or other evidence shall be traceable beginning at the time samples are collected. This will be accomplished through the use of COC procedures. COC forms (Figure 3-5) will accompany the sample

shipment and will be shipped in the appropriate shipping container (cooler). Copies of the completed COC forms will be included in appropriate data validation packages. A sample is said to be under custody if:

- It is in an individual's physical possession.
- It is in the individual's view, after being in his/her possession.
- It was in the individual's physical possession and he/she secured it to prevent tampering.
- It is placed in a designated secure area.

Field Custody Procedures

1. To simplify the COC record, as few people as possible should handle the samples or physical evidence. For this reason, one individual from the field sampling team will be designated as the responsible individual for all sample transfer activities. This field manager will be personally responsible for the care and custody of the samples collected until they are properly transferred to another person or facility.

2. Field documentation of each sample will be made on a sample logsheet or site logbook entry. This documentation of each sample will be made in ink and will consist of, at a minimum, entry of the sample identification number, the sample location, and the time /date of collection.

3. All samples will be accompanied by a COC record similar to the example presented in Figure 3-4. This record will document the transfer of custody of samples from PTI to Quanterra. Each change of possession must be accompanied by a signature for relinquishment and receipt of the samples.

4. Completed COC forms will be placed in a plastic cover and placed inside of the shipping container used for sample transport from the field to the laboratory.

5. When samples are relinquished to a shipping company for transport, the tracking number from the shipping bill/receipt will be recorded on the COC form or in the project logbook.

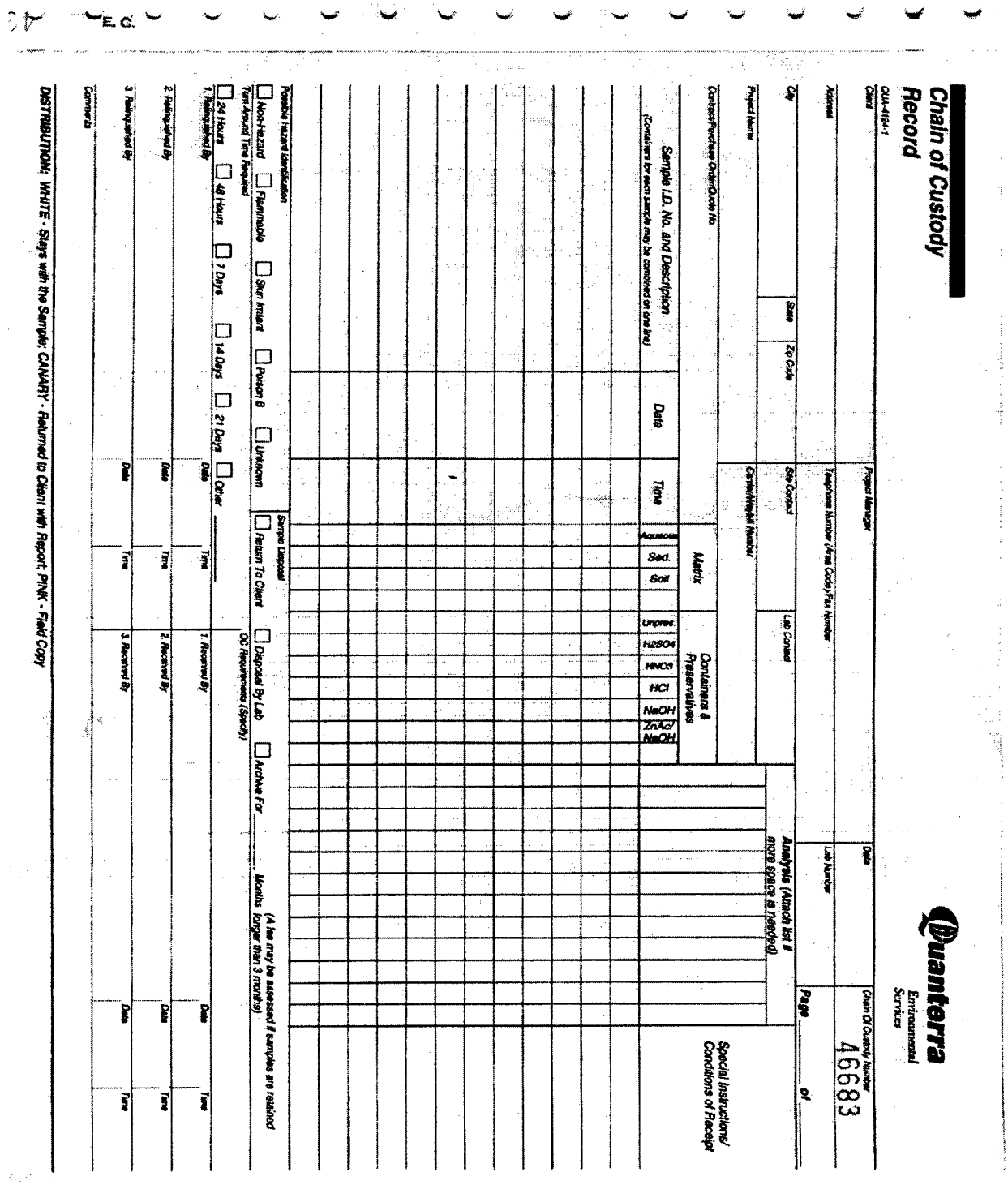
6. Custody seals will be used on the shipping containers when samples are shipped to the laboratory to ensure no sample tampering occurred during transportation. Custody seals will also be used on individual sample jars and will be signed and dated by the field sample custodian.

Laboratory Custody Procedures

The Quanterra laboratory sample custodian or designated alternate will receive and assume custody of samples until they have been properly logged into the laboratory and stored in a secure area. Upon receipt of a sample shipment, the shipping container will be inspected for security seals before it is opened. For canister samples, the shipping container will be opened and the canisters inspected for damage (i.e. broken handles, valve stems). The COC form will be compared to the canisters for accuracy. The remaining canister vacuum will be checked and evaluated for leakage by comparing the initial and final vacuums measure in the field to those measured in the lab. Any difference of over 2.0 inches Hg will be reported to the PTI Project Manager, and the canister assumed to be a leaker. Finally, the canisters will be diluted with UHP nitrogen and placed in a secure area at room temperature.

For samples in glass jars, the sample custodian will open the shipping container and check for breakage or evidence of leaks. The temperature of the ice chest will be measured upon receipt, and inspected for COC forms. The temperature will be recorded on the COC document and dated and signed. If the temperature is above 6^0C, the PTI Project Manager will be notified.

Figure 3-4 Quanterra COC Form



Chain of Custody Record

Quanterra Environmental Services

QUA-4182-1

Client | Project Manager | Date | Chain Of Custody Number 46683

Address | Telephone Number (Area Code)/Fax Number | Lab Number | Page ____ of ____

City | State | Zip Code | Site Contact | Lab Contact | Analysis (Attach list if more space is needed)

Project Name | Carrier/Waybill Number

Contract/Purchase Order/Quote No. | Matrix | Containers & Preservatives

Sample I.D. No. and Description (Containers for each sample may be combined on one line) | Date | Time | Aqueous | Sed. | Soil | Unpres. | H2SO4 | HNO3 | HCl | NaOH | ZnAc/NaOH | Special Instructions/ Conditions of Receipt

Possible Hazard Identification

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown | Sample Disposal ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 3 months)

Turn Around Time Required | QC Requirements (Specify)

☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other ____

1. Relinquished By | Date | Time | 1. Received By | Date | Time

2. Relinquished By | Date | Time | 2. Received By | Date | Time

3. Relinquished By | Date | Time | 3. Received By | Date | Time

Comments

DISTRIBUTION: WHITE - Stays with the Sample; CANARY - Returned to Client with Report; PINK - Field Copy

The sample custodian will verify that all information on the sample labels is correct and in accordance with the COC forms and will sign for receipt. The COC form will be retained in the project file, and a copy will be returned to the PTI Project Manager to verify receipt. Any discrepancy between the samples and the COC information, any broken sample containers, any leaking canisters, or any other abnormal situation will be reported to Quanterra's manager. PTI will be informed of the problem, and corrective action options will be discussed and implemented. Notations of the problem and resolution will be made on the COC form and initialed and dated by the sample custodian.

3.4.8 Sample Packaging and Shipping

Canister samples collected should be packaged and shipped as follows:

1. Place each canister in dedicated shipping container.
2. Fill the shipping container with packing material if needed.
3. Place the required paperwork (e.g., COC records) going to the laboratory inside an envelope and place inside shipping container.
4. Close the box and place at least two custody seals over the edges (one on the top and one on the bottom).
5. Deliver the shipping container to Federal Express (or other express carrier), using a standard airbill.

Samples collected in glass jars should be packaged and shipped as follows:

1. Place custody seals over the lids of each sample jar. Place each sample bottle in a plastic bag and seal the bag.
2. Fill a rigid insulated shipping container (cooler) one quarter full of packing material.
3. Place sample containers in cooler, allowing space between sample containers.
4. Fill several plastic bags with ice, seal the bags, and place the ice between samples.
5. Fill the cooler with packing material.
6. Place the required paperwork (signoff on COC form) going to the lab inside a plastic bag and tape it to the inside of the cooler lid.
7. Close the cooler, seal it with strapping tape, and place at least two custody seals over the edges (one on the front and one on the back).
8. Turn samples over to Federal Express. Try to ship samples on Tuesday through Thursday to insure that temperature will hold.

All SUMMA canister samples are to be shipped to: Quanterra Incorporated, 18501 East Gale Ave., City of Industry, CA, 91748 (phone (626) 965-1006).

All HCl, chlorine, and dioxin samples will be shipped to: Quanterra Incorporated, 880 Riverside Parkway, West Sacramento, CA 95605 (phone (916) 373-5600).

All TDS, TSS, scrubber liquor and condensate samples for VOCs, and reagent panel (TCLP VOCs) samples will be shipped to: Quanterra Incorporated, 1721 South Grand Avenue, Santa Ana, CA 92705 (phone (714) 258-8610.

The Phosgene samples will be shipped to: Air Toxics Ltd., 180 Blue Ravine Road, Suite B, Folsom, CA 95630 (phone (916)985-1000).

The corrosivity (EPA Method 1110) will be done by Nevada Environmental Laboratory, 1030 Matley Lane, Reno, NV 89502 (phone (702) 348-2522).

3.5 ANALYTICAL PROCEDURES AND CALIBRATION

The selection of appropriate methods to prepare and analyze the samples from the PTI technology demonstration was based on the specific analytes of interest, the sample matrix, and the minimum detectable concentrations needed to verify the developer's claims and meet the project objectives discussed in Section 3.1. The references used are as follows:

(1) *Test Methods for Evaluating Solid Waste*, Volumes 1A-1C: Laboratory Manual, Physical/Chemical Methods; and Volume II: Field Manual, Physical/Chemical Methods, SW-846, Third Edition. Update IIB. Office of Solid Waste, U.S. Environmental Protection Agency, Document Control No. 955-001-00000-1, January , 1995.

(2) Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA 600 / 4-84 / 041, April 1984.

(3) Code of Federal Regulations (CFR) 1997. Title 40. Part 60.

(4) U.S. Environmental Protection Agency (EPA). *Methods for Chemical Analysis of Water and Wastes.* Environmental Monitoring and Support Laboratory. Cincinnati, Ohio. EPA-600/4-79-020. March 1983.

(5) Dasibi Model 1003-AH ozone analyzer. Principle of operation is by UV photometry.

Table 3-11 summarizes the preparation and analytical methods chosen for this Demonstration program. The analytical method for the critical VOC measurement is summarized in Section 3.5.1 and calibration procedures are discussed in Section 3.5.2.

3.5.1 Analytical and Preparation Procedures

The analytical procedures to be employed for the project measurements are described in the following subsection. Specific QC procedures and acceptance criteria are presented in Section 3.7.

VOC's by Method TO-14 - SCAN (Influent/Effluent Gas Stream)

The analysis of volatile organic compounds that are collected in SUMMA® polished stainless-steel canisters will be performed using a gas chromatograph / mass spectrometer operated in the scan mode (GC/MS-SCAN). Once the samples are received in Quanterra's lab, the sample canisters will be checked against the COC forms to ensure that all the necessary data are complete and the field pressures are compared to the lab measurements to verify that the canisters did not leak in transit. The canisters will then be pressurized with UHP-grade nitrogen to dilute the sample and facilitate its removal from the canister.

A measured volume of the gas sample is cryotrapped at $< -150^{0}C$, then rapidly heated to volatilize the trapped sample onto the GC column, and starting the data acquisition. The target compounds identified in Table 3-2 will be quantified, as well as any others on the TO-14 analyte list.

TABLE 3-11: Preparation And Analytical Methods For The PTI Site Demonstration

Parameter	Sample Location(s)[1]	Preparation Method	Analytical Method	Reference(s)
TMNOC	A, B	NA	TO-12[2]	2
VOCs	A, B, F, G	NA	TO-14 - SCAN[2]	2
HCl, chlorine	B, G	NA	EPA 26	3
NO_x	B, G	NA	EPA 7E	3
CO	B, G	NA	EPA 10	3
Ozone	B, G	NA	CEM	5
Phosgene	B, G	NA	TO-6	2
Dioxins	B, G	NA	EPA 23	3
VOCs	C, E-1, E-2	NA	8260A	1
TDS	C	NA	160.1	4
TSS	C	NA	160.2	4
Corrosivity	C, E-1, E-2	NA	EPA 1110	1
pH	C	NA	probe	
TCLP		1311		
VOCs	D	NA	8260A	1

1 Sample locations shown in Appendices 3A and 3B.

2 The Quanterra Standard Operating Procedures (SOPs) for Methods TO-14 and TO-12 are confidential and cannot be included in this document. Sufficient detail has been presented to allow an appropriate review.

Total Non-Methane Organic Carbon (TNMOC) by TO-12.

The samples for analysis by Method TO-12 will be collected in SUMMA canisters using the same technique as for the collection of the TO-14 samples. When both TO-12 and TO-14 analyses are required at the same time, one canister will provide enough sample for both analyses.

HCl and Chlorine by Method 26.

The collection of samples for HCl and chlorine will be collected using EPA method 26 over a 60 minute time period. Upon completion of sampling, the teflon sample line will be rinsed with deionized water and the rinse water and the H_2SO_4 impinger contents placed in one sample container. The contents of the NaOH impingers will be transferred to a separate bottle. The HCl is trapped in the H_2SO_4 solution (as chloride ion), and the chlorine is trapped in the NaOH solution as HOCl (hypochlorous acid) which is reduced to chloride ion by addition of sodium thiosulfate solution, yielding two chloride ions per chlorine molecule. The resulting solutions are analyzed by ion chromatography.

NO_x, CO, and Ozone by CEM.

All CEM equipment will be calibrated before the test program according to the procedures outlined in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, EPA 600/4-77-027B. On-site calibration checks will be performed prior to the start of each test as specified in the applicable reference method. Table 3-12 summarizes the sampling equipment calibrations to be performed in preparation of this project. Table 3-13 lists the additional field checks that will be performed on the sampling equipment on-site prior to the testing to ensure that equipment was not damaged during transport. Any equipment that does not check properly within the specifications of Tables 3-12 and 3-13 will not be used. The following checks are performed prior to testing to ensure the CEM is operating properly:

- System integrity checks involve assuring the system is free from leaks.
- System bias checks which involve comparing responses by injecting calibration gases (were possible) at the analyzer and through the entire system.
- Calibration and linearity checks on each analyzer.
- Precision checks are made, response times are determined.

Table 3-12: Gas Emission Sampling Field Equipment Calibration Summary [a]

Equipment	Calibrated Against	Allowable Error
Standard Pitot Tube	NA	NA
Digital Indicator	Millivolt signal	±0.5%
Thermocouple	Thermocouples	±1.5%
Impinger (or condenser thermometer)	ASTM-3F	±2°F
Balance	Type-S weights	±0.5 g
Barometer	NIST-traceable barometer	±0.1 in. Hg

a As recommended in Quality Assurance Handbook for Air Pollution Measurements System: Volume III. Stationary Source Specific Methods. EPA 600/4-77-027B, August 1977.

Table 3-13: Field Checks of Gas Emission Sampling Equipment

Equipment	Checked Against	Allowable Difference
Standard Pitot tube	Inspection	No visible damage
Digital indicator	Millivolt signal	±0.5%
Thermocouples	ASTM-2F or ASTM-3F	±1.5%

Phosgene by TO-6.

Collection of phosgene samples will be performed using an impinger train, with samples collected over a 60 minute period. The contents of the impingers will be transferred to a sample bottle and sealed prior to shipment to the lab for analysis. This method can be used to detect phosgene at the 0.1 ppbv level.

Dioxins by Method 23.

Upon completion of sampling (180 min. sample time), the ends of the XAD resin cartridge will be sealed. The applicable parts of the sampling train will then be rinsed with acetone, followed by methylene chloride. Both of these rinses will be collected in the same container. A third rinse will be performed with toluene and collected in a separate container. The impinger catches will be discarded. An adsorbent cartridge will be spiked with a surrogate mixture prior to sampling in order to measure the sampling train efficiency.

The XAD resin and solvent rinses will be combined, extracted for 16 hours with toluene, and concentrated prior to analysis. Based on this method, a portion of the concentrated sample is injected into a high resolution gas chromatograph / high resolution mass spectrometer (HRGC/HRMS).

TCLP-VOCs

The reagent panels will be subjected to the EPA Toxicity Characteristic Leaching Procedure (TCLP - Method 1311) for VOCs. The samples of the first two reagent panels from both reactors will be composited in the laboratory to yield one sample. This will be extracted under zero-headspace conditions, followed by analysis of the leachate for VOCs by Method 8260A. If this first extract fails the TCLP, all of the reagent panels will be disposed of as hazardous waste. The second composite sample (reagent panels 11 and 12, respectively) will be analyzed to provide more information for the SITE report. If the first composite sample passes TCLP, the reagent panels will be disposed of in an ordinary landfill and the second sample will not be analyzed.

3.5.2 Calibration Procedures

Each analytical protocol defines calibration procedures and acceptance criteria in the referenced method. The following section summarizes these requirements for the analyses discussed in the previous subsection; these criteria are also summarized in Table 3-14, Section 3.7.

VOCs by Method TO-14 - SCAN (Influent and effluent Gas Streams)

Canister samples will be analyzed by Quanterra's Air Toxics Laboratory located in City of Industry, California. The samples will be analyzed using gas chromatography equipped with a Mass Selective Detector. An initial multipoint calibration will be performed consisting of a system blank and a minimum a five point calibration. The lowest calibration point is at or near the reporting limit. A single point check standard must be analyzed (every 12 hours), with 100% of the target compound response factors within 30% of the five point calibration curve average response factors. Failure to meet these criteria results in a new 5 point calibration being run. A method blank will be analyzed every 12 hours before samples are run, the results of which must indicate no target compounds at levels above the reporting limits (RL). The method blank is prepared by adding humidified nitrogen to a canister, and analyzing it in the same manner as a sample. If any of the above criteria are not met, corrective actions must be taken before analyses can proceed.

Deviations from the source method include:

1. Use of a 0.53 mm column instead of a 0.32 mm column, and a jet separator to reduce the flow into the HP MSD form 3 mL/min to 1 mL/min, which is the maximum flow that the HP system can handle.
2. Quanterra uses the pressure of the sample canister to drive the sample through the trap, instead of the sample being pulled through the trap using a vacuum pump.

Total Non-Methane Organic Carbon (TNMOC) by Method TO-12.

The initial calibration consists of a five point calibration curve, each point being analyzed three times, with the relative standard deviation (RSD) ≤ 3% required for acceptance. Continuing calibration consists of two points analyzed once each with a required RPD ≤ 15% between the continuing and the initial calibration. Failure to meet these criteria will result in recalibration and reanalysis of the samples in that batch, prior to analysis of any additional samples. Each sample is analyzed twice with the relative percent difference (RPD) required to be ±5%, the average of the two analyses is reported. A RPD >5% will result in the sample being reanalyzed.

HCl and Chlorine by Method 26.

Quanterra will follow the procedures of calibration of the ion chromatograph for chloride analysis described in Method 26. Stock solutions of calibration standards and calibration check standards are prepared from different NIST traceable sources and contain chloride ions. Working solutions are made from the stock solutions. The ion chromatograph is calibrated daily, or after a failed calibration verification sample, with five standards within the linear range to create a calibration curve. An acceptable linear response is indicated by a correlation coefficient of greater than 0.995. Continuing calibration check sample will be analyzed every 20 samples with an RPD of ≤ 15%.

Phosgene by TO-6

An initial five point calibration will be performed with each point analyzed three times. The relative standard deviation (RSD) must be ≤ 10% for the calibration to be acceptable. The daily continuing calibration check recoveries must be within 25% of the initial calibration to be considered acceptable, with recovery criteria of 90-110%. Failure to meet this criteria will result in recalibration.

Dioxins by Method 23

Initial calibration consists of a five point calibration curve. The relative standard deviation for the analytes and internal standards will be considered acceptable with a RSD of 25%. Continuing calibration check standard will be analyzed every 20 samples. The RPD of the average relative response factors (RRF) from the initial calibration (ICAL) to that of the internal standard (IS) must be ≤ 25% for natives, and ≤ 30% for OCDF. Internal standards consist of ^{13}C labeled polychlorinated homologues is added to each sample prior to extraction to determine extraction efficiency. The internal standard percent recovery criteria will be 25-130% for OCDD and PCDD/F, and 40-130% for all others.

TCLP-VOCs by Method 8260A

Initial calibration consists of a five point calibration curve. Continuing calibration will be performed every 12 hours with the percent relative standard deviation for each individual calibration check compounds (CCCs, consisting of : 1,1-Dichloroethene, Chloroform, 1,2-Dichloropropane, Toluene, Ethylbenzene, and Vinyl chloride) must be ≤30% of the initial calibration. If ≥30%, corrective action must be taken to eliminate system leaks and/or column reactive sites before attempting recalibration. If the %RSD is less than 15%, then response factor is assumed to be constant over the calibration range, and the average response factor may be used for quantitation. If the %RSD is greater than 15%, a calibration curve must be constructed using a first or higher order regression fit. A system performance check is made every 12 hours using the SPCCs (system performance check compounds) by checking the response factors. The minimum response factors for the SPCCs are: Chloromethane ≥ 0.1, 1,1-Dichloroethane ≥ 0.1, Bromoform ≥ 0.25, Chlorobenzene ≥ 0.3, and 1,1,2,2-Tetrachloroethane ≥0.3. If these criteria are not met the system must be evaluated and corrective action taken before sample analysis begins. A method blank, MS/MSD and LCS, are run on a batch basis, not to exceed 20 samples. All control limits are 60-140% recovery with an RPD of 20%.

3.6 Data Reduction, Validation And Reporting

The analytical methods discussed in the previous section of this QAPP describes the calculations used to reduce the measurement data into units of reporting which will meet the comparability needs of the project. This section of the document provides an overview of the data reduction, validation and reporting scheme as summarized in Figure 3-5.

3.6.1 Data Reduction

All measurement system outputs must be reduced into units which are consistent with the methods and which meet the comparability objective. A summary of reporting units was given in Table 3-7 of Section 3.3. In general, all raw data are recorded in laboratory notebooks or on worksheets in standardized format by the analyst performing the test. Each analytical method contains detailed instructions and equations for calculating the respective analyte concentration.

It is expected that all canister samples received will be pressurized for analysis. The canisters are diluted with UHP-grade N_2 and a dilution factor (DF) for each sample is calculated as follows:

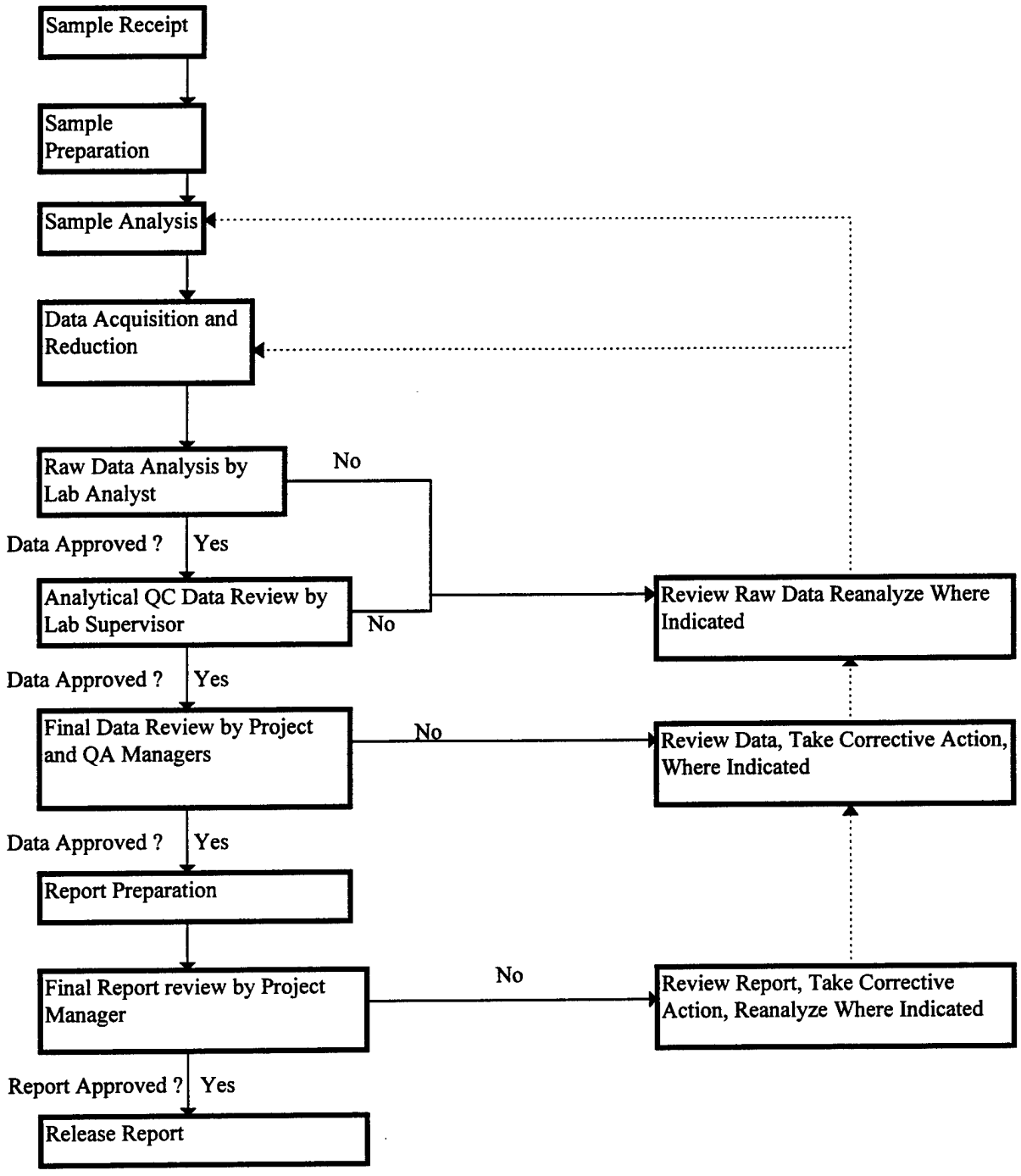
$$\text{Sample DF} = \frac{\text{PF - PI (psig)}}{\text{PT + 14.7 (psig)}}$$

where PF - pressure in canister after sampling (psig) as measured at the laboratory.
PI - pressure in canister before sampling (psig) as measured at the laboratory.
PT - pressure in canister after pressurization with UHP N_2 (psig)

3.6.2 Data Validation

The measurement data generated by the analyst are validated in several ways. Strict adherence to the analytical methods, and ensuring that the instrumentation employed was operated in accordance with defined calibration procedures, are critical functions to determining the validity of the generated data. Results generated by an unauthorized method, unapproved deviation from the standard protocol, or during the operation of uncalibrated or malfunctioning equipment will be rejected. The laboratory SOPs, along with the criteria given in various sections of this document, clearly define when such occurrences require corrective action and what that action should be (see Section 3.10).

Figure 3-5: Summary of Data Reduction, Validation, and Reporting Scheme.



Within the laboratory, raw data reductions are verified by an independent analyst or a section QC specialist. Any problems or errors discovered during this review will initiate a 100 percent review of the batch. All QC samples are compared to QA objectives for precision and accuracy; any outliers are immediately flagged. Analytical outlier data are defined as those QC data lying outside of a specific limit for precision or accuracy for the specific method. Following the identification of the outlier, reasons for the failure are investigated, including instrumentation problems, calculation problems, or difficulties with sample volume or sample matrix. Similarly, any outlier surrogate recoveries (for organic analyses) require investigation. The PTI Project Manager will be notified promptly in order to determine whether re-analysis is justified. If re-analysis of the sample (when feasible) indicates sample matrix interferences, a statement to that effect accompanies the original data and the entire batch is considered acceptable. If the reason for the failure cannot be determined, and reanalysis indicates that the original analysis was in error, the effect on the analytical batch is evaluated, and all interpretations and corrective actions are documented. As necessary, qualifying statements will describe any problems encountered and any restrictions on the use of the data.

Field data will be validated by a similar procedure. The field personnel will review 100 percent of the data generated, including calibration data and all calculations. The field personnel will sign and date all field notebooks. The field supervisor will review at least 10 percent of the generated data. The PTI Project Manager will perform a review of 10 percent of the data quality indicators, including field calibration checks, and compare them to acceptance criteria. Any suspect data will be flagged and identified with respect to the nature of the problem.

Project outlier data are defined as those sample data lying outside of specified acceptance limits established about the central tendency estimator (e.g., the arithmetic mean) of the project's entire data set. Project outlier data will be identified and reported in the final project report but will not be used to determine overall project results. Prior to rejecting any data, the Tetra Tech Project Manager will discuss the data with the EPA's QA Officer.

3.6.3 Data Reporting

All original laboratory data will be recorded in a permanent manner and will be readily traceable through all steps of the data generation/reduction/validation/review process. Field measurements will be recorded in appropriate field notebooks and results will be reported in tabulated summary form.

Laboratory data are originally reported by the analyst on analysis-specific report forms. These data are reviewed and approved by the section manager. The reported data are then validated, as discussed previously, and approved for reporting by the QC specialist. The final report requires the laboratory manager's approval prior to being issued. The project manager then compares the combined field and analytical data to the project goals.

For this project, the following deliverables will be included in the data package submitted to Tetra Tech by PTI from the subcontractors Quanterra and Best Environmental:

- A summary of laboratory activities performed.
- A listing of laboratory identifications, project identification numbers, and field descriptions for all samples, blanks, and QA samples.
- A summary of exceeded holding times to include explanations.

- A table showing sample identification, analytical parameter, date sampled, date of laboratory receipt, extraction date, and date analyzed. Re-extraction and/or analysis dates should be included.

- QA discussion for each parameter, to include analytical anomalies, corrective actions, samples lost, and deviations from QAPP specifications. Any batch QC results should be reported.

- List of detection limits for all parameters.

- Copies of field notebooks and COC records.

- Summary data sheets, including quantitation reports and chromatograms for each sample, surrogate recovery summary, matrix spike summary (including individual concentrations of spiked and unspiked samples), method blank summary, tuning form, initial and daily calibration summary and quantitation report and chromatogram, where appropriate.

Samples will be retained by Quanterra for 2-3 weeks after analysis. All raw data associated with this project will be retained by Quanterra until notified by Tetra Tech that the final technical report has been accepted by EPA.

3.6.4 Final Technical Report

The validated field and analytical data will be used to prepare the Innovative Technical Evaluation Report (ITER) evaluating the demonstration technology and assessing its potential applications. The purpose of the ITER is to provide concise SITE technology-specific information to remediation users in a timely manner. The reader can utilize the Table of Contents and data tables (as a stand alone) with straightforward text as a handbook. Tables should serve as a source of information for those in the treatability phase of the remedial process. Both text and tables would be used by those during the remedial design phase. This report will include information on all nine criteria used by RPMs. The appendix written by the developer will also be included in the document and referenced as such. The document will include the following additional information: (1) percent time online, schedule - actual vs. planned and implementation problems, (2) availability information (is the tested equipment the only piece of equipment), and (3) evaluation of the technology in light of the nine criteria from the RI/FS process.

In addition, the primary technical report (or data package) will be prepared to summarize the information received from the laboratory. A QA section will be included and will contain the following:

- A thorough discussion of the procedures used to define data quality and usability and the results of these procedures. The discussion will focus on the data quality indicators such as precision, accuracy, completeness, comparability, and representativeness and will include summary tables of the QC data obtained during the demonstration. Results will be compared to the data quality objectives set forth in the QAPP to provide an assessment of the factors that contributed to the overall quality of the data.

- The results of any technical systems and/or performance audits performed during the course of the project will be documented, including corrective actions initiated as a result of these audits and any possible impact on the associated data. If any internal audits were performed, these too will be reviewed.

- All changes to the original QAPP will be documented regardless of when they were made. The rationale for the changes will be discussed along with any consequences of these changes.

- The identification and resolution of significant QA/QC problems will be discussed. Where it was possible to take corrective action, the action taken and the result of that action will be documented. If it was not possible to take corrective action (for example, a sample bottle was broken in transit), this too will be documented.

- A discussion of any special studies initiated as a result of QA/QC issues and/or corrective actions, including why the studies were undertaken, how they were performed, and how the results impacted the project data.

- A summary of any limitations on the use of the data will be provided including conclusions on how these constraints affect project objectives.

The QA section will provide validation of the measurements to be used in the evaluation (and subsequent acceptance/rejection) of the innovative technology. This section (and the final report) will be subject to review by the Tetra Tech Project and QA Managers. The review will assess the assumptions made in evaluating the data and the conclusions drawn. The Project and QA Managers must approve the reports prior to release.

3.7 INTERNAL QUALITY CONTROL

Reliable analytical measurements of environmental samples require continuous monitoring and evaluation for the analytical processes involved (i.e. quality assurance). To ensure optimum valid data generation, a scientifically sound and strictly adhered to quality control program must be incorporated into the sample collection and analytical laboratory program. Such a QC program employs a prescribed sequence of routine procedures to control and measure the quality of the data generated. Inherent in this program to maximize valid data generation is the use of scientifically sound sample collection procedures and approved analytical methods and calibration protocols, as described previously. Additionally, specific quality control samples, collected and analyzed by the appropriate methods, are introduced into the laboratory as a check on the overall analytical system. These samples are defined below and are summarized in Table 3-14 along with frequency and acceptance criteria. If deviations from acceptance criteria cannot be corrected by the laboratory, immediate notification of PTI Project Manager is necessary.

3.7.1 QC for Field Activities

The sampling strategy to be used to collect samples during the PTI demonstration was presented in-depth in Section 3.4. The different types of field QC checks are described in detail below, along with frequency and acceptance criteria.

Field Duplicates

A field duplicate sample is defined as one of two sample aliquots collected simultaneously or sequentially. Field duplicate frequency is outlined in Table 3-4.

Field duplicates of vapor samples will be collected by filing one canister, then filling a second canister immediately following the first one. The field duplicate samples will be analyzed for VOCs using Method TO-14, and TNMOC by TO-12.

Field Blanks

Collection and analysis of field blanks are intended as QC checks on the integrity of sample collection and handling procedures and equipment decontamination procedures. The frequencies of collection for these field blanks were presented in Table 3-4.

For the Method 26 procedure, one field blank will be collected during week 7. This blank will be generated by preparing the Method 26 train and recovering the impingers without sampling.

For dioxin sampling, one field blank will be collected by preparing the train described in Subsection 3.4.1 and then recovering the sample without air being drawn through the train. This blank will be analyzed only if dioxins are detected in the sample.

Blinds

Blinds will be obtained from EPA Research Triangle Park for VOCs and dioxins in the gas phase. These will be sent to the laboratory as investigative samples and are subject to the same acceptance criteria and corrective actions as actual samples.

Trip Blanks

Trip blanks are not appropriate for canister sampling and are not planned. Each canister will be checked for leakage before shipment to the field, in the field, and at receipt by the laboratory. Liquid VOC samples will include a trip blank as required by McClellan AFB.

3.7.2 QC for Laboratory Activities

This section describes the various types of internal quality control checks to be performed by the laboratory during the analyses of the critical parameters. Table 3-14 summarizes which QC checks will be performed for each parameter and the frequency, acceptance criteria, and corrective action to be followed. Calibration procedures were discussed in Section 3.5.2 and are summarized in the table.

Laboratory Control Sample TO-14

Laboratory Control Samples (LCS) are samples with known amounts of analyte which are carried through the entire analysis procedure. Since this sample should yield consistent results, anomalous results indicate a laboratory analytical problem, not a matrix problem. In addition, this sample will provide a limiting measure of accuracy. A laboratory control sample (LCS) will be analyzed every 20 samples or daily, which ever is more frequent and consists of methylene chloride, 1,1-dichloroethylene, trichloroethylene, toluene, and 1,1,2,2-tetrachloroethane, all at a nominal spike concentration of 50 ppb. The percent recovery for the compounds in the LCS must be within the window 70-120% for the critical VOCs. For each lot of 20 samples, a laboratory control sample duplicate (LCSD) must be analyzed. The LCSD is identical to the LCS and must meet the same recovery criteria. In addition the relative percent difference (RPD) between the LCS and the LCSD must be ≤ 20 %. If either control samples fail, the LCS which failed will be reanalyzed. Samples will not be considered reportable until the LCSD criteria are met. This LCS will be prepared in a canister using UHP nitrogen. Internal standards are monitored each 12 hour shift by comparing areas of the internal standards in each sample with the areas of the internal standards in the daily continuing calibration standard. Sample areas are considered acceptable if they fall between 50 and 150% of the daily standard areas.

HCl and Chlorine by Method 26

A LCS/LCSD sample pair will be analyzed every 20 samples with control limits of 85-115% and a RPD of $\leq$ 15%. A method blank will be run daily and must have chloride ion concentration less than the reporting limits.

Phosgene by TO-6

Each set of samples analyzed will include a reagent blank which must indicate a phosgene concentration less than the reporting limits. The matrix spike will be prepared by splitting one sample, and spiking one part of the split. A matrix spike will also be analyzed every 20 samples, and will be considered acceptable if the range for the percent recovery is within 70-130%.

Dioxins by Method 23

For each batch of samples analyzed, an additional control sample will be run, in the form of a single control sample (SCS), consisting of a control matrix that is spiked with the appropriate target compounds. The SCS control limits are 60-140% recovery, and a RPD of $\leq$50% from that of the initial calibration.. The SCS will be analyzed for each sample batch for which a LCSD (laboratory control sample duplicate) is not analyzed. The LCS and LCSD will have a RPD of $\leq$50% and a recovery range of 60-140% in order to be considered acceptable.

The recoveries for the surrogates added to the adsorbent cartridge prior to collection of the sample, must be within 70-130 percent. A method blank will be run with every sample batch, with the acceptance criteria being; tetrachloro isomers less than 20 pg/sample, heptachloro isomers less than 100 pg/sample, and the octachloro isomers less than 200 pg/sample. The LCS contains the following compounds: 2,3,7,8-TCDF, 1,2,3,7,8-PeCDF, 2,3,4,7,8-PeCDF, 1,2,3,4,7,8-HxCDF, 1,2,3,6,7,8-HxCDF, 2,3,4,6,7,8-HxCDF, 1,2,3,7,8,9-HxCDF, 1,2,3,4,7,8-HpCDF, 1.2.3.4.7.8.9-HpCDF, OCDF, 2,3,7,8-TCDD, 1,2,3,7,8-PeCDD, 1,2,3,4,7,8-HxCDD, 1,2,3,6,7,8-HxCDD, 1,2,3,4,6,7,8-HpCDD, and OCDD.

TCLP-VOCs by Method 8260A

Continuing calibration will be performed every 12 hours with the percent relative standard deviation for each individual calibration check compounds (CCCs, consisting of : 1,1-Dichloroethene, Chloroform, 1,2-Dichloropropane, Toluene, Ethylbenzene, and Vinyl chloride) must be ≤30% of the initial calibration. If ≥30%, corrective action must be taken to eliminate system leaks and/or column reactive sites before attempting recalibration. If the %RSD is less than 15%, then response factor is assumed to be constant over the calibration range, and the average response factor may be used for quantitation. If the %RSD is greater than 15%, a calibration curve must be constructed using a first or higher order regression fit. A system performance check is made every 12 hours using the SPCCs (system performance check compounds) by checking the response factors. The minimum response factors for the SPCCs are: Chloromethane ≥ 0.1, 1,1-Dichloroethane ≥ 0.1, Bromoform ≥ 0.25, Chlorobenzene ≥ 0.3, and 1,1,2,2-Tetrachloroethane ≥0.3. If these criteria are not met the system must be evaluated and corrective action taken before sample analysis begins. A method blank, MS/MSD and LCS, are run on a batch basis, not to exceed 20 samples. The control limits for the MS/MSD and LCS are 60-140% recovery with an RPD of 20%.

Method Blanks

All parameters analyzed in the laboratory require the analysis of a method blank also known as a reagent blank with each batch of samples analyzed, or every 20 samples, whichever is more frequent. A method blank consists of an aliquot of reagent water (or humidified nitrogen for TO-14 and TO-12) carried through all preparation and analysis steps, and is designed to document that the analytical equipment and reagents are free of contamination and/or interferences. If method blanks are observed to be above the RL for a given parameter, the effect on the sample data should be evaluated. If the amount found in the blank is less than five percent of the amount found in the samples, the data can be flagged without reanalysis.

Table 3-14: Summary of Laboratory Internal QC Checks for the PTI Site Demonstration

Parameter	Matrix	Method(s)	QC Check	Frequency	Acceptance Criteria	Corrective Action
VOCs	Gas Influent, Effluent	TO-14-SCAN	Initial calibration 5 points	Initially and when continuing check unacceptable	RSD ≤30%	Evaluate system, recalibrate
			Continuing calibration	Every 12 hours	100% of Target compounds ≤30% RSD	Reanalyze continuing calibration check; recalibrate; reanalyze affected samples
			Laboratory Control Sample[a]	Every 20 samples or daily	Recovery 70-120%	Review analyses; re-analyze if necessary; notify PTI Project Manager
			Method Blank	Daily	Concentration < target reporting limits (Section 3.1)	Review analysis; repeat analysis
			Laboratory Control Sample Duplicate	Every 20 samples	LCS and LCSD RPD ≤ 20%; recovery 70-120%	Repeat analyses; re-analyze if necessary; notify PTI Project Manager
VOCs	Leachate, scrubber discharge, condensate	TCLP, 8260A	BFB tune is run initially, and as required.	Initially and every 12 hours	See Method 8260A for BFB tune criteria	Retune, repeat BFB analysis
			Initial calibration 5 points	Initially and as required	%RSD for CCCs ≤ 30%, SPCC RF see Section 3.5	Evaluate system, recalibrate
			Continuing calibration check	Every 12 hours	%RSD for CCCs ≤ 20%, SPCC RF see Section 3.5	Evaluate system, repeat calibration check, recalibrate, reanalyze affected samples
			Method Blank	Daily	Concentration less than reporting limits	Review analysis; repeat analysis
			MS/MSD	Every 20 samples or daily	Laboratory control limits 60-140%, RPD ≤ 20%	Review analyses; reanalyze if necessary

Table 3-14: Summary of Laboratory Internal QC Checks for the PTI Site Demonstration (continued)

Parameter	Matrix	Method(s)	QC Check	Frequency	Acceptance Criteria	Corrective Action
VOCs	Leachate, scrubber discharge, condensate	TCLP, 8260A	LCS	1 per batch, not to exceed 20 samples.	Laboratory control limits 60-140%	Review analyses; reanalyze if necessary
			Surrogate	All samples	60-140%, RPD of 20%.	Review analyses; reanalyze if necessary
TNMOC	Gas Effluent, Influent	TO-12	Initial calibration 5 points	Initially and when continuing check unacceptable	5 points analyzed 3 times each, RSD ≤ 3 %	Evaluate system, Recalibrate
			Continuing calibration	Daily; 2 points	less than or equal to 15% difference from the average response factor from the initial calibration.	Reanalyze continuing calibration check; recalibrate; reanalyze affected samples
			Sample duplicate	All samples	must be ≤ 5% RPD	Re-analyze
			Method blank	Daily	must be < RL (0.5 ppm-C)	Review analyses; reanalyze if necessary
NO_X, O_3, CO	Gas Effluent	CEM	Leak check	Initially	No flow through rotameter	Correct problem and re-check
			System Bias Check	Initially	<5% of direct injection span	Correct problem and re-check
			Calibration check	After each run	<5% of direct injection span	Recalibrate
HCl, chlorine	Gas Effluent	26	Initial calibration	Daily or after a failed QC check sample	$r^2 \geq 0.995$	Evaluate system, Recalibrate
			Continuing Calibration	Every 20 samples	RPD of 15%	Re-analyze, recalibrate if necessary
			Method blank	Daily	Concentration < Reporting limits	Re-analyze
			LCS/LCSD	Every 20 samples	Control limits 85-115%, RPD of 15%	Re-analyze
Phosgene	Gas Effluent	TO-6	Initial 5 point calibration	Initially and when continuing check unacceptable	5 points analyzed 3 times each, RSD of response factors ≤ 10 %	Evaluate system, Recalibrate
			Continuing Calibration	Daily or with each sample batch	RPD <25%, Laboratory Limits 90-110%	Re-analyze, recalibrate if necessary
			Method blank	Daily	Concentration < Reporting limits	Re-analyze

Table3-14: Summary of Laboratory QC Checks for the PTI Site Demonstration (continued)

Parameter	Matrix	Method(s)	QC Check	Frequency	Acceptance Criteria	Corrective Action
Phosgene	Gas Effluent	TO-6	Matrix spike	Every 20 samples	Control limits 70-130%	Review analyses; reanalyze if necessary
Dioxins	Gas Effluent	23	Initial five point calibration	Initially and when continuing calibration check is unacceptable	Int. Std RSD ≤ 30%; Natives = RSD ≤ 25%., 30% for OCDF	Evaluate system, Recalibrate
			Continuing calibration	Every 20 samples	D of IS ≤ 30% from avg. RRF (ICAL). %D of natives ≤25%, 30% for OCDF from avg. RRF (ICAL).	Re-analyze, recalibrate if %D for relatives exceeds criteria
			Method blank	Every sample batch	Concentration tetra < 20, penta-hepta <100, octa < 200 pg/sample	Review data; repeat analysis
			Internal Standard	All samples	%R = 40-130%, 25-130% for OCDD and PCDD/F	Review data, reanalyze if necessary
			LCS/LCSD	Every sample batch	RPD < 50%	Review data; repeat analysis
			SCS (Single Control Sample)	Every batch for which LCSD is not analyzed	60-140 %R, RPD ≤50% of ICAL	Review data; repeat analysis
			Field blank - surrogates	Once	%R = 70-130%	Review data; repeat analysis

a This laboratory control sample consists of standards from a source different than the calibration standards.

Duplicates

Field duplicate samples will be analyzed for the gaseous VOC and TNMOC samples at a frequency of 10 percent.

3.8 PERFORMANCE AND SYSTEM AUDITS

Audits are independent means of confirming the operation or capability of a measurement system and documenting the use of QC measures designed to generate valid data of known and acceptable quality. An audit is by necessity performed by a technically qualified person who is not directly involved with the measurement system being evaluated. A performance audit is generally an objective audit of a quantitative nature, and a systems audit is a qualitative evaluation of the capability of a measurement system to produce data of known and acceptable quality.

Stanley Labunski, Tetra Tech's Quality Control Coordinator (QCC), or his designee for the SITE program, will review program performance and complete a Technical Systems Review (TSR) of procedures and methods for taking critical measurements specified in the Quality Assurance Project Plan (QAPP). Stanley Labunski, or his designee, will perform field and laboratory audits. Information obtained during these audits will be relayed back to the laboratory and field staff to ensure compliance with the QAPP and initiate corrective action when necessary.

3.8.1 Kick-Off Audit

Prior to any sample analyses, a kick-off audit will be conducted at the subcontractor laboratory to ensure that the contents of this QAPP are known and understood. Participants will include the Tetra Tech QCC, Tetra Tech Project Manager, Laboratory Project Manager, and analysts. Tetra Tech will schedule audits.

3.8.2 Performance Audits

Tetra Tech and Quanterra will cooperate with the EPA or other regulatory agencies with Agency-requested performance and/or system audits. Any performance and/or system audits requested will be coordinated through the NRMRL QA Officer and the Tetra Tech QA Manager.

Internal performance audits, which are conducted more frequently, consist of a "blind" spiked sample or reference standard introduced into the system unknown to the analyst by an individual independent of the measurement system for that parameter. Lab data validation procedures are a type of performance audit of the data reduction system since an independent analyst performs a second review of the calculation steps which are used to generate the sample concentration. The results of any external and internal performance audits for this project will be reported to Tetra Tech's QA Manager and made available for review.

3.8.3 System Audits

A system audit is a qualitative determination of the overall ability of a measurement system to produce data of known and acceptable quality, by an evaluation of all procedures, personnel, equipment, etc., utilized to generate the data. It is an evaluation of whether adequate QC measures, policies, protocols, safeguards, and instructions are inherent in the measurement system to enable valid data generation, and/or the immediate identification of outlier data and subsequent actions. Systems audits during the PTI Demonstration will be conducted by NRMRL QA personnel, under the direction of Ann Kern, and Tetra Tech's QA Manager, Kenneth Partymiller or his designee, and will include both field and analytical activities, including subcontractors.

A systems audit will review the project organization and technical personnel involved. Field activities will be evaluated, including: proper sampling equipment, procedures for equipment maintenance and decontamination, acceptable sampling protocol calibration procedures for field measurements, proper sample handling, storage and shipping procedures, and adequate field documentation and record keeping procedures.

A laboratory systems audit will include a review of the technical abilities of lab personnel involved with analyzing PTI samples. Instrumentation will be evaluated with respect to technical acceptability, maintenance procedures and records, availability of spare replacement parts (and/or service contracts), and general upkeep. Analytical methodology for all critical measurements of the Demonstration project will be reviewed, including all extraction/preparation steps, analysis steps, data reduction and validation procedures, applicable QC sample analysis records, calibration records and general recordkeeping/documentation practices. Additionally, sample handling and tracking procedures will be evaluated including sample receipt COC sample storage, sample/standard segregation, and results reporting. The Tetra Tech QCC or his designee will perform a systems audit for the subcontractor labs or review any external and/or internal systems audit results for these labs.

3.9 CALCULATION OF DATA QUALITY INDICATORS

The data quality objectives established for the demonstration of the PTI technology in Section 3.3 of this QAPP are based on project requirements and are designed to ensure that the data generated during the demonstration are of known and acceptable quality to achieve the project's technical objectives. This section of the QAPP delineates the QA objectives for each of the critical measurements in terms of the data quality indicators: precision, accuracy, completeness, method detection limits, representativeness, and comparability.

3.9.1 Precision

Precision is the ability of the measurement system to generate reproducible data. For the TO-14 and TO-12 analyses, precision is determined from the results of the analysis of duplicate samples and is reported as relative percent difference (RPD).

$$RPD = \frac{| C_1 - C_2 |}{((C_1 + C_2) / 2)} \quad X\ 100$$

Where

C_1 - Sample result

C_2 - Duplicate result

RPD will be calculated for both lab and field duplicates.

3.9.2 Accuracy

Accuracy is defined as the nearness of the analytical result to the "true" value. Accuracy is assessed by the analysis of laboratory control samples for Method TO-14 analyses and reported as percent recovery:

$$\% \text{ Recovery} = \frac{C_D}{C_R} X\ 100$$

Where, C_D is the determined concentration in the known standard and C_R is the true concentration of the known standard.

3.9.3 Completeness

Data completeness is a measure of the extent to which the data base resulting from a measurement effort fulfills the objective for the amount of data required. For this program, completeness is defined as the percentage of valid data obtained compared to the total number of tests required to achieve a statistical level of confidence in the results.

3.9.4 Target Reporting Limits (TRLs)

Target reporting limits (TRLs) objectives as presented in Table 3-2 are based on the project objectives. These are target values which may vary based on sample matrix.

These TRLs meet USAF Installation Restoration Program (IRP) requirements and are generally 2 to 3 times above laboratory method detection limits (MDLs). Data reported by Tetra Tech will not be in IRP format. Any such formatting requirements will be the responsibility of Quanterra. MDLs are generally determined by analyzing replicates of a spike containing the analyte of interest at a concentration 3 to 6 times the estimated MDL. The MDL is then determined by:

$$MDL = t_{(n-1,\ \sigma = 0.99)} \times S$$

Where, $t_{(n-1,\ \sigma = 0.99)}$ is the one-sided t-statistic appropriate for the number of replicates at the 99 percent level, and S is the standard deviation of the replicate analyses.

3.10 CORRECTIVE ACTION

Strictly defined sample handling procedures, calibration procedures, QC sample analyses, and all associated acceptance criteria are all part of a comprehensive QA program which enables recognition of situations which do not meet specific QA/QC requirements. The specific action steps to be taken in response to failed criteria are discussed in Section 3.7 (Internal Quality Control). This section of the QAPP discusses corrective action procedures as part of the QA program for the PTI demonstration.

3.10.1 Initiation of Corrective Action

The need for corrective action comes from several sources: equipment malfunction, internal QA/QC checks outside of acceptance criteria, deficiencies noted during performance or systems audits, and noncompliance with sampling/analysis/ QA requirements (e.g., hold times). In all instances, except for responding to audit findings, personnel (field and laboratory) directly performing the measurement task are responsible for identifying any nonconformance or potential problem with the protocols, equipment, or method. The responsible individual must immediately notify the appropriate supervisor that a problem exists. If the individual identifying the problem can correct it independently, such corrective action must take place before any further sample collection or analysis occurs. The corrective action to be taken must be determined on a case-by-case basis taking into account the nature of the problem and the extent of the error. Depending upon the circumstances, the specific steps to be taken and the initiation of the action can be decided by the field/laboratory technician, the section supervisor, the laboratory QA Manager, McClellan QA Manager, and/or the Tetra Tech QA Manager, if necessary, by all of them in conference.

3.10.2 Documentation of Corrective Action

If, at any time during analyses, a process is out of control, corrective action shall be taken and documented, with regard to:

- What actions were taken to bring the process back into control.
- What actions were taken to prevent recurrences of the out of control situation.
- What was done with the data obtained while the process was out of control.

The documentation is accomplished by filing out a corrective action form (see example given in Figure 3-7). This form is initiated either by field or laboratory personnel, the appropriate supervisor, or the QA Manager depending on where the problem is recognized. The report will include the following information:

- Nature of the problem.
- Analytical parameter affected.
- Sample lot affected.
- Personnel responsible for identifying the problem.
- Corrective action measure(s) taken and final disposition/resolution of the problem.

- Dates.
- Initials of the analyst or data reviewer.

The reason for initiating corrective action and steps taken to implement the corrective action will be summarized in monthly QC reports to management (see section 3.11.1).

Figure 3-6. Example of a Corrective Action Form

Corrective Action

Page _____ of _____
Report # ____

Date/Originator: _____

Person Responsible for Response: _____

Description of Problem and when identified (state analytical parameter and sample lot affected):

_____
_____
_____
_____
_____
_____

Cause of problem if known or suspected: _____
_____
_____
_____
_____
_____

Sequence of corrective action (state date, person, and action planned): _____
_____
_____
_____
_____
_____
_____
_____

Corrective action approval:_____ Date: _____
Follow-up dates: _____
Description of follow-up:_____
_____
_____

Final corrective action approved by:_____ Date: _____

3.11 QUALITY CONTROL REPORTS TO MANAGEMENT

The quality-related results, actions, and decisions required by this Quality Assurance Project Plan, and other documents describing the PTI Demonstration project necessitate a reporting mechanism to keep project management informed as to project status. These reports, discussed below, are intended to provide management with the information necessary to assess the adequacy and success of the QA program and represents a minimum requirement.

3.11.1 Monthly Reports

A detailed report on quality-related activities will be prepared monthly by Tetra Tech's QCC, Stanley Labunski, and submitted to Kenneth Partymiller. Information submitted in this report will include: any proposed changes or modifications to the QAPP, summary of field QA/QC activities, laboratory QA/QC activities, and an overall tentative assessment of data quality to date. Any proposed deviations from the QAPP will be approved by the QCC and EPA prior to implementation. The reports will discuss any problem conditions and corrective actions, audit events and results, sampling and analysis QA/QC status, and a general review of the achievement of data objectives for the project.

3.11.2 Technology Evaluation Report (TER)

The TER will include a separate QA section that documents the QA/QC activities which lend support to the credibility and validity of the data as discussed in Section 3.6.4. A summary of the data quality information will be provided including an assessment of the QA objectives which were achieved and which, if any, were not, why they were not, and the impact to the project.

3.12 ADDITIONAL REFERENCES

U. S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste (SW-846), Third Edition. November, 1986.

U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste (SW-846), Third Edition. Final Update, September 1990.

Department at the Air Force. Handbook to Support the Installation Restoration Program IRP) Statements of Work. Volume I - Remedial Investigation / Feasibility Studies (RI/FS), May 1991.

Process Technologies, Inc. Marketing Brochures, 1993.

United States Air Force. Quality Assurance Project Plan for McClellan Air Force Base, California. Final, August 1997.

United States Air Force. Private/Public Partnership Innovated Technologies, 1992.

United States Air Force. Overview of Errvironmental Program and Selected Contaminated Sites at McClellan Air Force Base Sacramento, California. 1992.

United States Air Force. McClellan Air Force Base Soil Vapor Extraction Treatability Investigation Site S, Operable Unit D Work Plan Addendum. 1993.

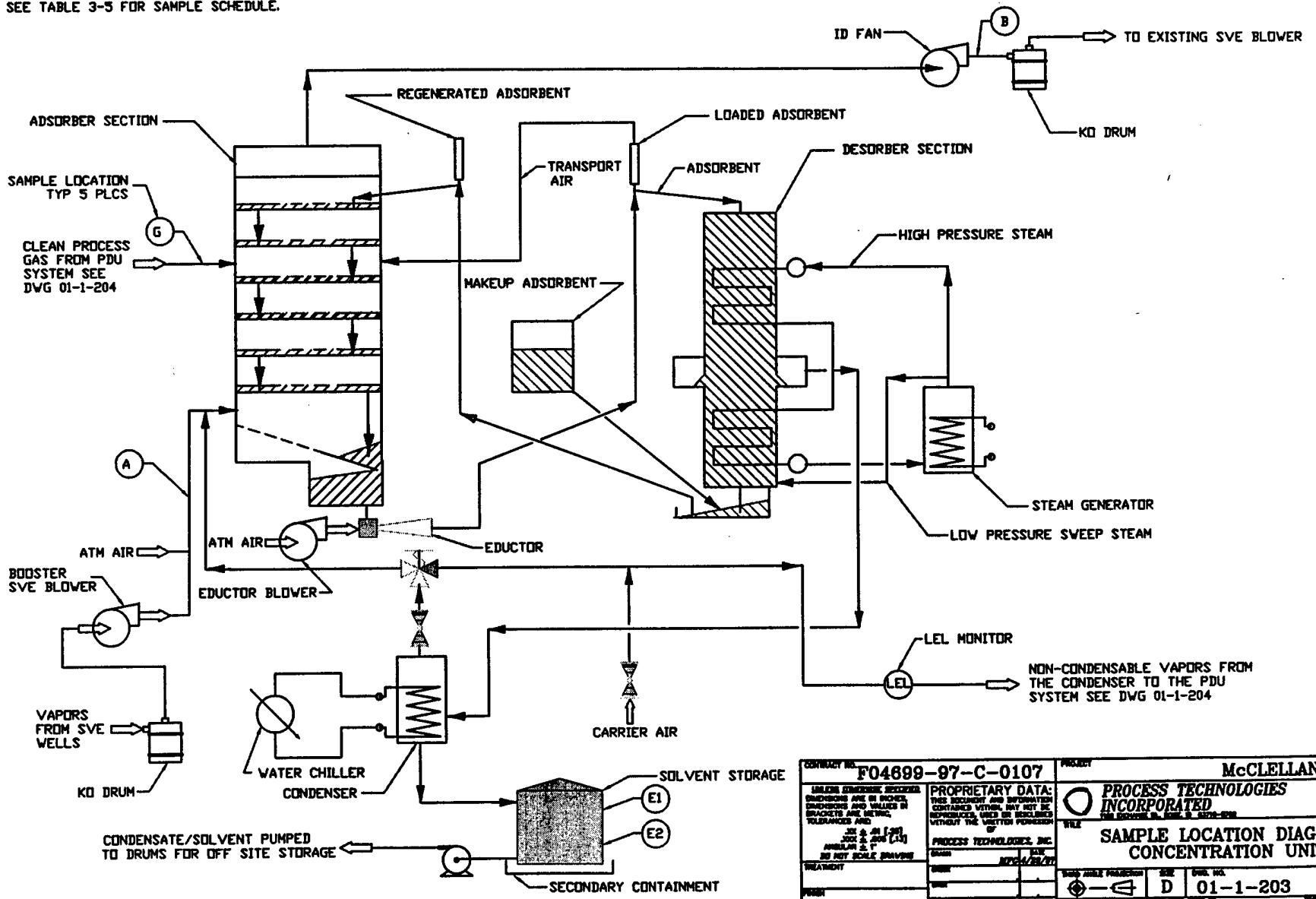
Compendium of Methods for the Determination of Toxic Organic Compounds In Air. EPA/600/4-84/041, April 1984

APPENDIX 3A

SAMPLE LOCATIONS - CONCENTRATION UNIT

NOTES:
1. SEE TABLE 3-1 FOR SAMPLE DETAILS.
2. SEE TABLE 3-5 FOR SAMPLE SCHEDULE.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
0	ENCORP COMMENTS	5/9/98	JDF
B	FOR ENCORP COMMENTS	9/22/97	JDF



CONTRACT NO. F04699-97-C-0107

PROPRIETARY DATA: THIS DOCUMENT AND INFORMATION CONTAINED WITHIN, MAY NOT BE REPRODUCED, USED OR DISCLOSED WITHOUT THE WRITTEN PERMISSION OF PROCESS TECHNOLOGIES, INC.

PROJECT: McCLELLAN AFB

PROCESS TECHNOLOGIES INCORPORATED

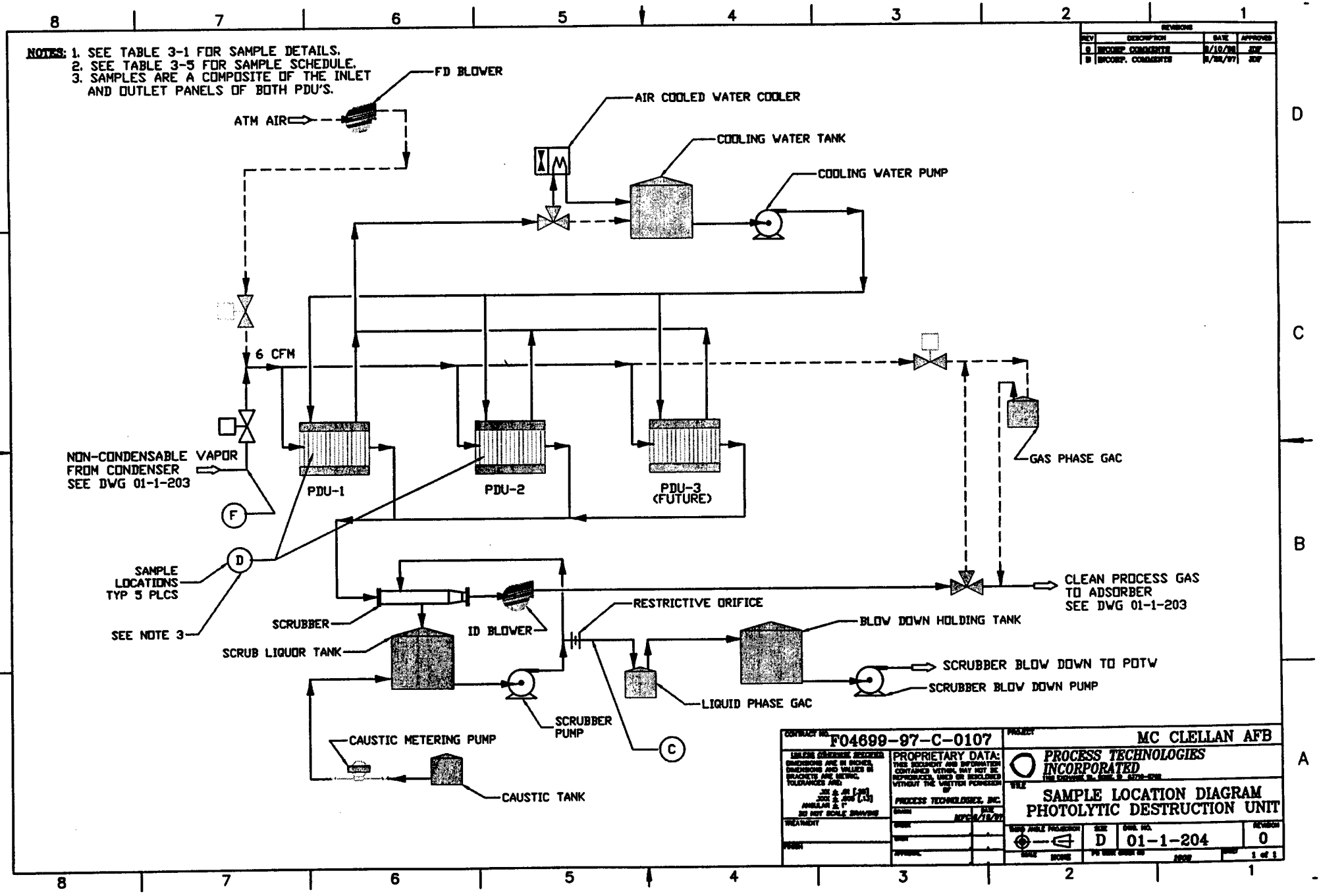
TITLE: SAMPLE LOCATION DIAGRAM CONCENTRATION UNIT

SIZE: D | DWG. NO.: 01-1-203 | REVISION: 0

SCALE: NONE | SHEET 1 of 1

APPENDIX 3B

SAMPLE LOCATIONS - PHOTOLYTIC UNIT


NOTES: 1. SEE TABLE 3-1 FOR SAMPLE DETAILS.
2. SEE TABLE 3-5 FOR SAMPLE SCHEDULE.
3. SAMPLES ARE A COMPOSITE OF THE INLET AND OUTLET PANELS OF BOTH PDU'S.
FD BLOWER
ATM AIR
AIR COOLED WATER COOLER
COOLING WATER TANK
COOLING WATER PUMP
6 CFM
NON-CONDENSABLE VAPOR FROM CONDENSER SEE DWG 01-1-203
PDU-1
PDU-2
PDU-3 (FUTURE)
GAS PHASE GAC
SAMPLE LOCATIONS TYP 5 PLCS
SEE NOTE 3
SCRUBBER
ID BLOWER
RESTRICTIVE ORIFICE
BLOW DOWN HOLDING TANK
CLEAN PROCESS GAS TO ADSORBER SEE DWG 01-1-203
SCRUB LIQUOR TANK
SCRUBBER BLOW DOWN TO POTW
SCRUBBER BLOW DOWN PUMP
LIQUID PHASE GAC
SCRUBBER PUMP
CAUSTIC METERING PUMP
CAUSTIC TANK
REVISIONS
REV DESCRIPTION DATE APPROVED
0 INCORP. COMMENTS 8/10/98 JDF
B INCORP. COMMENTS 8/28/97 JDF
CONTRACT NO. F04699-97-C-0107
PROPRIETARY DATA:
PROCESS TECHNOLOGIES, INC.
PROJECT MC CLELLAN AFB
PROCESS TECHNOLOGIES INCORPORATED
TITLE SAMPLE LOCATION DIAGRAM PHOTOLYTIC DESTRUCTION UNIT
SIZE D
DWG. NO. 01-1-204
REVISION 0
SHEET 1 of 1

APPENDIX 3C

PTI FIELD DATA SHEET

PROCESS TECHNOLOGIES INCORPORATED
McClellan AFB SITE IC-31 PTI FIELD DATA SHEET

DATE:_____ TIME:_____ BY:_____
TEST NUMBER:_____
TEST PARAMETERS:

DATA Time of Day ►			
SVE Inlet Flow (SCFM)			
SVE Inlet Temp (F)			
Dilution Air Flow (SCFM)			
Dilution Air Temp (F)			
Dilution Air Press ("wc)			
Combined Inlet Air Flow (SCFM)			
Combined Inlet Air Temp (F)			
Combined Inlet Air Press ("wc)			
Outlet Gas Flow (SCFM)			
Outlet Gas Temp (F)			
Outlet Gas Press ("wc)			
Adsorber Press Top (kPa)			
Adsorber Press Mid (kPa)			
Adsorber Press Bottom (kPa)			
Desorber Press Mid (kPa)			
Desorber Press Bottom (kPa)			
Condenser Temp (F)			
Chilled Water Temp (F)			
Dilution Air to PDU's (SCFM)			
Feed Gas Temp to PDU's (F)			
Feed Gas Press to PDU's ("wc)			
PDU Cooling Water Temp In (F)			
PDU#1 Cooling Water Temp Out (F)			
PDU#2 Cooling Water Temp Out (F)			
PDU#1 Cooling Water Flow (GPM)			
PDU#2 Cooling Water Flow (GPM)			
PDU#1 Press Drop In to Out ("wc)			
PDU#2 Press Drop In to Out ("wc)			
Scrubber Press Drop Inlet to Fan ("wc)			
Scrubber Outlet Press ("wc)			
Cooling Water Tank Temp (F)			
Scrubber Liquid Flow (GPM)			
Scrubber pH			
SVE Return Header Press ("wc)			
Concentrator Outlet Filter Press ("wc)			
Booster Blower Suction Press ("wc)			
PDU#1 Temp (F)			
PDU #2 Temp (F)			
Desorber Temp Mid (F)			
Desorber Temp Bot (F)			
Boiler Press (psig)			
Ambient Conditions (F)			
Inlet Gas FID Reading (ppm)			
Outlet Gas FID Reading (ppm)			
Power Meter Reading (kwh)			
Water Meter reading (gallons)			
Solvent Tank Level (inches)			

APPENDIX 3D

SUMMA CANISTER SAMPLING SOP

Quanterra
Environmental Services

PROCEDURE FOR OBTAINING A SUMMA CANISTER AIR SAMPLE

Two types of air samples can be collected in SUMMA canisters: grab and composite. A grab sample is simply an instantaneous collection of air obtained by opening the canister valve and allowing the evacuated canister to rapidly (30-60 seconds) come to equilibrium with the source pressure (usually ambient air). A composite sample is similar to a grab sample except that the air is metered into the canister over a length of time via a vacuum flow regulator at a rate corresponding to the total sampling time requested.

1.0 Procedure for obtaining sample

1.1 Prior to sampling, verify that the vacuum in the canister is greater than 28 inches of mercury. Some canisters come equipped with a pressure gauge while others require that a pressure gauge (supplied by Quanterra) be attached to the can.

1.2 If the vacuum observed is less than 28 inches Hg, contact the Quanterra project management and record the value on the chain-of-custody (COC) provided.

1.3 If a sampling line is going to be attached to the canister, flush the line with several volumes of sample, if possible.

1.3.1 For grab samples

Remove the valve cap from the canister and attach the stainless steel particulate filter (if supplied) to the canister valve. Attach the sample line to the particulate filter.

1.3.2 For composite samples

Remove the valve cap from the canister and attach the stainless steel particulate filter to the vacuum flow regulator (VFR). Attach the sample line to the particulate filter. Attach the VFR to the canister valve. In some cases the particulate filter will already be attached to the VFR, and some styles of SUMMA canisters will already have the VFR attached.

1.4 To begin sampling, rotate the valve counter clockwise 3-4 turns. You should be able to hear air rushing into the canister for grab samples and for short duration composite samples. Note the start time.

1.4.1 For Grab samples

Allow the canister to equilibrate for 30-60 seconds and close valve (do not overtighten, may result in leaking), remove the sample line and particulate filter from the valve, and record the final pressure. The gauge should read a small vacuum.

IMPORTANT: If the source is at positive pressure, do not allow the pressure in the canister to exceed 20 psig.

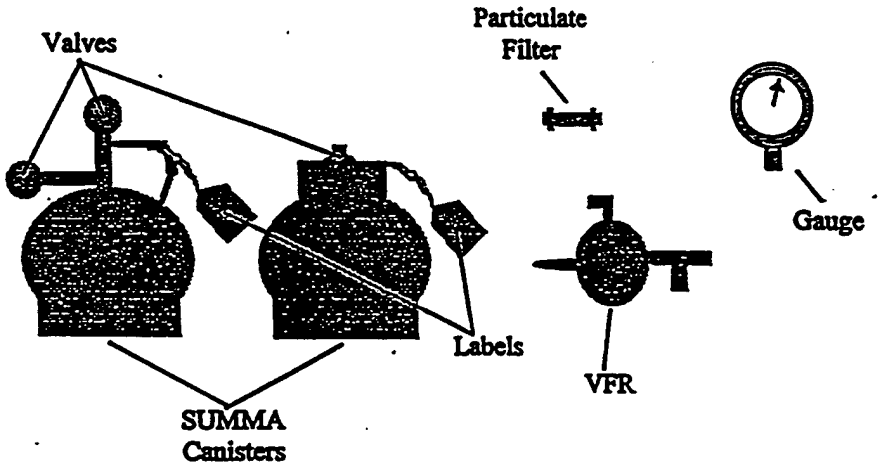
1.4.2 For Composite samples

Leave the valve open for the required time frame and occasionally monitor the vacuum of the canister. The VFR works optimally when the vacuum is greater than 5 inches of Hg. Should the vacuum in the canister go to ambient pressure before the allotted sampling time, close the valve and note the time at which the vacuum reached ambient (do not overtighten, may result in leaking). Remove the sample line from the particulate filter, and the VFR from the canister (leave the VFR on the canister if that was its initial configuration when shipped from Quanterra), and record the final pressure. The gauge should still be displaying a negative pressure.

1.5 Replace valve caps.

REMINDERS:

1. Do not overtighten valve. Overtightening can actually cause the valve to leak. Handtight is usually sufficient. Valve caps should be tight - 1/4 turn past fingertight.
2. Do not affix any labels to the canister body. Record any information on the label supplied with the can, or affix your label to the canister label.
3. You will need an adjustable wrench or 9/16" crescent wrench. The fitting on the canister, VFR, and particulate filter are 1/4" Swagelok-type fittings.



APPENDIX 3E

PRIMARY OBJECTIVE AGREEMENT

POA PART 1 ATTACHMENT

Primary Project Objective # 1 of 3 NRMRL QA ID Number: _____

(Documentation for Steps A and B is required for all project categories.)

(A) Statement of Primary Project Objectives:

To evaluate the ability of the PTI system to achieve an overall removal efficiency of 95% of total volatile organic compounds (VOCs) in the feed gas stream at a 90% confidence level.

Confidence level disclaimer statement (if applicable):

NA

EPA acceptance of POA received by PTI via email on 2/3/98 - P. DePercin

EPA Project Manager Signature

(B) Critical Measurements to Support the above Primary Project Objective:

Concentration of the VOCs in the blower gas stream at the PTI system inlet and outlet. These measurements will be determined by EPA method TO-12 (total nonmethane organic carbon).

(Documentation for Steps C, D, and E is required for all project categories except for those Category IV projects which are so fundamental in nature that decision error and risk are of little consequence.)

(C) Decision Error A:

Conclude that the PTI system achieved > 95 % DRE, when in fact, the technology achieved < 95% DRE.

Decision Error B:

Conclude that the PTI system achieved < 95 % DRE, when in fact, the technology achieved > 95% DRE.

(D) Consequence(s) for Decision Error A:

None.

Consequence(s) for Decision Error B:

None.

POA PART 1 ATTACHMENT (continued)

Primary Project Objective: # 1 of 3
NRMRL QA ID Number: _____

(E) Acceptable Risk for Decision Error A:

0.10

Acceptable Risk for Decision Error B:

Acceptable risk for decision error B has not been selected. A large amount of data from repeated test runs is required if decision error B were set at approximately the same level as that for decision error A. This cannot be done within the project budget or within the time period for which the PTI system will be available during the SITE demonstration.

****

POA PART 2 ATTACHMENT

(Documentation for Part 2 is required for Category I or Category II(SITE) projects, or whenever confidence levels can be determined pre-project.)

Confidence intervals and supporting calculations for pre-project confidence levels (primary objective only):

To determine whether the overall removal efficiency of the total VOCs from the feed gas stream meet 95% removal efficiency. The average removal efficiency for the total VOCs will be determined by collecting and analyzing matched pairs of samples from the influent and effluent stream of the PTI system. Total VOC removal efficiency for all VOCs will be based upon the data obtained using EPA Method TO-12 (TNMOC). The data will be treated as follows:

The average removal efficiency will be calculated by adding the total removal efficiencies and dividing by the total number of sample pairs. The data will be tested for normality and evaluated using the using the following equations. If the data is not normally distributed, it will be tested for other distributions, and evaluated using the appropriate equations from "Statistical Methods for Environmental Pollution Monitoring " by Richard Gilbert, Van Nostrand Reinhold Company, New York 1987.

POA PART 2 ATTACHMENT (continued)

Primary Project Objective: # 1 of 3
NRMRL QA ID Number: _____

Each matched pair of inlet and outlet concentration data (TNMOC) is denoted by X_i and Y_i respectively, $i = 1, \ldots, n_i$ where n is the number of matched pair samples. The ratio of outlet to inlet concentration, $R_i = Y_i / X_i$, and the average fraction remaining $R_{ave} = \sum R_i / n$, and s is the standard deviation of R_{ave}.

The upper confidence limit (UCL) will be calculated using the following equations:

$$UCL_{1-\alpha} = R_{ave} + t_{1-\alpha, n-1} (s/n^{1/2})$$

where the significance level (α) = 0.1, and $t_{1-\alpha, n-1}$ = Student t value at Significance level of α and n-1 degrees of freedom.

For the objective to be met (95% removal at 90% confidence level) $UCL_{1-\alpha}$ should be less than or equal to 0.05.

POA PART 1 ATTACHMENT

Primary Project Objective # 2 of 3 NRMRL QA ID Number: _____

(Documentation for Steps A and B is required for all project categories.)

(A) Statement of Primary Project Objectives:

To determine the percent removal achieved by the PTI system for critical VOCs in the feed gas stream at a 90% confidence level.

Confidence level disclaimer statement (if applicable):

NA

_____

EPA Project Manager Signature

(B) Critical Measurements to Support the above Primary Project Objective:

Concentration of the critical VOCs (defined as those compounds detected at > 1.0 ppmv by Method TO-14, at the inlet of the PTI system) in the inlet and outlet of the PTI system.

(Documentation for Steps C, D, and E is required for all project categories except for those Category IV projects which are so fundamental in nature that decision error and risk are of little consequence.)

(C) Decision Error A:

NA.

Decision Error B:

NA.

(D) Consequence(s) for Decision Error A:

None.

Consequence(s) for Decision Error B:

None.

POA PART 1 ATTACHMENT (continued)

Primary Project Objective: # 2 of 3
NRMRL QA ID Number: _____

(E) Acceptable Risk for Decision Error A:

0.10

Acceptable Risk for Decision Error B:

Acceptable risk for decision error B has not been selected. A large amount of data from repeated test runs is required if decision error B were set at approximately the same level as that for decision error A. This cannot be done within the project budget or within the time period for which the PTI system will be available during the SITE demonstration.

****

POA PART 2 ATTACHMENT

(Documentation for Part 2 is required for Category I or Category II(SITE) projects, or whenever confidence levels can be determined pre-project.)

Confidence intervals and supporting calculations for pre-project confidence levels (primary objective only):

Determination of the percent removal efficiencies for the PTI system for the critical VOCs. The average removal efficiency for each critical VOC will be determined by collecting and analyzing matched pairs of samples from the influent and effluent stream of the PTI system. The data will be treated as follows:

The average removal efficiency for each VOC will be calculated by adding the removal efficiencies for each VOC and dividing by the number of sample pairs. The data will be tested for normality and evaluated using the using the following equations. If the data is not normally distributed, it will be tested for other distributions, and evaluated using the appropriate equations from "Statistical Methods for Environmental Pollution Monitoring " by Richard Gilbert, Van Nostrand Reinhold Company, New York 1987.

POA PART 2 ATTACHMENT (continued)

Primary Project Objective: # 2 of 3
NRMRL QA ID Number: _____

Each matched pair of inlet and outlet concentration data (TO-14) is denoted by X_i and Y_i respectively, $i = 1, \ldots, n_i$ where n is the number of matched pair samples. The ratio of outlet to inlet concentration, $R_i = Y_i / X_i$, and the average fraction remaining $R_{ave} = \sum R_i / n$, and s is the standard deviation of R_{ave}.

The upper confidence limit (UCL) and lower confidence limits (LCL) will be calculated using the following equations:

$$UCL_{1-\alpha/2} = R_{ave} + t_{1-\alpha/2,\, n-1}\ (s/n^{1/2})$$

$$LCL_{1-\alpha/2} = R_{ave} - t_{1-\alpha/2,\, n-1}\ (s/n^{1/2})$$

where the significance level (α) = 0.1, and $t_{1-\alpha,\, n-1}$ = Student t value at Significance level of α and n-1 degrees of freedom.

The 90% confidence limits for percent removal will be calculated by first multiplying the UCL (and LCL) values by 100 and then subtracting from 100.

POA PART 1 ATTACHMENT

Primary Project Objective # 3 of 3 NRMRL QA ID Number: _____

(Documentation for Steps A and B is required for all project categories.)

(A) Statement of Primary Project Objectives:

Estimate treatment costs for the PTI system to achieve an overall removal efficiency of 95% for total VOCs in a 1000 scfm system.

Confidence level disclaimer statement (if applicable):

Costs will not be statistically evaluated.

_____
EPA Project Manager Signature

(B) Critical Measurements to Support the above Primary Project Objective:

Feed gas flow rates, VOC removal efficiency, caustic solution usage, reagent panel utilization, condensate volumetric accumulation measurements, waste water volumetric accumulation measurements, electrical power consumption, on-line availability, capital costs for equipment and installation, cost within battery limits, and labor hours for operation and maintenance.

(C) Decision Error A:

NA; cost will not be statistically evaluated.

Decision Error B:

NA; cost will not be statistically evaluated.

(D) Consequence(s) for Decision Error A:

NA

Consequence(s) for Decision Error B:

NA

POA PART 1 ATTACHMENT (continued)

Primary Project Objective: # 3 of 3
NRMRL QA ID Number: _____

(E) Acceptable Risk for Decision Error A:

NA

Acceptable Risk for Decision Error B:

NA

****

POA PART 2 ATTACHMENT

(Documentation for Part 2 is required for Category I or Category II(SITE) projects, or whenever confidence levels can be determined pre-project.)

Confidence intervals and supporting calculations for pre-project confidence levels (primary objective only):

NA; cost will not be statistically evaluated.

Secondary Objectives

1. To determine the percent removals achieved by the PTI system for the noncritical VOCs detected at the inlet of the PTI system. The noncritical VOCs are all those detected at the PTI system inlet at less than 1.0 ppmv, by EPA Method TO-14., these results are noncritical.

2 To determine the VOC percent removals achieved by the photolytic destruction unit (PDU) by EPA Method TO-14/scan.

3. To determine the amount of VOCs leached from the reagent panels when subjected to the EPA's Toxicity Characteristic Leaching Procedure (TCLP). All reagent panel analysis is noncritical.

4. To determine if the aqueous scrubber discharge meets McClellan AFB wastewater treatment facility waste acceptance criteria. The discharge will be analyzed using EPA Methods 8260A for VOCs, and Methods 26, 160.1, 160.2, and 1110 for Cl, total dissolved solids (TDS), total suspended solids (TSS), and corrosivity. These results are noncritical.

5. To characterize the condensate and knockout pot accumulation for disposal purposes, using EPA Methods 8260A, and 1110. These results are noncritical.

6. To determine the concentrations of hydrochloric acid, chlorine (Method.26), phosgene (TO-6), O_3, CO, and NO_X (CEM), and dioxins (Method 23) exiting the PDU and the PTI system. These results are noncritical.

7. Document observed operating problems and their resolutions

SECTION 4.0

HEALTH AND SAFETY PLAN

4.1 INTRODUCTION

This Health and Safety Plan (HSP) establishes specific guidelines and requirements for the protection of Process Technologies Incorporated (PTI) personnel, its subcontractors, and visitors during the demonstration of the PTI system. This plan has been prepared in accordance with the regulatory requirements of the Code of Federal Regulations, 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response. It addresses those activities performed during the installation, sampling, operation, and demobilization of the PTI system.

PTI, the USAF's contractor for McClellan AFB, is responsible for coordinating the installation, operation, and demobilization of the PTI system. PTI is therefor responsible for maintaining safety records pertinent to these activities and safe guarding of PTI personnel, its subcontractors and visitors involved in the PTI Demonstration or entering the test area during the demonstration. As part of this effort, PTI will ensure that all personnel comply with the procedures and guidelines specified within the HSP. PTI has the responsibility of, and will perform, health and safety monitoring specified within this HSP.

4.1.1 Scope and Applicability

The information provided in this HSP was developed for the protection of PTI personnel, its subcontractors, and visitors associated with the demonstration of the PTI process. Other personnel that are resident at the site, but not involved with PTI's demonstration, are not covered under this plan. The purpose of this HSP is to clearly define individual and corporate responsibilities, establish personal protection standards and mandatory safety procedures, and provide for contingencies that may arise while operations are being conducted at McClellan AFB, Investigation Cluster, Site IC 31. PTI disclaims responsibility for any use of this information other than the express purpose for which it is intended and assumes no liability for the use of this information for any other purpose. The evaluations and hazards and their controls reflect professional judgments subject to the accuracy and completeness of information available when the HSP was prepared.

4.1.2 Overview of Demonstration Project

Table 4-1 provides some general information about the PTI Demonstration Project at McClellan AFB. Appendix 3A and 3B are Sample Location Diagrams of the of the PTI treatment system including sampling and measuring points.

4.1.3 McClellan AFB Description

Figure 2-1 is a map of McClellan AFB and Investigation Cluster, Site IC 31. A description of McClellan AFB is provided in Section 1-2.

4.1.4 Demonstration Site Description

The demonstration site description is provided in Section 2.3.

4.2 ORGANIZATION AND RESPONSIBILITIES

The implementation of the HSP depends on an efficient organization and clearly delineated responsibilities for each person involved. The health and safety component of the PTI team for this project is organized in accordance with PTI's Health and Safety Program. As such, the PTI Health and Safety Officer (HSO) located in Boise, ID provides overall direction of the demonstration project Health and Safety Plan. The PTI Project Manager (PM) is in responsible charge at the Site for all PTI activities, health and safety or otherwise. A Site Safety Coordinator (SSC) has also been assigned as the PM's representative, who will be on-site at all times throughout the operation of the demonstration project to implement the details of this plan. The responsibilities of each person implementing the details of the HSP are included in this section.

Table 4-1. General Information for the PTI Demonstration Project

Site Name:	McClellan AFB, Investigation Cluster, Site IC 31
Site Location:	Sacramento, California
McClellan AFB Contracting Officer:	Larry Jaramillo
McClellan AFB Project Manager:	Craig Burnett
McClellan AFB Project Coordinator:	Tim Chapman
EPA NRMRL Contract:	Paul dePercin
PRC Project Manager:	Kirankumar Topudurti
EPA TIO Contact	Carlos Pachon
PTI Field Manager/ Site Safety Coordinator:	Randy Cooper
PTI Health and Safety Officer:	Michael Gray
PTI Project Manager:	John Ferrell
Purpose of Field Work:	To test and determine the effectiveness of PTI's combined Concentrator/UV photolytic destruction technology in destroying VOCs from contaminant-laden soil gas.
Approximate Duration of Proposed Field Work:	Mid February 1998 through Mid-May1998
PTI Project Information Available From:	John Ferrell, PTI (208) 385-0900
Overall Hazard Summary:	Low

PTI is responsible for all activities involved in system installation, maintenance, operation, decontamination, and demobilization, as well as all health and safety considerations related to activities that occur during these operations. All health and safety monitoring for chemical contaminants related to the PTI Demonstration will be performed by PTI. If any non-PTI personnel, subcontractors or visitors, are within the PTI demonstration area (i.e., McClellan AFB staff, its subcontractors, BDM, EPA TIO, Clean Sites, EPA NRMRL, and PRC staff involved in the demonstration), PTI will immediately notify the McClellan AFB Project Coordinator of any hazard. PTI will also make available all health and safety records of PTI operations for inspection by EPA, or Occupational Safety and Health Administration (OSHA) personnel, and will provide copies of all such records on an as requested basis. PTI will perform heat stress monitoring for the personnel covered under this plan if environmental and work conditions so dictate. Records of heat stress monitoring will be provided as mentioned above.

4.2.1 Project Manager

John Ferrell is the PTI PM. He has ultimate responsibility for PTI's field work at the site. He will coordinate on-site health and safety activities and will provide technical supervision for ongoing activities at the site. Primary responsibilities of the PM in the health and safety area include:

- Approving the HSP before the commencement of any field activities, after ensuring that it has been reviewed by an appropriately qualified individual.
- Designating an individual to serve as the SSC for this project.
- Assuring that personal protective equipment is available and properly utilized by all personnel on-site.
- Assuring that all personnel are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and are familiar with the preplanned procedures for dealing with emergencies.
- Assuring that all personnel are aware of the potential hazards associated with site operations.

- Supervising the safety performance of all personnel to ensure that safe work practices are employed.
- Correcting conditions that may result in injury to personnel or exposure to hazardous substances.

4.2.2 PTI Health and Safety Officer

Michael Gray is the PTI Health and Safety Officer (HSO) for PTI personnel involved in this demonstration project. He is responsible for the overall health and safety of all PTI workers and subcontractors on this project and coordinates with the PM for all activities related to the site operations. He will provide technical information and assistance to the PM on the hazards of waste components and the demonstration processes. He will also provide information for measuring and controlling exposure to toxic or unsafe components. He will not be on-site but has designated the PM or the SSC to carry out health and safety procedures. Additional duties and responsibilities of the PTI HSO include:

- Developing the HSP.
- Obtaining copies of applicable Federal, State, and Local regulations for the site.
- Reviewing the health and safety monitoring and incident reports submitted by the SSC for PTI personnel.
- Coordinating safety problems with the PM and SSC.
- Determining what level of protection (protective clothing and/or respirator) will be used by PTI personnel at the site under the conditions as reported by the PM or SSC.
- Maintaining a current copy of the HSP along with medical qualification correspondence and records.

4.2.3 Site Safety Coordinator.

Randy Cooper, the SSC, will be responsible for implementing the details of this HSP. As the full-time representative of the PTI HSO, the SSC will conduct routine inspections to verify compliance with this HSP and will have full authority to resolve safety and health issues arising during site operations provided that he reports his findings and decisions to the HSO in a timely fashion. The SSC will train project team members on the subjects of potential hazards and provisions for exposure monitoring, use and care of personal protective equipment, and on the specific requirements of this plan. If site conditions become unsafe, the SSC has the authority to request the PM to suspend all site activities until the unsafe conditions are corrected. The duties of the SSC, as they pertain to PTI personnel, include:

- Ensuring the proper cleaning and maintenance of protective equipment.
- Supervising the ordering of pertinent safety and emergency supplies and equipment.
- Overseeing the maintenance of records of occupational illnesses and injury (OSHA Form 102 or equivalent) and records of individual site assignment and exposure monitoring results.
- Enforcing all health and safety procedures applicable to PTI personnel while they are on-site.
- Determining the need for additional safety equipment (e.g., respirators), depending on site-specific conditions.
- Obtaining emergency medical assistance.
- Preparing and submitting incident reports.
- Conducting daily reviews of key aspects of this HSP to respond to any changes in weather, site, or operational conditions.
- Presenting initial Health and Safety training for new subcontractor employees, in the absence of the HSO.

- Ensuring that entry and access to the site (exclusion zone) is controlled.
- Ensuring that personnel (employees and visitors) allowed access inside the exclusion zone or other controlled areas have completed the required training.
- Ensuring that chemicals brought to the site and waste generated on-site by PTI personnel are properly handled, labeled, and stored.

4.2.4 Non-PTI Personnel

Non-PTI personnel involved with the PTI demonstration project include McClellan AFB staff and subcontractors, BDM, EPA TIO, Clean Sites, EPA NRMRL, and PRC staff. These personnel are responsible for:

- Completing work assignment in a safe and effective manner.
- Immediately reporting any occupational illness or injury to the PTI PM and/or SSC and the McClellan AFB Project Manager and Contracting Officer, including any potential exposure to hazardous substances for which protection was not provided.
- Wearing and maintaining personal protective equipment as specified in the HSP.
- Reporting to the SSC any hazards not documented in the HSP or inadequately controlled by procedures contained in the HSP.

4.3 TASK DESCRIPTION

Details of the PTI demonstration are presented in Section 2.4 of the WIP. The test program for this demonstration is generally composed of the following tasks:

- Site preparation/system installation - PTI and its subcontractors will install the PTI system and any peripheral equipment and perform health and safety monitoring during these activities. The McClellan AFB site contractor, URS, may provide assistance for utility connections.
- Process demonstration/sampling - PTI will be responsible for coordinating the operation and maintenance of the PTI system during the demonstration. PTI will also be responsible for sampling and of monitoring the PTI influent and effluent gas streams as well as the reagent panels used in the PTI unit, condensate (aqueous and organic phases), and caustic scrubber liquor used in the scrubber. Health and safety monitoring will be performed by PTI for chemical exposure and heat stress (as required) during demonstration activities for PTI personnel.
- Process demobilization - These activities include: disconnection; decontamination and shipment of process system components; disposal of process generated waste; and termination of support systems (electric, water, etc.). Demobilization will be the sole responsibility of PTI and its subcontractors. The McClellan AFB site contractor, URS, may provide assistance for utility disconnects.

4.4 HAZARDS ANALYSIS

4.4.1 Chemical Hazards

The soil vapor at Site IC 31 is predominantly contaminated with volatile organic compounds (VOCs). Table 4-2 lists a number of volatile contaminants found at the site which may present a hazard. MSDS's for the these contaminants are included as Appendix 4B. Information regarding the contaminant's OSHA Permissible Exposure Limits (PEL), concentrations Immediately Dangerous to Life and Health (IDLH), skin affects, vapor pressures, flash points, and estimated concentrations has also been included within this table. NIOSH Short Term Exposure Limits (STEL) are used in place of PELs when these values are more conservative. It should be noted that the air contaminant concentrations reported in Table 4-2 are those expected from the SVE off gas. Concentrations which workers may be

Table 4-2. Primary Soil Vapor Contaminants, McClellan Air Force Base, Site IC 31

Compound	OSHA PEL (ppm)	IDLH[2] (ppm)	Skin Irritant (Yes/No)	Vapor Pressure (mm Hg)	Flash Point(°F)	Estimated VOC Concentration(ppmv)[4]
Benzene	1	500	Yes	75 @ 68°F	12	3.9
Carbon tetrachloride	2[1]	200	Yes	91 @ 68°F	NA	1.0
Chlorobenzene	75	1,000	Yes	9 @ 68°F	82	.2
Chloroform	2[1]	500	Yes	160 @ 68°F	NA	3.1
1,2-Dichlorobenzene	50	200	Yes	1 @ 68°F	151	ND
1,1-Dichloroethane	100	3,000	Yes	182 @ 68°F	2	4.3
1,1-Dichloroethene	5	Un-known	Yes	500 @ 68°F	-9	3.7
1,2-Dichloroethene (total)	200	1,000	Yes	180 @ 68°F	36	2.7
Ethylbenzene	100	800	Yes	7 @ 68°F	55	.7
Freon 12 (Dichlorodifluoro-methane)	1000	15,000	No	4,332 @ 68°F	NA	ND
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	1,000	2,000	Yes	285 @ 68°F	NA	1.3
Methylene Chloride	500	2,300	Yes	350 @ 68°F	NA	1.1
Methyl ethyl ketone	200	3,000	Yes	78 @ 68°F	16	ND
Styrene	50[1]	700	Yes	5 @ 68°F	88	ND
Tetrachloroethene	25	150	Yes	14 @ 68°F	NA	1.7
Toluene	100[1]	500	Yes	21 @ 65°F	40	.7
1,1,1-Trichloroethane	350	1,000	Yes	100 @ 68°F	NA	4.2
Trichloroethene	100	1,000	Yes	58 @ 68°F	90	32.5
Freon 11 (Trichloro-fluoromethane)	1,000	10,000	Yes	677 @ 68°F	NA	ND
1,2,4-Trimethyl-benzene	25[1]	Un-known	Yes	1 @ 68°F	112	ND
Vinyl chloride	1	Un-known	Yes	2,507 @ 68°F	NA	ND
m,p-Xylenes	100	900	Yes	6 @ 68°F	81.5[3]	.7
o-Xylene	100	900	Yes	5 @ 68°F	90	.7

1 NIOSH Short Term Exposure Limit, NIOSH Pocket Guide to Chemical Hazards, U.S. Department of Health and Human Services. June 1994.

2 Immediately Dangerous to Life or Health. Represents the maximum concentration for unimpaired escape within 30 minutes.

3 Average value

4 McClellan Air Force Base Quarterly Observation Report, January through March, 1997, Investigation Cluster Site IC 31. Values are a composite of the TO14 results.

NA Not Applicable.

ND Not Detected

exposed to during the demonstration will be greater within the PTI process equipment. Appropriate chemical safety measures will be taken to ensure that the OSHA PEL exposure limits are not exceeded.

Since the PTI system will be located on a concrete pad, contaminated soil is not expected to present a hazard during the Demonstration and thus dermal contact with soil should not be an issue. Minimal water is expected to be collected by the SVE system. However, direct dermal contact with contaminated water extracted from the soil should be avoided. Splashes, leaks, and spills from the knock out drum located at the suction of the blower that provides process gas from the SVE unit to the PTI system may occur, exposing unprotected workers to contaminants. Leaks will normally not present a personnel hazard since the entire PTI system operates under a constant negative pressure. Routine collection and handling of gaseous samples may also provide an opportunity for contaminants to contact the skin, if inappropriate PPE are used.

Common symptoms of overexposure to compounds at the site are drowsiness, headache, dizziness, loss of coordination, fatigue, tremors, and irritation of the eyes, nose, throat, or skin.

Chemical hazards associated with the operation of the PTI system include 25% sodium hydroxide solution (NaOH) used to maintain the correct pH of the scrubber liquor or to prepare batches of 5% NaOH solution, flammable organic liquids collected from the operation of the condenser, and the photolytic reaction by products which can include chlorine, ozone, carbon monoxide and phosgene gas, and hydrogen chloride liquid that may accumulate if moisture condenses inside the photolytic reactors. These components normally are not present outside of the equipment or in the atmosphere of the cargo container where personnel are working since the reactors are air tight and the system is closed and operates under a negative pressure. The following provides general system descriptions and safeguards for the protection of personnel.

The SVE process gas is concentrated in the PTI supplied concentrator. The concentrator operates under a negative pressure which precludes the release of organic contaminated process gas to the atmosphere and exposing personnel. The concentrator adsorber section outlet gas, which will contain very low levels of contaminants, is conveyed back to the SVE system. The outlet gas stream leaving the desorber section of the concentrator passes through a condenser where heavy organic compounds and strip steam are condensed leaving chlorinated organic compounds to be destroyed in the PTI photolytic reactors. The condensed liquid is collected in the solvent storage tanks, via a closed piping system, which are provided with secondary containment, level indication, and overflow protection. The solvent storage tanks are also provided with pressure/vacuum relief where any out-breathing is directed to the concentrator, the photolytic reactors, or to activated carbon. The risk of dermal and respiratory exposure to personnel will occur during solvent transfer operations and will be mitigated by utilizing the proper PPE and operating procedures.

Approximately 10 gallons of 25% NaOH solution are contained in the chemical feed tank to maintain the scrubber solution pH during operations. The caustic is automatically metered into the recycle line of the scrubber pumps when the pH probe indicates a scrubber solution pH of less than 9. The chemical feed tank is located inside the cargo container and on a structure that provides easy access to the chemical feed tank and secondary containment of the caustic. It is anticipated that the chemical feed tank will need to be filled two or three times during the demonstration. At the discretion of the PTI PM, the scrubber liquor may be prepared in approximately 30 gallon batches using 25% NaOH solution and water. If the scrubber solution needs to be drained, fittings are in place in the scrubber piping system to connect drain hoses for either gravity or pumped draining of the tank. Direct dermal contact with the caustic or scrubber solution will be prevented by wearing proper PPE when handling caustic, and by the closed system design where make up caustic is automatically introduced into the scrubber solution.

The PTI photolytic reactor system is also a closed system that operates under a negative pressure to ensure that hazardous components are not released to the work environment of the cargo container. Safety features associated with the photolytic reactor system include a purge blower used to purge the reactors with air during start up, after shutdown, and prior to performing reagent panel changes, pressure/vacuum relief, and automatic by-passing should a malfunction occur. The pressure relief and automatic by-passing features allows the process gas to be directed either back to the concentrator or to activated carbon.

To ensure the safety of personnel, Draeger tube monitoring will be performed in the cargo container during start up and operation of the PTI system to ensure that there are no releases of chlorine, ozone, carbon monoxide, and phosgene gas that may be generated by the photolytic destruction process. In addition, the cargo container is continuously ventilated at a minimum of 6 air changes per hour to preclude the build up of IDLH concentrations of the above mentioned gases and a continuous chlorine gas monitor is located inside the cargo container that will both alarm and shut down the PTI photolytic reactors should chlorine gas be detected.

When the reactor reagent material is being changed, the access to the reactor internals is from outside the cargo container. Prior to opening the reactor, the reactor is purged with air for a sufficient period to ensure that no harmful gas is present. After the reactor is reassembled, it is pressure tested using compressed atmospheric air to verify an air tight seal. As a precautionary measure, when changing and sampling the reactor reagent panels, it is required that a respirator, Tyvek garment, safety glasses, hard-hat, and pair of acid resistant gloves be worn.

4.4.2 Physical Hazards

Due to the time of year that field work will be conducted (mid February to mid-May), a low potential exists for heat stress. In the event that heat stress becomes a concern, personnel will comply with PTI's heat stress program located in Section 4.5.4.

During system operation, many of the sampling ports and reactor surfaces may be hot (140 °F to 160 °F). Although the potential for severe skin damage from touching these surfaces is low, insulating gloves must be worn over chemically resistant gloves during sampling and monitoring procedures, when in close proximity to hot surfaces. In addition, steam is used to regenerate adsorbent and as a strip/carrier gas for the organic vapors. All steam and condensate lines as well as equipment operating above 140 °F will be insulated and/or clearly labeled.

Given the electric power requirements for the PTI system, the potential for electrocution must be considered. The system's electrical wiring harness is fully grounded; nonetheless, all wiring and external contacts should be avoided. To minimize the potential for electrical shock, only properly trained and authorized personnel should come in contact with the electrical harness. There is a safety switch to shut off power to the system should an emergency condition arise. Applicable OSHA standards for protection from electrical hazards (29 CFR 1926.500) shall apply.

The presence of volatile contaminants in the influent gas stream could result in pockets of concentrated flammable contaminants during processing. However, due to the constant flow of air through the system and the relatively high flow rate (400 to 500 scfm), buildup of explosive gases in the system is unlikely. The lower explosive limit (LEL) and upper explosive limit (UEL) for the primary volatile (vapor pressure >1 mm Hg at 20°C) contaminants are listed in Table 4-3. Periodic monitoring using an explosimeter will be conducted around the PTI System and ancillary equipment. Action levels for explosion are described in Subsection 4.5.4.

Flammable liquids are also collected as a result of the operation of the condenser. This material is held in storage tanks having secondary containment and a pressure/vacuum breather vent. The vent discharge will be directed through either the adsorber section of the concentrator or an activated carbon canister, and away from any spark generating equipment. The transfer equipment will be suitable to handle this material. Personnel involved with the transfer of flammable liquids will be required to have face shields, safety glasses, hard hat, Tyvek, and rubber gloves and boots.

The main component in the photolytic reactors is high intensity ultraviolet light. Although the lamp end protruding above the reactor top plate has a UV blocking boot, all personnel that will be in the vicinity of the reactors will be required to have UV blocking safety glasses to preclude eye damage.

Normal physical hazards associated with rotating equipment and noise also are present and must be addressed.

Personnel will use care when working in wet or muddy areas. In areas of extreme mud, pallets or similar devices will be used to reduce slip and fall hazards. Care will be exercised when working on, or around, equipment to minimize slip and fall hazards. Care will be exercised when working on, or around, rain-wetted scaffolding.

Table 4-3. Upper and Lower Explosive Limits

Compound	10% of LEL (%)	20% of LEL (%)	LEL (%)	UEL(%)
Benzene	0.1	0.2	1.2	7.8
Carbon Tetrachloride	NVS	NVS	NVS	NVS
Chlorobenzene	0.1	0.2	1.3	9.6
Chloroform	NVS	NVS	NVS	NVS
1,2-Dichlorobenzene	0.2	0.4	2.2	9.2
1,1-Dichloroethane	0.5	1.1	5.4	11.4
1,1-Dichloroethene	0.7	1.3	6.5	15.5
1,2-Dichloroethene (total)	0.6	1.2	5.6	12.8
Ethylbenzene	0.1	0.16	0.8	6.7
Freon 11 (Trichloro-fluoromethane)	NVS	NVS	NVS	NVS
Freon 12 (Dichlorodi-fluoromethane)	NVS	NVS	NVS	NVS
Freon 113 (1,1,2-Trichloro-1,2,2-Trifluoroethane)	NVS	NVS	NVS	NVS
Methylene Chloride	1.3	2.6	13	23
Methyl Ethyl Ketone	0.1	0.28	1.4	11.4
Styrene	0.1	0.18	0.9	6.8
Tetrachloroethene	NVS	NVS	NVS	NVS
Toluene	0.1	.22	1.1	7.1
Trichloroethene	0.8	1.6	8.0	10.5
1,1,1-Trichloroethane	0.8	1.5	7.5	15
1,2,4-Trimethylbenzene	0.1	0.18	0.9	6.4
m,p-Xylene	0.1[a]	0.22[a]	1.1[a]	7.0[a]
o-Xylene	0.1	0.18	0.9	6.7
Vinyl Chloride	0.4	0.72	3.6	33

NOTE: Based on NIOSH Pocket Guide to Chemical Hazards, June 1994.

NVS is no value stated in available health and safety literature

a Average value of m- and p-xylene

4.4.3 Biological Hazards

There is a possibility of contracting Lyme disease or Rocky Mountain Spotted Fever (RMSF). SITE personnel should check often for tick bites. If bitten, personnel should carefully remove tick with tweezers, making certain to remove pincers and being careful not to crush the tick. After removing the tick, hands should be washed and the area disinfected. If the tick resists or cannot be completely removed, medical attention should be sought immediately.

Personnel should look for symptoms of Lyme disease or RMSF. Lyme is a rash that looks like a "bulls-eye," with a small welt in the center, appearing several days to weeks after the tick bite. RMSF is a rash comprised of red spots under the skin, appearing 3 to 10 days after the tick bite. If both diseases are present, the following symptoms may be present: chills, fever, headache, fatigue, stiff neck, and bone pain. Medical attention should be sought immediately.

Venomous snakes and spiders may be found at this site. These cold-blooded animals are likely to be found in sunny locations during cold weather. During warm days they will most likely be found in shadows. All site personnel should take precautions. Long pants and boots will be worn to help protect employees from these hazards.

4.4.4 Task Hazard Analysis

Table 4-4 summarizes the job safety analysis by task for the PTI Demonstration.

Table 4-4. Job Safety Analysis by Task

Task	Associated Hazard	Hazard Control Method
Site preparation/system installation	Electrical, Mechanical Biological	Training, PPE, Observation
Baseline sampling/monitoring	Skin absorption, Inhalation, Explosion, Biological	Training, PPE, Observation, LEL/O_2 Monitoring
Process demonstration/sampling	Skin absorption, Inhalation, Electrical, Mechanical Biological, Fire	Training, PPE, Observation, Fire Extinguisher, Secondary Containment
Process demobilization	Skin absorption, Inhalation, Electrical, Mechanical Biological	Training, PPE, Observation

4.4.5 Noise

Due to the equipment and machinery to be used, noise levels are of a concern. Noise levels will be monitored by PTI throughout the demonstration. If noise levels are > 85 dBA, conversations must be shouted at a distance of 3 feet, and for those operating near the vacuum extraction units, hearing protection will be required.

4.5 HAZARD MONITORING AND CONTROL

This section defines the actions that will be taken to monitor and control the hazards identified in Subsection 4.4. The specified control measures were determined based on the level of risk perceived to be associated with a particular activity.

4.5.1 Training

All PTI personnel working at the demonstration area are required to undergo extensive training, as required by OSHA, in order that they can perform their assigned tasks in a safe and productive manner. Non-PTI personnel (subcontractors, consultants, McClellan AFB personnel, visitors, etc.) are not required to have this training. The basic training program must comply with OSHA requirements and include:

- A personal protective equipment course, including a detailed respiratory protection program
- Health and safety training
- Emergency response procedures

The basic training program requires 40 hours of classroom training covering the above topics. An 8-hour refresher course is required annually. All managers and supervisors directly responsible for hazardous waste operations will complete one 8-hour manager/supervisor training course in addition to the 40-hour training and 8-hour refresher course.

Site-specific training will also be provided that specifically addresses the site activities, procedures, monitoring, and equipment for the site operations. It will include a site and facility layout, hazards and emergency services at the site, and the standard operating procedures required at the site. The training will detail all provisions contained within this HSP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity. This training will be presented prior to commencing field activities at the site.

In addition, all PTI project personnel will be given safety briefings as necessary to ensure that personnel are aware of the requirements of this HSP and to further assist personnel in safely conducting their activities. Briefings will be provided when new operations are to be conducted, when changes in work practices are to be implemented, or if the site or environmental conditions change. Briefings will also be given to facilitate conformance with prescribed safety practices and when performance deficiencies are identified during routine daily activities or as a result of safety audits. All site-specific training and safety briefings will be documented, including date and time, name and signature of person providing briefing, content of briefing, and signature of attendees.

4.5.2 Personal Protective Equipment

Based on the potential hazards of the site and the type of work being performed, personnel at the Demonstration site will be required to wear appropriate personal protective equipment (PPE). The specific type of PPE will depend on the operational status of the PTI system, worker proximity to the test area, and monitoring data.

All personnel in the exclusion zone (see Section 4.5.5) during sampling activities will be required to wear specific work equipment, including the following:

Level "D"

Boots - Knee boot (over shoe), chemical resistant, steel toed/steel shanked, or
Boots - Over sock, chemical resistant, steel toed/steel shanked, or
Shoes - Steel toed/steel shanked
Safety Glasses - Wide vision, chemical splash (Z87)
Hard Hat
Cotton Pants (jeans)
When samples are handled, nitrile gloves will also be worn.

Level "C"

Add respirator - combination organic vapor and HEPA filter cartridge.

Level D protection is suggested for most of the situations anticipated since hazardous levels of air contaminants are not expected to be present. Level C protection will be worn if air monitoring using a photo-ionization detector (PID), with a 10.2 eV lamp, in the exclusion zone indicates concentration levels in excess of the TWA's listed in Table 4-2.

4.5.3 Medical Surveillance

As a prerequisite to work in the field during the demonstration, all PTI personnel will undergo a physical examination that includes a medical and work history with special emphasis on symptoms related to the handling of hazardous substances, and on fitness for duty. The examination should evaluate the worker's ability to wear any personal protective equipment under conditions (i.e., temperature extremes) that may be expected at the work site. Workers who are provided annual physical examinations in compliance with OSHA standard 29 Code of Federal Regulations 1910.120(F)(3) will not be required to undergo an additional physical examination prior to site entry.

4.5.4 Monitoring and Sampling Plan

PTI will be responsible for all health and safety and chemical hazard monitoring during the demonstration for the personnel covered by this plan. All employees working on-site will be informed of monitoring results. The PTI monitoring plan is summarized in Table 4-5.

Table 4-5. Monitoring Program

Type of Monitoring	Method of Monitoring	Location of Monitoring	Recommended Frequency of Monitoring	
			Week 1	Weeks 2-8
LEL	Combustible gas indicator with oxygen sensor	General area and any sources of flammable gases	Once per day	Weekly
Oxygen	Combustible gas indicator with oxygen sensor	General area and any sources of flammable or asphyxiating gases	Once per day	Weekly
Organic Vapors	Organic Vapor Analyzer	Breathing zone of workers subject to highest levels	Twice a week	Bimonthly
HCl	Hydrogen chloride detector tubes	Breathing zone of workers subject to highest levels	Twice a week	Bimonthly
Ozone	Ozone detector tubes	Inside cargo container and outside near the exhaust fan discharge	Twice a week	Bimonthly
Chlorine	Chlorine detector tubes	Same as Ozone	Twice a week	Bimonthly
Phosgene	Phosgene detector tubes	Same as Ozone	Twice a week	Bimonthly
Carbon Monoxide	CO detector tubes	Same as Ozone	Twice a week	B-monthly
Vinyl Chloride	Vinyl chloride detector tubes	Breathing zone of workers subject to highest levels	Twice a week	Bimonthly
Noise	Sound Level Meter	Work zones adjacent to noise generating equipment.	Initial Base-line Survey	As Required

Exposure to VOCs or HCl may occur during process sampling. Organic vapor readings shall be taken twice per week at the downwind side of the SVE and PTI units, and at least two locations adjacent to the units during the first week of operation. If action levels are exceeded, monitoring frequencies will be increased to daily until the source of the contamination is discovered, corrective actions are taken, and action levels are not exceeded for one day. If action levels are not exceeded during week 1, bimonthly monitoring will be performed for the rest of the

demonstration. Measurements shall be recorded in the log book. Prior to entering the exclusion zone, downwind measurements shall be taken to determine the level of respiratory protection required. Should breathing zone readings taken on-site at any time during the demonstration exceed 5 ppm over background for 5 minutes, all exclusion zone entries shall be made in Level C protection until current conditions are assessed.

An explosimeter/O_2 meter shall be used to take measurements as specified in Table 4-5 at the condenser and condensate storage tank, and at least two locations adjacent to the unit during startup and shakedown and process demonstration/sampling activities. The following action levels regarding explosivity shall be observed (action level values for specific compounds are given in Table 4-3): less than 10 percent LEL - continue; 10 to 20 percent LEL - continue with extreme caution as higher levels are encountered; and greater than 20 percent LEL - explosive hazard, withdraw from area immediately. The SSC is to return after 15 minutes to take readings for approximately 15 minutes. If the LEL has dropped to below 20 percent, activities may begin again. The following action levels regarding O_2 readings shall be observed: 19.5-21 - continue or <19.5 percent - halt operations and evacuate until readings are approximately 20 percent.

Vinyl chloride Draeger tubes will be used as part of the monitoring program to ensure that no vinyl chloride is present in the cargo container or in the area adjacent to the concentrator. The action levels are listed below:

- < 1 ppm Level D
- 1-5 ppm Level C
- > 5 ppm Stop work

Monitoring will be conducted with hydrogen chloride detector tubes at the same frequency as vinyl chloride. The action levels listed below will be followed:

- < 1 ppm Level D
- 1-5 ppm Level C
- > 5 ppm Stop work

Monitoring will be conducted with ozone detector tubes at the same frequency as vinyl chloride. The action levels listed below will be followed:

- < .1 ppm Level D
- .1-5 ppm Level C
- > 5 ppm Stop work

Monitoring will be conducted with chlorine detector tubes at the same frequency as vinyl chloride. The action levels listed below will be followed:

- < .5 ppm Level D
- .5-10 ppm Level C
- > 10 ppm Stop work

Monitoring will be conducted with carbon monoxide detector tubes at the same frequency as vinyl chloride. The action levels listed below will be followed:

- < 35 ppm Level D
- 35-1200 ppm Level C
- > 1200 ppm Stop work

Monitoring will be conducted with phosgene detector tubes at the intervals specified in Table 4-5. The action levels listed below will be followed:

- < .1 ppm Level D
- .1-2 ppm Level C
- > 2 ppm Stop work

In order to ensure that on-site personnel have proper hearing protection, PTI will use a Sound Level Meter (SLM) and monitor noise levels during startup and operations at the intervals specified in Table 4-5. The action levels listed below will be followed:

- < 85 dBA Continue operations
- 85-120 dBA Continue operations with hearing protection
- > 120 dBA Continue operations with hearing protection, audiometric monitoring, and training

Instrument calibration and maintenance requirements include the following:

- Carefully inspect each piece of monitoring equipment prior to use. All monitoring instruments shall be intrinsically safe and calibrated prior to use. Instrument calibration shall be documented in the logbook. Failure of any of the equipment listed below to work properly must be reported to the PM immediately. The Explosimeter/O_2 meter shall be calibrated according to manufacturer's instructions, and recharged at the end of each use.

- Calibrate the PID (using the 10.2 eV probe) prior to each use, according to manufacturer's instructions. Recalibrate after cleaning the lamp or when background levels drift. This instrument is sensitive to humidity and may require periodic lamp cleaning. Recharge at the end of each use.

- Shakedown and process demonstration/sampling.

Extreme caution should be exercised when sampling. The sampler should not directly breathe the slip-stream from the sampling location. Sample ports, as well as any surrounding surfaces that may be hazardous, must be clearly marked with data on temperature, pressure, chemical state, and any other pertinent information. Details of the location and frequency of sampling are given in Section 3.4 (Sampling Program) of the WIP.

A program of heat stress monitoring will be implemented by PTI for personnel engaged in strenuous physical activity whenever the outside temperature exceeds 84 °F. Both heart rate (pulse) and oral temperature will be monitored hourly at first and subsequently reduced at the discretion of the SSC. The TLV table for work/rest periods as described in Table 4-6 will be followed and will be modified if monitoring indicates that a decrease or increase in the work/rest sequence is warranted. Monitor in accordance with Table 4-5 and record levels in log book.

- Heart Rate (HR) 30 Seconds
  If not in excess of 110/minute, maintain W/R.
  If > 110/minute, shorten work period by 10 minutes.
  If > 110/minute after shortening, shorten next work period by 33%.

- Body Temperature (BT)
  If not in excess of 99.6°F (37°C), maintain W/R.
  If > 99.6°F (37°C), shorten work period by 33%.
  If > 100.6°F (38.1°C), use of semipermeable or impermeable garment not permitted.

- Both HR and BT in Excess
  If both the heart rate and body temperatures exceed guidelines, use the most conservative of the W/R regimens.

Table 4-6. Permissible Heat Exposure TLV's Wet Bulb Globe Temperatures

Work/Rest Regimen	Work Load					
	Light		Moderate		Heavy	
	°C	°F	°C	°F	°C	°F
Continuous	30.0	84.0	26.7	80.0	25.0	77.0
75W/25R	30.6	87.0	28.0	82.5	25.9	78.5
50W/50R	31.4	88.5	29.4	85.0	27.9	82.0
25W/75R	32.2	90.0	31.1	88.0	30.0	84.0

4.5.5 Site Control Measures

Standard operating procedures needed to control and minimize health and safety hazards are described in this section. To minimize the transfer of hazardous substances from contaminated to uncontaminated areas, three discrete zones will be delineated with specific decontamination procedures required for each zone. These areas are the work or "exclusion zone," the "contamination reduction zone," and the clean or "support zone." The approximate boundaries of each area are shown in Figure 4-1. PTI will be responsible for designating, cordoning off, equipping, and constructing these zones.

Exclusion Zone: This is the area where contamination would most likely occur. All personnel entering the exclusion zone must wear the prescribed protective clothing and equipment. The boundary of the exclusion zone will be clearly marked with yellow tape or signs. This exclusion zone will remain in place until the PM or SSC determines that there is no possibility of contamination. The exclusion zone is restricted to personnel who have completed the training requirements of 29 CFR 1910.120, and who have been designated to perform sampling, or have been given permission by the PTI PM. In addition, no person will enter the zone without a buddy or without being in contact with another person on the site. The exclusion zone is designated as EL-3 in Figure 4-1.

Contamination Reduction Zone: This zone occurs at the interface of the exclusion zone and support zone. This transition zone serves as a buffer to further reduce the probability of the support zone becoming contaminated. This zone provides additional assurance that the physical transfer of contaminated substances on people, equipment, or in the air is limited through a combination of decontamination, distance between zones, air dilution, zone restrictions, and work functions. Entry to, or departure from, the exclusion zone must be by way of the contaminant reduction zone. All equipment will be decontaminated at the contamination reduction zone. Personnel without proper safety equipment will not be allowed to enter this area. Personnel returning from the exclusion zone will not move from the decontamination area toward the support zone without decontaminating and/or removing their safety equipment.

Personnel in the zone must be verbally briefed regarding the hazards that are applicable at the particular time of the site visit and must meet the training and medical monitoring requirements of the state hazardous waste operations regulation. The contamination reduction zone is designated as EL-2 in Figure 4-1.

Support Zone: At the site, the HSO or SSC, in consultation with the PM, will designate a "clean" area outside the contamination reduction zone. The zone is designated as EL-1 in Figure 4-1.

- The support zone is a location where field team members may take a rest break, eat, drink, or smoke. Toilet facilities are located nearby. Clean safety equipment may be brought into the support zone. Contaminated equipment (including personal safety gear) must be removed or decontaminated before entering the support zone. Water, first aid supplies, and communications equipment (for communications with persons not at the site) will be located in the support zone.

NOTES: THE WORK ZONES ARE APPLIED DURING REAGENT PANEL CHANGE OPERATIONS TO PRECLUDE THE SPREAD OF CONTAMINATION.

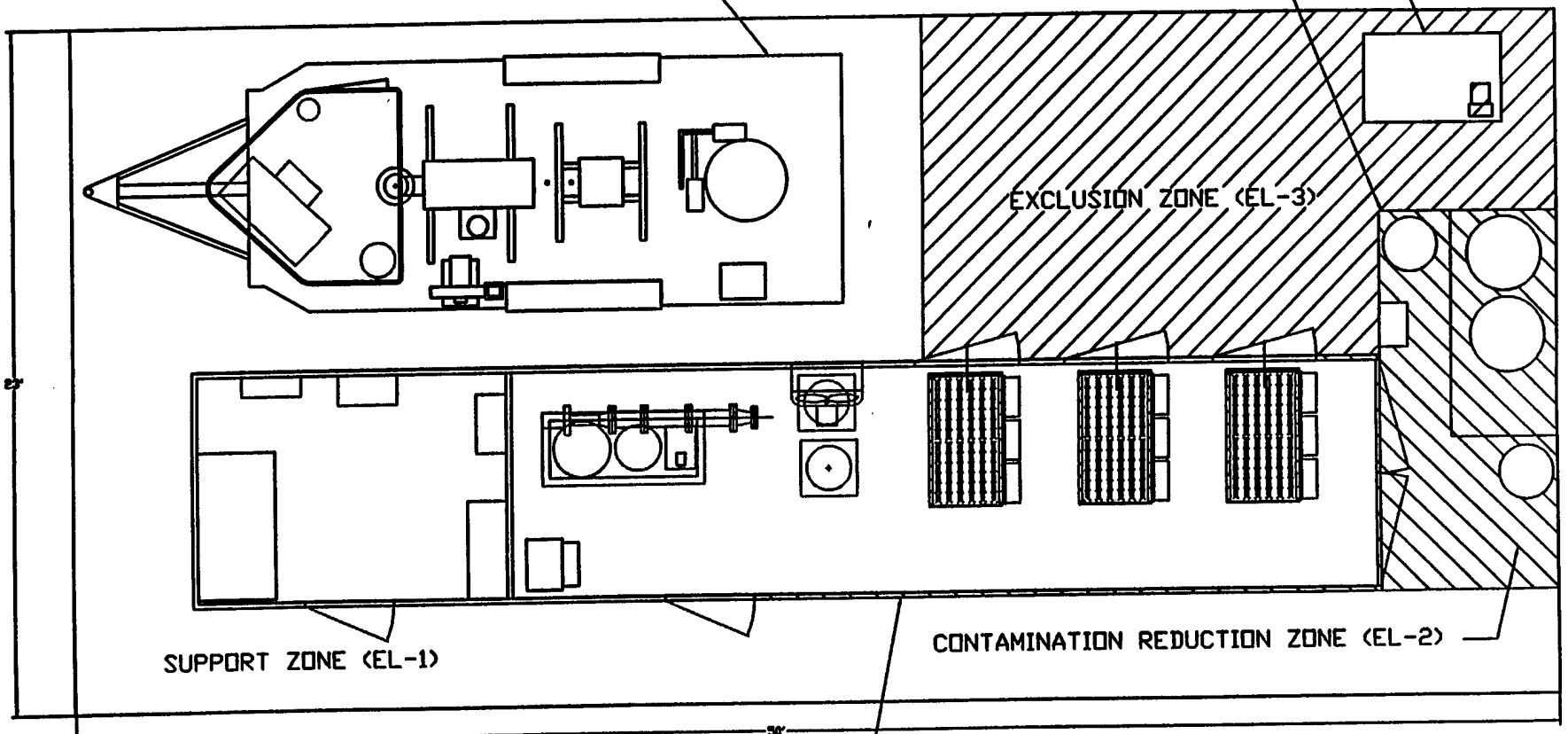


Figure 4-1. Work Zones Layout

REVISIONS			
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PROJECT: McCLELLAN AFB

PROCESS TECHNOLOGIES INCORPORATED

TITLE: PTI SYSTEM WORK ZONES LAYOUT

SIZE: D | DWG. NO.: FIGURE 4-1 | REVISION: 0

SCALE: NONE | SHEET: 1 of 1

- All personnel working at the PTI Demonstration Site must have read this Health and Safety Plan and signed a statement confirming they understand and will abide by the requirements of the plan. Visitors are not required to read the HSP but must be accompanied by PTI personnel at all times when at the PTI Demonstration Site. The following standard operating procedures shall apply to all personnel activities:

- Only properly trained and equipped personnel shall be allowed to work in potentially contaminated areas.

- The number of personnel and equipment in the exclusion zone will be kept to a minimum, consistent with safe site operations.

- Visual contact shall be maintained between pairs on-site in order to assist each other in case of emergencies.

- Workers shall not leave the exclusion zone or the contamination reduction zone until contaminated equipment and clothing have been removed and decontaminated or properly disposed. Except in emergencies, personnel shall not leave the contamination reduction zone without first removing Tyvek suits and gloves, if applicable.

- Contact with contaminated materials and surfaces shall be avoided. All personnel shall comply with contamination control measures.

- All discarded waste materials shall be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left on-site.

- PTI has developed a hazardous waste management plan which is attached as Appendix 4A. As a result, all discarded waste materials shall be handled according to the procedures developed by PTI and in such a way to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left on-site.

- All personnel entering the site shall be instructed by PTI in emergency procedures including locations of emergency equipment, procedures for site evacuation, emergency assembly areas and head count procedures, alarm systems, and site communications.

- All work paths and work areas must be kept clear of slip and trip hazards by PTI personnel. In addition, all areas presenting the potential for a fall hazard must be clearly posted and work must be routed away from the hazards by PTI. OSHA standards for walkways, stairways, etc. (29 CFR 1926.500) shall apply.

- No work by personnel will be conducted at elevations over six feet or where a fall potential exists without the use of a fall protection device.

- All electrical power must have a ground fault circuit interrupter as part of the circuit. All equipment must be suitable and approved for the class of hazard. Applicable OSHA standards for protection from electrical hazards (29 CFR 1926.500) shall apply. All electrical work must be performed by a licensed electrician. Safety precautions during maintenance and repair of the PTI unit shall include locking out of circuits being serviced, with the electrician performing the work retaining the key until the work is complete. Lockouts shall be documented in the Health and Safety/Personnel Entry logbook and will be coordinated by PTI.

- Work areas must have adequate lighting for employees to see to work and identify hazards (50-foot candles minimum.) This is typically comparable to a single 75 to 100 watt bulb. Personnel should carry flashlights in all normally dark areas for use in the event of a power failure. Applicable OSHA standards for lighting [29 CFR 1910.120 (m)] shall apply.

- When the temperature exceeds 84 °F, and personnel are wearing protective clothing, a heat stress monitoring program shall be implemented as appropriate. PTI's SSC will be responsible for implementing this program for personnel covered by this plan and for monitoring personnel for the signs and symptoms of heat stress.

- An ample supply of cool drinking water and a shaded rest area will be available at all times in the support zone. This area will be used by personnel to take regular breaks and to replenish fluids. Additional heat stress prevention measures are discussed in Section 4.5.4.

- Overhead and underground utility hazards shall be identified and or inspected by PTI prior to conducting operations. Personnel will stand clear of any such hazards.

- The number of ground personnel working around heavy equipment shall be minimized. Whenever personnel are required in the area of heavy equipment, a spotter should be assigned to each machine. This spotter will assist the operator in locating ground personnel and will direct personnel away from the machine. Workers should maintain eye contact with operators.

- Because of the potentially flammable materials at this site, the use of flame, heat or spark-producing equipment (e.g., cutting or welding torches) during process demonstration/ sampling will be avoided. If required during installation or demobilization activities, a hot work permit will be obtained from McClellan AFB.

- No work is expected to occur at night. Therefore, it is anticipated that lighting equipment for evening work will not be required.

- Field personnel shall position themselves upwind (if possible) of chemical exposure sources when conducting sampling activities, sampling collection, and equipment decontamination procedures.

4.5.6 Decontamination Plan

The following steps describe the decontamination sequence for each level of protection to be used on-site:

- Step 1 - Wash boots and outer gloves
- Step 2 - Remove boots
- Step 3 - Remove outer gloves
- Step 4 - Remove Tyvek garments
- Step 5 - Remove respirator
- Step 6 - Remove inner gloves
- Step 7 - Wash hands, face, and respirator (if applicable)

The following decontamination procedures apply if any personnel are accidentally splashed with contaminated materials:

- Proceed to decontamination area and decontaminate the personal protective equipment, assisted by a second person, if necessary.

- Use emergency eyewash when needed.

- Remove contaminated personal protective equipment and check for contaminated skin or clothing. If an individual is contaminated, remove clothing and wash the contaminated area of the body.

- Collect the waste and rinse water for disposal.
- Report to SSC to obtain medical evaluation.

Disposable coveralls, disposable sampling materials, unusable safety equipment (torn gloves, used respirator cartridges, punctured boots, etc.), and other contaminated materials, such as bags and paper towels, will be screened for organic vapor contamination using a PID or Organic Vapor Analyzer and disposed of in proper containers at the site. These items must be discarded using a procedure that will exclude reuse. Used respirator cartridges are assumed to be contaminated and will be treated as such. Used cartridges will not be discarded in a trash can or waste basket. All items will be placed in heavy plastic garbage bags. The bags will be sealed in 55-gallon drums for disposal by McClellan AFB personnel.

Items such as boots, goggles, safety helmets, and reusable overalls are considered reusable. These items are decontaminated by washing them with a detergent such as Alconox, then rinsing thoroughly. The method for washing reusable equipment is presented below:

- Wash equipment in a small plastic tub or on plastic sheeting
- Wash off items with detergent. Remove all traces of dirt or other material
- Rinse thoroughly with clean water.

Details concerning decontamination of sampling equipment used by PTI during this demonstration are presented in Section 3.4.6 of the WIP. In general, the procedure includes:

- Wash with detergent such as Alconox
- Rinse with deionized (DI) water.

Because of the sensitivity of the gas monitoring equipment (i.e., PID and LEL meters), decontamination of such equipment shall consist of wiping the exterior down with a damp disposable cloth and air dried before leaving the decontamination area.

The used water from equipment and personnel decontamination is assumed to be contaminated and thus will be managed as a hazardous waste. It will be stored in drums until a determination on the regulatory status of the water is made. The waste will then be disposed of in accordance with all applicable regulations.

Decontamination activities will be located to prevent and/or minimize cross contamination to uncontaminated personnel and equipment. Figure 4-2 is a diagram of the decontamination station (Decon Station) layout. Decon Station contents include:

- Water
- Detergent
- Wash tub
- Rinse tub
- Long handled brushes
- Waste receptacle for PPE
- Waste receptacle for municipal solid waste (not contaminated)
- Drum for wastewater
- Trays for equipment decon
- Assorted small brushes for equipment decon
- Squirt bottles for rinsing equipment
- Absorbent material or pads

NOTES:

THE DECON STATION IS REQUIRED ONLY WHEN REAGENT PANEL CHANGE OPERATIONS ARE BEING PERFORMED. THIS PRECLUDES THE SPREAD OF CONTAMINATION SHOULD THE PANELS BE CLASSIFIED HAZARDOUS.

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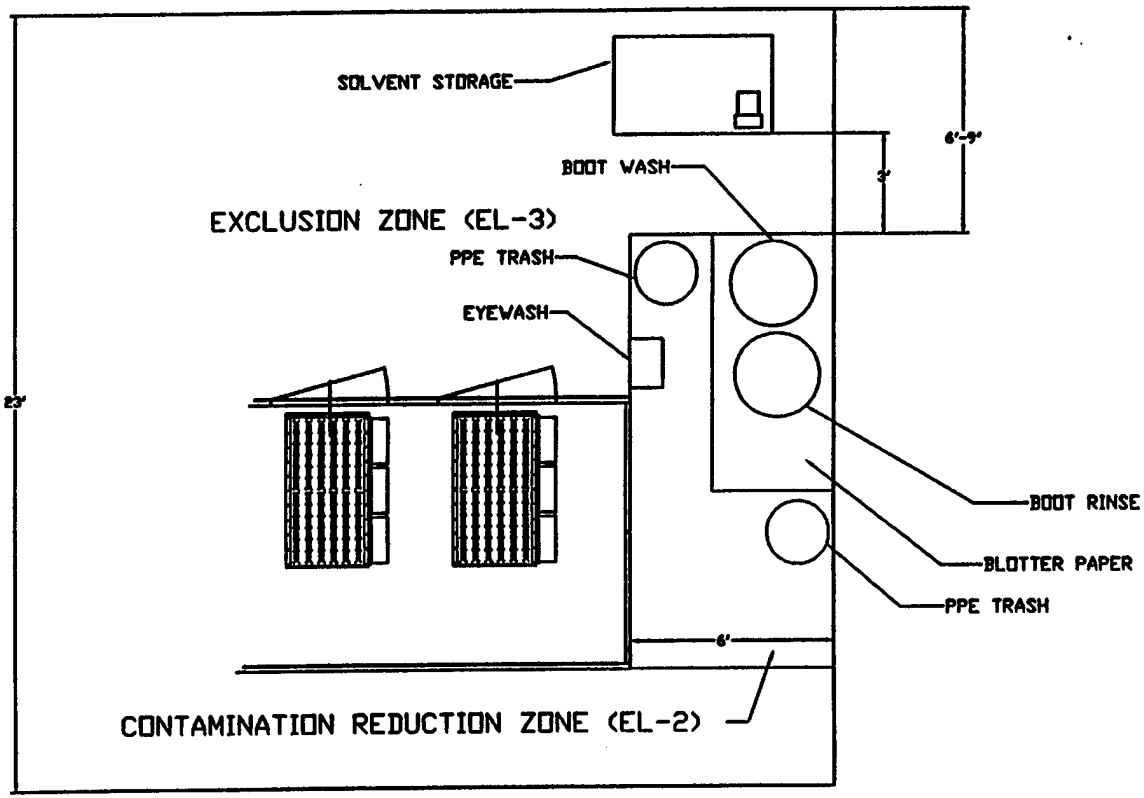

Figure 4-2. Decontamination Station Layout

CONTRACT NO. F04699-97-C-0107	PROJECT McCLELLAN AFB	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994. DECIMALS .XX ± .01 [.25] .XXX ± .005 [.13] ANGULAR ± 1° DO NOT SCALE DRAWING	PROPRIETARY DATA: THIS SECURITY AND INFORMATION CONTAINED WITHIN MAY NOT BE REPRODUCED, USED OR DISCLOSED WITHOUT THE WRITTEN PERMISSION OF PROCESS TECHNOLOGIES, INC.	PROCESS TECHNOLOGIES INCORPORATED 1725 DEVONSHIRE BLVD., SUITE B, OXNARD, CA 93030 (805) 485-8586
TREATMENT	DRAWN	TITLE PTI SYSTEM DECON STATION LAYOUT
FINISH	CHECKED	THIRD ANGLE PROJECTION
	APPROVAL	SIZE D DWG. NO. FIGURE 4-2 REVISION 0
		SCALE NONE WEIGHT SHEET 1 of 1

4.5.7 Sanitation

Potable water and/or Gatorade for personnel will be carried on-site in coolers by PTI. Personnel will have access to toilet facilities. An emergency shower and eye wash needs to be available, since corrosive chemicals are used in the PTI system.

4.5.8 Confined Space Entry Plan

No confined space entries are anticipated at this time. If required during maintenance activities, the HSP will be revised prior to performing this activity.

4.5.9 Hazardous Waste Management

Any hazardous wastes derived from existing hazardous wastes present at the site or generated as a result of this technology demonstration will be the responsibility of McClellan AFB. Contaminated disposable coveralls, disposable sampling materials, unusable safety equipment (torn gloves, used respirator cartridges, punctured boots, etc.), contaminated decon water, and other contaminated materials such as bags and paper towels which are generated by personnel during the Demonstration as well as the condensate collected from the process will be stored according to procedures specified in the Hazardous Waste Management Plan which is included as Appendix 4A.

4.5.10 Other Hazard Control Measures

Additional work limitations include:

- No eating, drinking, or smoking in the exclusion zone.
- Partial decontamination must be performed prior to rest and drink breaks. A shaded rest area must be provided when ambient temperatures exceed 84°F. Heat stress symptoms should be reviewed prior to work on-site.
- No facial hair that would interfere with respirator fit shall be allowed. An exception applies for the use of a full head-cover with forced-air breathing apparatus for emergency evacuation purposes only.
- Use the "Buddy System" at all times in the exclusion zone.

4.5.11 Enforcement of the Site-Specific Health and Safety Plan

Formal inspections to ensure that personnel associated with the PTI demonstration are complying with the HSP will be conducted on a periodic basis, and informal inspections may be conducted at any time by the SSC. The McClellan AFB Project Coordinator will work with PTI to ensure all deficiencies are corrected immediately and documented for the project record.

Ineffective procedures will be identified and corrected. If employees are consistently not following given procedures, the reason will be determined through close observation and interviews with non-compliant individuals. Changes to the procedure will be implemented if a specific deficiency in the procedure is identified.

4.6 EMERGENCY RESPONSE PLAN

An emergency is defined as an accident, illness, explosion, hazardous situation at the site, or intentional acts of harm. Although effective implementation of the HSP can minimize the probability of an emergency, an emergency situation cannot be totally prevented. Hence, the following items will be supplied by PTI and located during the site orientation:

- First aid kit
- Eye wash
- Fire extinguisher (multi-purpose)
- Site telephone (cellular)
- Telephone contact list (Table 4-7 lists emergency contacts)
- Map showing route to hospital
- Stretcher or blanket
- Supplies of clean water
- Deluge shower (when required for emergency decontamination)

The following general fire prevention measures will be implemented for field operations where fire risks are encountered:

- Open fires shall not be permitted at any time in any work area.
- If access to any portion of a building must be blocked, the SSC shall notify the PM and the McClellan AFB Project Coordinator.
- A multi-purpose fire extinguisher shall be located in the cargo container where the photolytic destruction system is located and on the trailer where the concentrator and utility systems are located.
- PTI will locate equipment powered by internal combustion engines so that the exhausts are well away from combustible materials.

Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed, and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed. First aid should be administered while awaiting an ambulance or paramedics. Minor first aid situations will be handled by on-site personnel with professional follow up care administered as necessary. In cases of major injury or sickness, medical assistance will be summoned by calling 116 if on base, and 911 if off base. The response time for on-site medical assistance is reportedly 5 to 10 minutes.

The nearest public hospital to Site IC 31 is American River Hospital. The hospital route recommended is shown in Figure 4-3. As shown, exit the site through the main gate to Watt Avenue. Turn right onto Watt Avenue and travel south to Whitney Avenue. Turn left onto Whitney Avenue and travel east to Mission Avenue. Turn left onto Mission Avenue and travel north to Engle Road. Turn right (east) onto Engle Road. Hospital is at 4747 Engle Road.

4.7 SPILL CONTAINMENT PROGRAM

The substances that could potentially be involved in a spill are water and organics collected from the condenser, cooling water used to cool the Photolytic Reactors, and caustic scrubber solution used to neutralize acid gases generated from the photolytic reaction by products. Spills could occur due to leaks in the process piping and during the handling and transportation of theses substances. PTI will be responsible for implementing appropriate spill containment procedures. PTI's Spill Prevention Program is included in the Hazardous Waste Management Plan included herein as Appendix 4A.

4.8 RECORD-KEEPING

Records include the HSP, training records, monitoring equipment calibration records, exposure monitoring results, incident and accident reports, and audit reports. Types or categories of records to be kept by PTI are listed in Table 4-8. Occurrence of any incident involving PTI personnel or subcontractors will be documented with response actions taken and the eventual disposition recorded. An incident is defined as an accident, illness, or case of exposure (suspected or actual). Should an incident occur during any of the site activities, the PTI HSO or SSC is responsible for notifying the PTI PM and submitting an accident report (Figure 4-4). Prompt notice also will be provided to the McClellan AFB Project Coordinator and Contracting Officer. Another team member may submit the report if the SSC is unable to do so. The incident report will include the following:

- Date, time, and place of occurrence
- Person(s) involved
- Type of incident
- Description of incident and action taken
- Recommendations for prevention of a similar occurrence.

The SSC will forward the incident report to the PM and PTI HSO for review and distribution. The PM and PTI HSO will investigate the incident thoroughly to develop possible solutions for preventing a recurrence of the incident

Table 4-7: Emergency Contact/Notification System

Agency	Location/Description	Telephone
Police	On Base	From Base: 112 Other: 916-643-6168
	Off Base	Emergency: 911
Ambulance	On Base	From Base: 116
	Off Base	Emergency: 911
Paramedics		Emergency: 911
Fire Department	On Base	From Base: 117 or Other: 916-643-5622
	Off Base	Emergency: 911
On-base Health Clinic	On Base: Building 541	
Hospital	On Base	From Base: 116
	Off Base: American River Hospital 4747 Engle Road Carmichael, CA 95608	916-848-2100
Poison Control Center		
EPA National Response Center		(800) 424-8802
EPA ERT Emergency		(201) 321-1660
Center for Disease Control	Emergency Response Day Night	(404) 639-0615 (404) 639-3311 (404) 639-2888
CHEMTREC		(800) 424-9300
TSCA HOTLINE		(202) 554-1404
RCRA HOTLINE		(800) 424-9346
Bureau of Alcohol, Tobacco, & Firearms		(800) 424-9555
Bureau of Explosives, A.A. Railways		(202) 835-9500
Federal Express - Hazardous Material Information		(901) 922-1666
McClellan AFB Project Coordinator	Tim Chapman	(916) 643-1739
McClellan AFB Project Manager	Craig Burnett	(916) 643-3672
PRC Project Manager	Kirankumar Topudurti	(312) 856-8742
PTI PM	John Ferrell	(208) 385-0900
PTI SSC	Randy Cooper	(208) 385-0900
PTI Health and Safety Officer	Michael Gray	(208) 385-0900
PTI Site Cellular Phone	PTI Operations	(208) 867-1768
PTI Pager	PTI Operations	1-888-961-3842

Figure 4-3: ROUTE TO AMERICAN RIVER HOSPITAL.

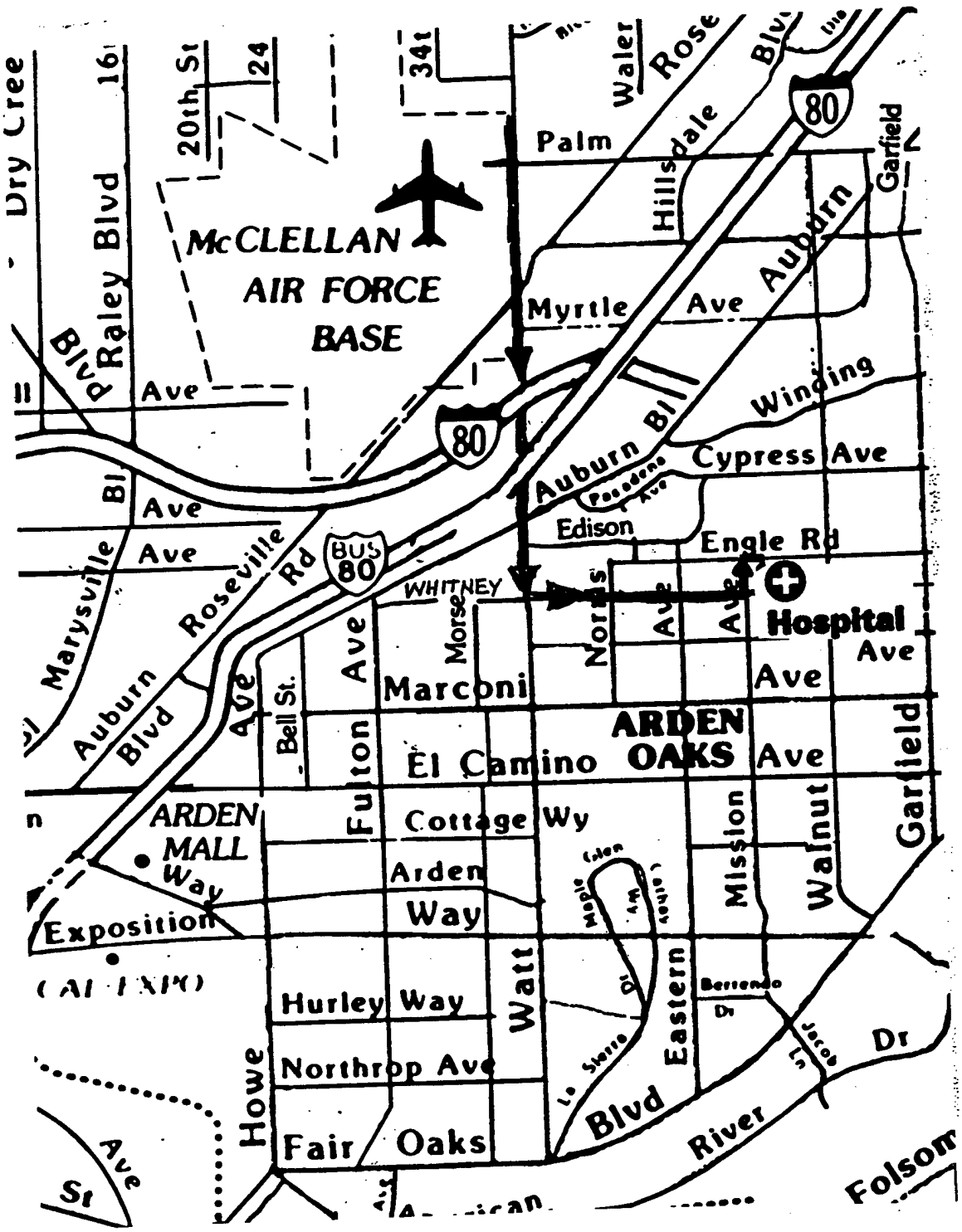

Table 4-8. Record Keeping

Health and Safety Area	On-site Record-keeping Required?	Monitoring/ Record-keeping Frequency	Location of Documentation
Hazardous Chemical			
- Area Monitoring	Yes	Daily/Weekly	Logbook
- Personnel Monitoring	No	See Table 4-5	Medical File, letter to affected employee
Oxygen Level Measurements	Yes	See Table 4-5	Logbook
Flammability Measurements (%LEL)	Yes	See Table 4-5	Logbook
Instrument Calibration	Yes	Prior to Use	Logbook
Electrical			
- Lockout/Tagout Records	Yes	As Needed	Logbook
Temperature Extremes			
- Wet Bulb Globe Temperature	Yes	As Needed	Logbook
- Daily Temperature	Yes	Daily	Logbook
Noise			
- General Area Measurements	No	See Table 4-5	Logbook
- Personnel Exposure Samples	No	Activity Specific	Medical file, letter to employee
Illumination			
- Area Foot-Candle Measurement	No	As Needed	Logbook
Personnel Medical Monitoring	No	Per Requirement	Medical file, letter to employee
Safety/Emergency Response			
- OSHA 200 Log	Yes	As Needed	Logbook
- Accident/Incident Reports	Yes	As Needed	Logbook & Separate Records
Personal Protective Equipment			
Clothing	Yes	Daily	Logbook if Defective
Respirators	Yes	Daily	Logbook if Defective
Gloves	Yes	Daily	Logbook if Defective
Boots	Yes	Daily	Logbook if Defective
Training of Employees	Yes	Annually	Site Office

Figure 4-4. Example of Incident Report.

PTI INCIDENT REPORT

DATE _____

Project: _____ Project No. _____

Injured Employee: _____ Employee No. _____
Date Injured: _____ Time: _____ a.m. p.m.

Date Reported: _____ Last Day Worked: _____

Did Employee Return to Work? _____ Date Returned: _____

Where Accident Occurred: _____

Witnesses: _____

Work Performed When Injured: _____

_____

Kind and Extent of Injury: _____

_____

Name and Address of Doctor/Hospital: _____

_____

_____

Description of Accident: _____

_____

_____

Was There Equipment Malfunction? ___ Yes ___ No

Describe Damage to Equipment or Property: _____

_____

_____

Unsafe Condition or Act Causing Accident: _____

_____

_____

Figure 4-4. Example of Incident Report (continued).

Action Taken to Prevent Similar Accident: _____

_____

Additional Recommendations or Action: _____

_____

_____

__ Photo(s) Taken (number of photos taken)

Field Supervisor: _____

APPENDIX 4A

HAZARDOUS WASTE MANAGEMENT PLAN

APPENDIX 4A
HAZARDOUS WASTE MANAGEMENT PLAN

1.0 Policy And Responsibilities

This plan has been developed to identify responsibilities and provide Process Technologies Incorporated (PTI) with procedures to manage hazardous wastes in compliance with McClellan Air Force Base, State, and Federal regulations. This plan also applies to all subcontractor personnel that may work for PTI as part of PTI Demonstration project.

1.1 Waste Management Responsibilities

The specific procedures in this plan are applicable for any hazardous waste generated exclusively by PTI (and PTI's subcontractors) as a result of work at McClellan AFB. McClellan AFB will assume management responsibility for any hazardous wastes derived from existing hazardous wastes present at the site. If PTI (or PTI's subcontractors) generates hazardous wastes that are derived from existing hazardous wastes present at the site, they will be responsible only for placing these wastes in appropriate containers as they are generated.

Most of the hazardous materials generated from the PTI Demonstration will be collected from the condenser where a mixture of water and heavy organic contaminants are condensed from the SVE process gas stream prior to entering the photolytic reactors. Granular activated carbon (GAC) is also used to remove hazardous contaminants in the process gas stream in the event of an emergency by pass of the concentrator or in the scrubber liquor when the scrubber tank is drained. There may also be a small level of contaminants in the solid reagent panels within the reactors, normally not sufficient to classify the reagent panels as a hazardous material. Any of these wastes that are hazardous are expected to be so because they are derived from existing hazardous wastes present at the site. PTI personnel will coordinate closely with McClellan AFB staff to assure that these materials are managed in accordance with applicable requirements. However, the storage, treatment, and/or disposal of any hazardous wastes derived from existing hazardous wastes present at the site will be the responsibility of McClellan AFB.

1.2 Personnel Responsibilities

The PTI Project Manager for the PTI Demonstration Project is John Ferrell. He is responsible for oversight of all hazardous waste management activities during this project. As such, the PTI Project Manager is responsible for reviewing all waste management procedures that are implemented and identify any problems or discrepancies with the implementation of the waste management procedures. In the event problems or discrepancies are found, procedural changes will be identified and presented to the project team including PTI subcontractors. The PTI Field Manager, Randy Cooper, is responsible for implementing the waste management procedures in compliance with McClellan AFB, State, and Federal regulations.

2.0 General Procedures

No hazardous waste will be imported onto the McClellan AFB by PTI. Some of the materials, instruments, and equipment that will be used on the project may contain substances listed in 40CFR261.33. These substances, if discarded, spilled, or spent, are considered hazardous wastes. If any materials containing such hazardous substances are spilled or otherwise handled in a manner which generates a hazardous waste, the hazardous waste management procedures described in this plan will be followed.

The expected types of materials that may be brought on McClellan AFB by PTI include 25% sodium hydroxide solution (used in the scrubber), calibration gases, solutions used during gas sampling activities, and equipment that may contain small quantities of hazardous substances.

2.1 Base Notification

Prior to importing any materials on to McClellan AFB which contain hazardous substances as defined above, the McClellan AFB Project Coordinator will be notified. At the direction of the McClellan AFB Project Coordinator, additional personnel at the Base (e.g., Fire Department or others) will also be notified regarding the nature of the material and the quantity, location, and method of storage.

In the event that any hazardous waste is generated, the McClellan AFB Project Coordinator and Environmental Manager will be notified as soon as practical following implementation of any emergency response/containment measures required.

2.2 Implementation

If any hazardous substance is spilled or otherwise becomes a waste that is the responsibility of PTI on this project, the following procedures shall be implemented:

1. Prior to generating the waste, it will be determined whether the waste will be hazardous, nonhazardous, or potentially hazardous. This determination will be based on the best available existing information and criteria contained in Section 3.0.

2. If a spill has occurred, implement the spill prevention, control, and countermeasure (SPCC) plans described in the McClellan AFB SPCC.

3. Notify the McClellan AFB Project Coordinator and Environmental Manager of the event that generated the waste.

4. Containerize the waste material in appropriate containers and label all containers with appropriate labels describing the drum/container ID number, contractors name, date that waste materials were placed in the container, expected waste material contents in the container, point of contact, and general site location. If, based on the determination described in Step 1), the waste is known to be hazardous, complete and attach a "Hazardous Waste" label. If sampling and analysis data are needed to determine whether the waste is hazardous, attach "Pending Analysis" label.

5. Conduct a review of operating procedures to determine the cause of the waste generation and evaluate operational/equipment/process changes which will eliminate or reduce the potential for further waste generation.

6. Upon receipt of required analytical data, determine whether the waste is hazardous as described in Section 3.0. Evaluate the regulatory requirements for proper packing, labeling, storage, transportation, and disposal of any hazardous waste.

7. After concurrence with the McClellan AFB Project Coordinator and Project Manager, arrange for proper disposal of the waste material in compliance with applicable regulations.

3.0 Identification Of Wastes

If a waste material is generated, it must be evaluated to determine if it is a hazardous waste. The criteria used for this evaluation are described in 40CFR261 and involve two methods. First, if the waste is a listed waste, it is a hazardous waste and subject to RCRA regulations. Second, if a waste possesses one or more of selected hazardous characteristics (corrosivity, ignitability, reactivity, or toxicity as defined in 40CFR261.1) a waste may be classified as hazardous and subject to RCRA regulations. These two waste determination methods include the following:

3.1 Listed Wastes

Certain classes of hazardous wastes are considered listed wastes because they exhibit the characteristics of hazardous wastes or contain toxic constituents. The listed wastes include the following:

1. **F-List**. 40CFR261.31 lists hazardous wastes from nonspecific sources, primarily generic manufacturing and processing wastes such as spent solvents. No F-List wastes are expected to be generated exclusively by PTI during this project.

2. **K-List**. 40CFR261.32 lists hazardous wastes from specific sources, primarily wood preserving, petroleum refining, and chemical manufacturing. No K-List wastes will be generated exclusively by PTI during this project.

3. **P-List**. 40CFR261.33(e) lists acutely hazardous commercial chemical products that are classified as hazardous wastes if discarded or spilled. No P-List products are expected to be used by PTI during this project.

4. **U-List**. 40CFR261.33(f) lists hazardous commercial chemical products that are classified as hazardous wastes if discarded or spilled. No U-List chemical products are expected to be used by PTI during this project.

Wastes that are mixed with or derived from listed hazardous wastes are also generally considered to be hazardous wastes. The definition of these "mixture" and "derived from" wastes is included in 40CFR261.3. These types of hazardous wastes are expected to be generated during this project. For example, the condensate collected may contain TCE and the source of the TCE is a spent solvent that was spilled or disposed of at McClellan AFB, then the condensate will be listed hazardous waste. Similarly, spent GAC from treating off gas may be a listed waste if it contains TCE that was spilled or disposed of as a spent solvent, if PTI was not responsible for generating the original listed waste (in this case the spent solvent) then PTI will not have management responsibility for the "mixture" or "derived from" waste.

3.2 Characteristic Wastes

If a waste is not a listed hazardous waste, it may be a hazardous waste if it exhibits the characteristics of hazardous wastes. The characteristics of hazardous wastes are as follows.

1. **Ignitability**. 40CFR261.21 describes the characteristic of ignitability. Ignitable characteristic wastes include liquids with low flash points (<60°C) and ignitable compressed gases and oxidizers, as identified by Department of Transportation (49CFR173). No ignitable hazardous wastes are expected to be generated exclusively by PTI during this project.

2. **Corrosivity.** 40CFR261.22 describes the characteristics of corrosivity. Corrosive wastes include aqueous wastes with pH less than 2 or greater than 12.5. Sodium hydroxide solution is used to scrub acid from the process gas exiting the photolytic reactors. At the time this

solution is discharged from the system, the pH will be less than 9. Any spills of the 25% NaOH solution will be neutralized to reduce the pH to below 12.5. The spent reagent panels typically have a pH of approximately 4 to 5. As a result, no corrosive hazardous wastes are expected to be generated exclusively by PTI during this project.

3. **Reactivity**. 40CFR261.23 describes the characteristics of reactive wastes. Reactive hazardous wastes are materials that are unstable, generate toxic gases, or are capable of detonation at standard temperature and pressure. No reactive hazardous wastes are expected to be generated exclusively by PTI during this project.

4. **Toxicity**. 40CFR261.24 describes the characteristic of toxicity. Toxic characteristic wastes are those that leach toxic constituents at concentrations above regulatory levels when tested using the Toxicity Characteristic Leaching Procedure (TCLP). The spent reagent panels may contain minute levels of organic compounds that were not destroyed. Previous tests at McClellan AFB have demonstrated that the spent reagent panels pass TCLP testing. The spent reagent panels used for this demonstration will also be tested per the TCLP protocol and are also expected to pass. As a result, no toxic hazardous wastes are expected to be generated exclusively by PTI during this project.

4.0 Hazardous Waste Management

If a waste is determined to be a listed or characteristic hazardous waste, the following procedures must be implemented.

4.1 Storage

The hazardous waste must be stored in accordance with RCRA requirements including appropriate storage containers, labeling, and inspection. Because the demonstration site location does not have an appropriately designed 90 day storage area, the waste will be transferred to an appropriate designated storage area at McClellan AFB.

4.2 Transport and Treatment/Disposal

The hazardous waste will be delivered to an appropriate Treatment Storage and Disposal Facility (TSDF) for ultimate treatment or disposal. Transport of hazardous waste will be accompanied by a hazardous waste manifest and applicable documentation.

4.3 Record Keeping

As the generator of the hazardous waste (when applicable to PTI), the PTI Project Manager shall compile and keep records demonstrating compliance with applicable requirements for handling, storing, permitting, record keeping, reporting, and transporting of the hazardous waste.

5.0 Spill Control And Contingency Plan

Performing any activities at the demonstration site involving or related to the handling of hazardous materials requires an awareness of chemical and emergency response actions that need to be implemented in the event of an accident, injury, spill, or chemical incident. The Health and Safety Plan developed for this project provides a description of procedures and emergency medical care provisions that will be implemented during the project. This includes general safety precautions, monitoring procedures,

emergency contacts, and route to access emergency medical care. In addition, PTI and its subcontractors working with hazardous materials will have spill clean up kits appropriate for the materials being handled.

The field procedures specified in the McClellan AFB SPCC will be followed in the event of an incident or emergency. This includes containment of any emergency where possible (e.g., use of fire extinguishers, containment, etc.) and notification of McClellan AFB emergency response teams. The necessary contacts and phone numbers for such response are included in the project Health and Safety Plan.

In the event that a spill or emergency incident occurs, the steps/procedures leading up to the event will be reviewed as a follow-up process. The follow-up process will be used to identify operational/equipment changes necessary to prevent the recurrence of the event. The PTI Project Manager will be responsible for implementation of the necessary operational/equipment changes.

5.1 Sources of Information

Numerous sources exist to provide information on various aspects of the handling of hazardous waste. The following is a partial list of organizations with telephone numbers that may be used.

Chemical Manufacturers Association (CHEMTREC)
(800) 262-8200 (emergency)
(801) 424-9300 (non-emergency)

RCRA Hotline
(800) 424-3452

Department of Transportation
(202) 366-7378

SARA Hotline
(800) 535-0202

NIOSH Hotline
(800) 356-7674

American Chemical Society
(800) 227-5588

APPENDIX 4B

MSDS SHEETS

SECTION 1

SITE RELATED MSDS SHEETS

SECTION 2

PTI DEMONSTRATION SYSTEM RELATED MSDS SHEETS

APPENDIX B

SECTION 1 SITE RELATED MSDS SHEETS

1.0 Benzene

1.1 Carbon Tetrachloride

1.2 Chlorobenzene

1.3 Chloroform

1.4 1,2-Dichlorobenzene

1.5 1,1-Dichloroethane

1.6 1,1-Dichloroethene

1.7 1,2-Dichloroethene (total)

1.8 Ethylbenzene

1.9 Freon 11 (Trichlorofluoromethane)

1.10 Freon 12 (Dichlorodifluoromethane)

1.11 Freon 113 (1,1,2-Trichloro-1,2,2-Trifluoroethane)

1.12 Methylene Chloride

1.13 Methyl Ehtyl Ketone

1.14 Styrene

1.15 Tetrachloroethene

1.16 Toluene

1.17 Trichloroethene

1.18 1,1,1-Trichloroethane

1.19 1,2,4-Trimethylbenzene

1.20 Xylene

1.21 Vinyl Chloride

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ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

ATTN: SAFETY DIRECTOR

EMERGENCY PHONE 1-414-273-3850

DATE 08/22/96
CUST#: 942742
PO#:

SEAN DILLON
PROCESS TECHNOLOGY INC
5383 W FRANKLIN RD
BOISE ID 83705-1112

M A T E R I A L S A F E T Y D A T A S H E E T

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

CATALOG #: 27070-9
NAME: BENZENE, 99.9+%, HPLC GRADE

SECTION 2. - - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #: 71-43-2
MF: C6H6
EC NO: 200-753-7

SYNONYMS
(6)ANNULENE * BENZEEN (DUTCH) * BENZEN (POLISH) * BENZENE (ACGIH:DOT: OSHA) * BENZIN (OBS.) * BENZINE (OBS.) * BENZOL (OSHA) * BENZOLE * BENZOLENE * BENZOLO (ITALIAN) * BICARBURET OF HYDROGEN * CARBON OIL * COAL NAPHTHA * CYCLOHEXATRIENE * FENZEN (CZECH) * MINERAL NAPHTHA * NCI-C55276 * PHENE * PHENYL HYDRIDE * PYROBENZOL * PYROBENZOLE * RCRA WASTE NUMBER U019 * UN1114 (DOT) *

SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

LABEL PRECAUTIONARY STATEMENTS
FLAMMABLE (USA)
HIGHLY FLAMMABLE (EU)
TOXIC
MAY CAUSE HERITABLE GENETIC DAMAGE.
DANGER OF SERIOUS DAMAGE TO HEALTH BY PROLONGED EXPOSURE.
TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
RISK OF SERIOUS DAMAGE TO EYES.
DANGER:
CONTAINS BENZENE.
CANCER HAZARD.
CAUSES IRRITATION.
TARGET ORGAN(S):
BLOOD
BONE MARROW
EYES
KEEP AWAY FROM SOURCES OF IGNITION - NO SMOKING.
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
TAKE OFF IMMEDIATELY ALL CONTAMINATED CLOTHING.

SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED

CONTINUED ON NEXT PAGE

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SIGMA Aldrich Fluka SUPELCO SIGMA DIAGNOSTICS SAF SIGMA-ALDRICH RESEARCH

CATALOG #: 27070-9
NAME: BENZENE, 99.9+%, HPLC GRADE

CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
REMOVE AND WASH CONTAMINATED CLOTHING PROMPTLY.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.
WATER MAY BE EFFECTIVE FOR COOLING, BUT MAY NOT EFFECT EXTINGUISHMENT.

SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS
DANGER:
EXTREMELY FLAMMABLE.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH AN ACTIVATED CARBON ADSORBENT, TAKE UP AND PLACE IN CLOSED CONTAINERS. TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -

REFER TO SECTION 8.

SECTION 8. - - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
USE NONSPARKING TOOLS.
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.

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SIGMA-ALDRICH

ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

CUST#: 942742

CATALOG #: 27070-9
NAME: BENZENE, 99.9+%, HPLC GRADE

WASH THOROUGHLY AFTER HANDLING.
CARCINOGEN.
TOXIC.
SEVERE EYE IRRITANT.
MUTAGEN.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - - -

APPEARANCE AND ODOR
COLORLESS LIQUID

PHYSICAL PROPERTIES
BOILING POINT: 80 C
MELTING POINT: 5.5 C
FLASHPOINT 12 F - 11C

EXPLOSION LIMITS IN AIR:
UPPER 8%
LOWER 1.3%
AUTOIGNITION TEMPERATURE: 1043 F 561C
VAPOR PRESSURE: 74.6MM 20 C 166MM 37.7 C
SPECIFIC GRAVITY: 0.874
VAPOR DENSITY: 2.77

SECTION 10. - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -

INCOMPATIBILITIES
OXIDIZING AGENTS

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

SECTION 11. - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS
DANGER: CONTAINS BENZENE, CANCER HAZARD.
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
CAUSES SKIN IRRITATION.
CAUSES SEVERE EYE IRRITATION.
EXPOSURE CAN CAUSE:
NAUSEA, DIZZINESS AND HEADACHE
NARCOTIC EFFECT

CHRONIC EFFECTS
CARCINOGEN.

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CATALOG #: 27070-9
NAME: BENZENE, 99.9+%, HPLC GRADE

MAY ALTER GENETIC MATERIAL.
BLOOD EFFECTS
TARGET ORGAN(S):
BLOOD
BONE MARROW
EYES

ADDITIONAL INFORMATION
INHALATION OF HIGH CONCENTRATIONS OF BENZENE MAY HAVE AN INITIAL STIMULATORY EFFECT ON THE CENTRAL NERVOUS SYSTEM CHARACTERIZED BY EXHILARATION, NERVOUS EXCITATION AND/OR GIDDINESS, DEPRESSION, DROWSINESS, OR FATIGUE. THE VICTIM MAY EXPERIENCE TIGHTNESS IN THE CHEST, BREATHLESSNESS AND LOSS OF CONSCIOUSNESS. TREMORS, CONVULSIONS AND DEATH DUE TO RESPIRATORY PARALYSIS OR CIRCULATORY COLLAPSE CAN OCCUR IN A FEW MINUTES TO SEVERAL HOURS FOLLOWING SEVERE EXPOSURES. ASPIRATION OF SMALL AMOUNTS OF LIQUID IMMEDIATELY CAUSES PULMONARY EDEMA AND HEMORRHAGE OF PULMONARY TISSUE. DIRECT SKIN CONTACT MAY CAUSE ERYTHEMA. REPEATED OR PROLONGED SKIN CONTACT MAY RESULT IN DRYING, SCALING DERMATITIS OR DEVELOPMENT OF SECONDARY SKIN INFECTIONS. THE CHIEF TARGET ORGAN IS THE HEMATOPOIETIC SYSTEM. BLEEDING FROM THE NOSE, GUMS OR MUCOUS MEMBRANES AND THE DEVELOPMENT OF PURPURIC SPOTS, PANCYTOPENIA, LEUKOPENIA, THROMBOCYTOPENIA, APLASTIC ANEMIA AND LEUKEMIA MAY OCCUR AS THE CONDITION PROGRESSES. THE BONE MARROW MAY APPEAR NORMAL, APLASTIC OR HYPERPLASTIC, AND MAY NOT CORRELATE WITH PERIPHERAL BLOOD-FORMING TISSUES. THE ONSET OF EFFECTS OF PROLONGED BENZENE EXPOSURE MAY BE DELAYED FOR MANY MONTHS OR YEARS AFTER THE ACTUAL EXPOSURE HAS CEASED.

RTECS #: CY1400000
BENZENE

IRRITATION DATA

SKN-RBT 15 MG/24H OPEN MLD	AIHAAP 23,95,62
SKN-RBT 20 MG/24H MOD	85JCAE -,25,86
EYE-RBT 88 MG MOD	AMIHAB 14,387,56
EYE-RBT 2 MG/24H SEV	85JCAE -,25,86

TOXICITY DATA

IHL-HMN LCLO:2 PPH/5M	TABIA2 3,231,33
ORL-MAN LDLO:50 MG/KG	YAKUD5 22,883,80
IHL-HMN LCLO:65 MG/M3/5Y	ARGEAR 44,145,74
UNR-MAN LDLO:194 MG/KG	85DCAI 2,73,70
ORL-RAT LD50:930 MG/KG	TXAPA9 7,767,65
IHL-RAT LC50:10000 PPM/7H	28ZRAQ -,113,60
IPR-RAT LD50:2890 UG/KG	36YFAG -,302,77
ORL-MUS LD50:4700 MG/KG	HYSAAV 32(3),349,67
IHL-MUS LC50:9980 PPM	JIHTAB 25,366,43
SKN-MUS LD50:48 MG/KG	NPIRI* 1,5,74
IPR-MUS LD50:340 MG/KG	ANYAA9 243,104,75
SKN-RBT LD50:>9400 MG/KG	TXAPA9 7,559,65
SKN-GPG LD50:>9400 MG/KG	TXAPA9 7,559,65

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CUST#: 942742

CATALOG #: 27070-9
NAME: BENZENE, 99.9+%, HPLC GRADE

ORL-MAM LD50:5700 MG/KG GISAAA 39(4),86,74

TARGET ORGAN DATA
PERIPHERAL NERVE AND SENSATION (SPASTIC PARALYSIS WITH/WITHOUT SENSORY CH
PERIPHERAL NERVE AND SENSATION (FLACCID PARALYSIS WITHOUT ANESTHESIA)
SENSE ORGANS AND SPECIAL SENSES (HEMORRHAGE)
SENSE ORGANS AND SPECIAL SENSES (TUMORS)
BEHAVIORAL (SOMNOLENCE)
BEHAVIORAL (TREMOR)
BEHAVIORAL (CONVULSIONS OR EFFECT ON SEIZURE THRESHOLD)
BEHAVIORAL (IRRITABILITY)
LUNGS, THORAX OR RESPIRATION (CHRONIC PULMONARY EDEMA OR CONGESTION)
LUNGS, THORAX OR RESPIRATION (TUMORS)
GASTROINTESTINAL (GASTRITIS)
GASTROINTESTINAL (NAUSEA OR VOMITING)
LIVER (OTHER CHANGES)
BLOOD (CHANGES IN CELL COUNT)
BLOOD (OTHER CHANGES)
BLOOD (LEUKEMIA)
BLOOD (LYMPHOMA INCLUDING HODGKIN'S DISEASE)
SKIN AND APPENDAGES (AFTER SYSTEMIC EXPOSURE: DERMATITIS, OTHER)
EFFECTS ON FERTILITY (PRE-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (ABORTION)
EFFECTS ON EMBRYO OR FETUS (EXTRA EMBRYONIC STRUCTURES)
EFFECTS ON EMBRYO OR FETUS (CYTOLOGICAL CHANGES)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
EFFECTS ON EMBRYO OR FETUS (FETAL DEATH)
EFFECTS ON EMBRYO OR FETUS (OTHER EFFECTS TO EMBYRO OR FETUS)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (BLOOD AND LYMPHATIC SYSTEMS)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (HEPATOBILIARY SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (OTHER DEVELOPMENTAL ABNORMALITIES)
EFFECTS ON NEWBORN (BIOCHEMICAL AND METABOLIC)
NUTRITIONAL AND GROSS METABOLIC (BODY TEMPERATURE INCREASE)
TUMORIGENIC (CARCINOGENIC BY RTECS CRITERIA)
TUMORIGENIC (NEOPLASTIC BY RTECS CRITERIA)
TUMORIGENIC (EQUIVOCAL TUMORIGENIC AGENT BY RTECS CRITERIA)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - - -

BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.

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CUST#: 942742

CATALOG #: 27070-9
NAME: BENZENE, 99.9+%, HPLC GRADE

OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - REGULATORY INFORMATION - - - - - - - - -

EUROPEAN INFORMATION
EC INDEX NO: 601-020-00-8
HIGHLY FLAMMABLE
TOXIC
R 11
HIGHLY FLAMMABLE.
R 45
MAY CAUSE CANCER.
R 48/23/24/25
TOXIC: DANGER OF SERIOUS DAMAGE TO HEALTH BY PROLONGED EXPOSURE THROUGH INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
S 45
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
S 53
AVOID EXPOSURE - OBTAIN SPECIAL INSTRUCTIONS BEFORE USE.

TLV AND SOURCE
FOR BENZENE:
ACGIH TLV-TWA: 10 PPM.
OSHA PEL: 8H TWA 1 PPM; STEL: 5 PPM (15 MIN.).

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK
ACGIH TLV-SUSPECTED HUMAN CARCINOGEN 85INA8 6,108,91
ACGIH TLV-TWA 10 PPM 85INA8 6,108,91
IARC CANCER REVIEW:HUMAN LIMITED EVIDENCE IMEMDT 7,203,74
IARC CANCER REVIEW:ANIMAL SUFFICIENT EVIDENCE IMSUDL 7,120,87
IARC CANCER REVIEW:ANIMAL LIMITED EVIDENCE IMEMDT 29,93,82
IARC CANCER REVIEW:HUMAN SUFFICIENT EVIDENCE IMEMDT 29,93,82
IARC CANCER REVIEW:ANIMAL INADEQUATE EVIDENCE IMEMDT 7,203,74
IARC CANCER REVIEW:GROUP 1 IMSUDL 7,120,87
MSHA STANDARD:AIR-CL 25 PPM (80 MG/M3) (SKIN)
DTLVS* 3,22,71
OSHA PEL (CONSTRUC):SEE CFR 29,1926.1128
CFRGBR 29,1926.55,94
OSHA PEL (FED CONT):CL 25 PPM (80 MG/M3) (SKIN)
CFRGBR 41,50-204.50,94
OSHA-CANCER HAZARD
FEREAC 52,34460,87
OEL-AUSTRALIA:TWA 5 PPM (16 MG/M3);CARCINOGEN JAN93
OEL-BELGIUM:TWA 10 PPM (32 MG/M3);CARCINOGEN JAN93

CONTINUED ON NEXT PAGE

CATALOG #: 27070-9
NAME: BENZENE, 99.9+%, HPLC GRADE

OEL-CZECHOSLOVAKIA:TWA 10 MG/M3;STEL 20 MG/M3 JAN93
OEL-DENMARK:TWA 5 PPM (16 MG/M3);SKIN;CARCINOGEN JAN93
OEL-FINLAND:TWA 5 PPM (15 MG/M3);STEL 10 PPM (30 MG/M3);SKIN;CAR JAN93
OEL-FRANCE:TWA 5 PPM (16 MG/M3);CARCINOGEN JAN93
OEL-GERMANY;SKIN;CARCINOGEN JAN93
OEL-HUNGARY:STEL 5 MG/M3;SKIN;CARCINOGEN JAN93
OEL-INDIA:TWA 10 PPM (30 MG/M3);CARCINOGEN JAN93
OEL-JAPAN:TWA 10 PPM (32 MG/M3);STEL 25 PPM (80 MG/M3);CAR JAN93
OEL-THE NETHERLANDS:TWA 10 PPM (30 MG/M3);SKIN JAN93
OEL-THE PHILIPPINES:TWA 25 PPM (80 MG/M3);SKIN JAN93
OEL-POLAND:TWA 30 MG/M3;SKIN JAN93
OEL-RUSSIA:TWA 10 PPM (5 MG/M3);STEL 25 PPM (15 MG/M3);SKIN;CAR JAN93
OEL-SWEDEN:TWA 1 PPM (3 MG/M3);STEL 5 PPM (16 MG/M3);SKIN;CAR JAN93
OEL-SWITZERLAND:TWA 5 PPM (16 MG/M3);SKIN;CARCINOGEN JAN93
OEL-THAILAND:TWA 10 PPM (30 MG/M3);STEL 25 PPM (75 MG/M3) JAN93
OEL-TURKEY:TWA 20 PPM (64 MG/M3);SKIN JAN93
OEL-UNITED KINGDOM:TWA 10 PPM (30 MG/M3) JAN93
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO BENZENE-AIR:8H CA TWA 0.1 PPM;CL 1 PPM/15M
NIOSH* DHHS #92-100,92
NOHS 1974: HZD 09070; NIS 126; TNF 11184; NOS 106; TNE 147583
NOES 1983: HZD 09070; NIS 92; TNF 10054; NOS 117; TNE 272275; TFE 143066
ATSDR TOXICOLOGY PROFILE (NTIS** PB/89/209464/AS)
EPA GENETOX PROGRAM 1988, POSITIVE: CARCINOGENICITY-MOUSE/RAT
EPA GENETOX PROGRAM 1988, POSITIVE: IN VITRO CYTOGENETICS-HUMAN LYMPHOCYTE
EPA GENETOX PROGRAM 1988, POSITIVE: IN VIVO CYTOGENETICS-HUMAN LYMPHOCYTE
EPA GENETOX PROGRAM 1988, POSITIVE: MAMMALIAN MICRONUCLEUS; SPERM MORPHOLOGY-MOUSE
EPA GENETOX PROGRAM 1988, NEGATIVE: CELL TRANSFORM.-SA7/SHE; IN VITRO SCE-HUMAN LYMPHOCYTES
EPA GENETOX PROGRAM 1988, NEGATIVE: IN VITRO SCE-HUMAN
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, APRIL 1996
NIOSH ANALYTICAL METHOD, 1994: HYDROCARBONS, BP 36-126 DEGREE C, 1500
NIOSH ANALYTICAL METHOD, 1994: BENZENE, BY PORTABLE GC, 3700
NIOSH ANALYTICAL METHOD, 1994: HYDROCARBONS, AROMATIC, 1501
NTP CARCINOGENESIS STUDIES (GAVAGE);CLEAR EVIDENCE:MOUSE,RAT
NTPTR* NTP-TR-289,86
NTP 7TH ANNUAL REPORT ON CARCINOGENS, 1992 : KNOWN TO BE CARCINOGENIC
OSHA ANALYTICAL METHOD #12

U.S. INFORMATION
THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

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ALDRICH CHEMICAL COMPANY, INC.
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CUST#: 942742

CATALOG #: 27070-9
NAME: BENZENE, 99.9+%, HPLC GRADE

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SIGMA-ALDRICH

ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

ATTN: SAFETY DIRECTOR

EMERGENCY PHONE 1-414-273-3850

DATE 08/02/96
CUST#: 942742
PO#: 1008

PROCESS TECHNOLOGY INC
P O BOX 476
BOISE ID 83701-0476

M A T E R I A L S A F E T Y D A T A S H E E T

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

CATALOG #: 31996-1
NAME: CARBON TETRACHLORIDE, 99.9%, A.C.S. REAGENT

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #: 56-23-5
MF: CCL4
EC NO: 200-262-8

SYNONYMS
BENZINOFORM * CARBONA * CARBON CHLORIDE * CARBON CHLORIDE (CCL4) * CARBON TET * CARBON TETRACHLORIDE (ACGIH:DOT:OSHA) * CHLORID UHLICITY (CZECH) * CZTEROCHLOREK WEGLA (POLISH) * ENT 4,705 * ENT 27164 * FLUKOIDS * HALON 1040 * METHANE TETRACHLORIDE * METHANE, TETRACHLORO- * NECATORINA * PERCHLOROMETHANE * R 10 * RCRA WASTE NUMBER U211 * R 10 (REFRIGERANT) * TETRACHLOORKOOLSTOF (DUTCH) * TETRACHLOORMETAAN * TETRACHLORKOHLENSTOFF, TETRA (GERMAN) * TETRACHLORMETHAN (GERMAN) * TETRACHLOROCARBON * TETRACHLOROMETHANE (OSHA) * TETRACHLORURE DE CARBONE (FRENCH) * TETRACLOROMETANO (ITALIAN) * TETRACLORURO DI CARBONIO (ITALIAN) * TETRAFINOL * TETRAFORM * TETRASOL * UN1846 (DOT) * UNIVERM * VERMOESTRICID *

SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

LABEL PRECAUTIONARY STATEMENTS
TOXIC
MAY CAUSE CANCER.
MAY CAUSE HERITABLE GENETIC DAMAGE.
TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
REPRODUCTIVE HAZARD.
READILY ABSORBED THROUGH SKIN.
TARGET ORGAN(S):
LIVER, KIDNEYS
NERVES, HEART
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
DO NOT BREATHE VAPOR.

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SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS

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CATALOG #: 31996-1
NAME: CARBON TETRACHLORIDE, 99.9%, A.C.S. REAGENT

AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
CONTAMINATION OF THE EYES SHOULD BE TREATED BY IMMEDIATE AND PROLONGED IRRIGATION WITH COPIOUS AMOUNTS OF WATER.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN.
REMOVE AND WASH CONTAMINATED CLOTHING PROMPTLY.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.

SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH AN ACTIVATED CARBON ADSORBENT, TAKE UP AND PLACE IN CLOSED CONTAINERS. TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -

REFER TO SECTION 8.

ADDITIONAL INFORMATION
REACTS VIOLENTLY WITH DIMETHYL FORMAMIDE (DMF) ABOVE 65 C.

SECTION 8. - - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

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P.O. BOX 355
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CUST#: 942742
PO#: 1008

CATALOG #: 31996-1
NAME: CARBON TETRACHLORIDE, 99.9%, A.C.S. REAGENT

AVOID PROLONGED OR REPEATED EXPOSURE.
READILY ABSORBED THROUGH SKIN.
WASH THOROUGHLY AFTER HANDLING.
TOXIC.
IRRITANT.
CARCINOGEN.
MUTAGEN.
REPRODUCTIVE HAZARD.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - - -

APPEARANCE AND ODOR
COLORLESS LIQUID

PHYSICAL PROPERTIES

BOILING POINT:	76 C TO 77 C	
MELTING POINT:	-23 C	
FLASHPOINT	NONE	
VAPOR PRESSURE:	143MM 30 C	91MM 20 C
SPECIFIC GRAVITY:	1.594	
VAPOR DENSITY:	5.32	

SECTION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - - -

INCOMPATIBILITIES
ALKALI METALS
FINELY POWDERED METALS
OXIDIZING AGENTS

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
PHOSGENE GAS
CARBON MONOXIDE, CARBON DIOXIDE

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - - -

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
CAUSES SKIN IRRITATION.
EXPOSURE CAN CAUSE:
STOMACH PAINS, VOMITING, DIARRHEA.
NAUSEA, DIZZINESS AND HEADACHE
DAMAGE TO THE EYES
DAMAGE TO THE LIVER
DAMAGE TO THE KIDNEYS

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CUST#: 942742
PO#: 1008

CATALOG #: 31996-1
NAME: CARBON TETRACHLORIDE, 99.9%, A.C.S. REAGENT

EXPOSURE TO AND/OR CONSUMPTION OF ALCOHOL MAY INCREASE TOXIC EFFECTS.

CHRONIC EFFECTS
CARCINOGEN.
MAY ALTER GENETIC MATERIAL.
MAY CAUSE REPRODUCTIVE DISORDERS.
TARGET ORGAN(S):
LIVER, KIDNEYS
NERVES, HEART
MALE REPRODUCTIVE SYSTEM
FEMALE REPRODUCTIVE SYSTEM

RTECS #: FG4900000
CARBON TETRACHLORIDE

IRRITATION DATA

SKN-RBT 4 MG MLD	XEURAQ MDDC-1715
SKN-RBT 500 MG/24H MLD	85JCAE -,91,86
EYE-RBT 2200 UG/30S MLD	XEURAQ MDDC-1715
EYE-RBT 500 MG/24H MLD	85JCAE -,91,86

TOXICITY DATA

ORL-MAN LDLO:429 MG/KG	ZHYGAM 19,781,73
IHL-HMN LCLO:1000 PPM	PCOC** -,198,66
IHL-HMN LCLO:5 PPH/5M	TABIA2 3,231,33
UNR-MAN LDLO:93 MG/KG	85DCAI 2,73,70
ORL-RAT LD50:2350 MG/KG	ARTODN 54,275,83
IHL-RAT LC50:8000 PPM/4H	NPIRI* 1,16,74
SKN-RAT LD50:5070 MG/KG	SPEADM 78-1,16,78
IPR-RAT LD50:1500 UL/KG	XEURAQ MDDC-1715
ORL-MUS LD50:8263 MG/KG	JPPMAB 3,169,51
IHL-MUS LC50:9526 PPM/8H	JIHTAB 29,382,47
IPR-MUS LD50:572 MG/KG	PHMCAA 10,172,68
SCU-MUS LD50:31 GM/KG	JPETAB 123,224,58
IPR-DOG LD50:1500 MG/KG	TXAPA9 10,119,67
ORL-RBT LD50:5760 MG/KG	GISAAA 33(1),32,68
SKN-RBT LD50:>20 GM/KG	ATDAEI 1,712,92
IVN-RBT LD50:5840 MG/KG	ZAPPAN 118,305,74
ORL-GPG LD50:5760 MG/KG	GISAAA 33(1),32,68
SKN-GPG LD50:>14937 MG/KG	TXAPA9 7,559,65
IPR-CKN LD50:4497 MG/KG	BVJOA9 127,304,71
ORL-MAM LD50:6 GM/KG	GTPZAB 32(10),25,88
IHL-MAM LC50:34500 MG/M3	GTPZAB 24(3),17,80

TARGET ORGAN DATA
SENSE ORGANS AND SPECIAL SENSES (MIOSIS)
BEHAVIORAL (SOMNOLENCE)
BEHAVIORAL (TREMOR)

CONTINUED ON NEXT PAGE

SIGMA-ALDRICH

ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

CUST#: 942742
PO#: 1008

CATALOG #: 31996-1
NAME: CARBON TETRACHLORIDE, 99.9%, A.C.S. REAGENT

BEHAVIORAL (ANOREXIA, HUMAN)
BEHAVIORAL (COMA)
BEHAVIORAL (ANTIPSYCHOTIC)
CARDIAC (CHANGE IN RATE)
LUNGS, THORAX OR RESPIRATION (CYANOSIS)
LUNGS, THORAX OR RESPIRATION (OTHER CHANGES)
GASTROINTESTINAL (NAUSEA OR VOMITING)
GASTROINTESTINAL (OTHER CHANGES)
LIVER (FATTY LIVER DEGENERATION)
LIVER (LIVER FUNCTION TESTS IMPAIRED)
KIDNEY, URETER, BLADDER (INTERSTITIAL NEPHRITIS)
BLOOD (HEMORRHAGE)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (HOMEOSTASIS)
EFFECTS ON NEWBORN (VIABILITY INDEX)
EFFECTS ON NEWBORN (WEANING OR LACTATION INDEX)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER. OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - -

EUROPEAN INFORMATION
EC INDEX NO: 602-008-00-5
TOXIC
R 23/24/25
TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
R 40
POSSIBLE RISK OF IRREVERSIBLE EFFECTS.
R 48/23
TOXIC: DANGER OF SERIOUS DAMAGE TO HEALTH BY PROLONGED EXPOSURE THROUGH INHALATION.
R 59

CONTINUED ON NEXT PAGE

We are committed to the success of our customers through science, technology and service.

SIGMA Aldrich Fluka SUPELCO SIGMA DIAGNOSTICS SIGMA-ALDRICH RESEARCH

CATALOG #: 31996-1
NAME: CARBON TETRACHLORIDE, 99.9%, A.C.S. REAGENT

DANGEROUS FOR THE OZONE LAYER.
S 23
DO NOT BREATHE VAPOR.
S 36/37
WEAR SUITABLE PROTECTIVE CLOTHING AND GLOVES.
S 45
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
S 59
REFER TO MANUFACTURER/SUPPLIER FOR INFORMATION ON RECOVERY/RECYCLING.

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK
ACGIH TLV-SUSPECTED HUMAN CARCINOGEN 85INA8 6,233,91
ACGIH TLV-TWA 5 PPM (SKIN) 85INA8 6,233,91
IARC CANCER REVIEW:ANIMAL SUFFICIENT EVIDENCE IMEMDT 20,371,79
IARC CANCER REVIEW:ANIMAL SUFFICIENT EVIDENCE IMEMDT 1,53,72
IARC CANCER REVIEW:HUMAN INADEQUATE EVIDENCE IMEMDT 1,53,72
IARC CANCER REVIEW:HUMAN INADEQUATE EVIDENCE IMEMDT 20,371,79
IARC CANCER REVIEW:GROUP 2B IMSUDL 7,143,87
MSHA STANDARD-AIR:TWA 10 PPM (65 MG/M3) (SKIN)
DTLVS* 3,43,71
OSHA PEL (GEN INDU):8H TWA 10 PPM;CL 25 PPM;PK 200 PPM/5M/4H
CFRGBR 29,1910.1000,94
OSHA PEL (CONSTRUC):8H TWA 10 PPM (65 MG/M3) (SKIN)
CFRGBR 29,1926.55,94
OSHA PEL (SHIPYARD):8H TWA 10 PPM (65 MG/M3) (SKIN)
CFRGBR 29,1915.1000,93
OSHA PEL (FED CONT):8H TWA 10 PPM (65 MG/M3) (SKIN)
CFRGBR 41,50-204.50,94
OEL-ARAB REPUBLIC OF EGYPT:TWA 5 PPM (30 MG/M3);SKIN JAN93
OEL-AUSTRALIA:TWA 5 PPM (30 MG/M3);SKIN;CARCINOGEN JAN93
OEL-BELGIUM:TWA 5 PPM (31 MG/M3);SKIN;CARCINOGEN JAN93
OEL-CZECHOSLOVAKIA:TWA 10 MG/M3;STEL 20 MG/M3 JAN93
OEL-DENMARK:TWA 2 PPM (13 MG/M3);SKIN JAN93
OEL-FINLAND:TWA 5 PPM (31 MG/M3);STEL 10 PPM (63 MG/M3);SKIN;CAR JAN93
OEL-FRANCE:TWA 2 PPM (12 MG/M3);STEL 10 PPM (60 MG/M3) JAN93
OEL-GERMANY:TWA 10 PPM (65 MG/M3);SKIN;CARCINOGEN JAN93
OEL-HUNGARY:STEL 10 MG/M3;SKIN;CARCINOGEN JAN93
OEL-INDIA:TWA 5 PPM (30 MG/M3);SKIN;CARCINOGEN JAN93
OEL-JAPAN:TWA 10 PPM (63 MG/M3);SKIN;CARCINOGEN JAN93
OEL-THE NETHERLANDS:TWA 2 PPM (12.6 MG/M3);SKIN JAN93
OEL-THE PHILIPPINES:TWA 10 PPM (65 MG/M3);SKIN JAN93
OEL-POLAND:TWA 20 MG/M3 JAN93
OEL-RUSSIA:TWA 10 PPM;STEL 20 MG/M3 JAN93
OEL-SWEDEN:TWA 2 PPM (13 MG/M3);STEL 3 PPM (19 MG/M3);SKIN;CAR JAN93
OEL-SWITZERLAND:TWA 5 PPM (30 MG/M3);STEL 10 PPM (60 MG/M3);SKIN JAN93

CONTINUED ON NEXT PAGE

SIGMA-ALDRICH

ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

CUST#: 942742
PO#: 1008

CATALOG #: 31996-1
NAME: CARBON TETRACHLORIDE, 99.9%, A.C.S. REAGENT

OEL-THAILAND:TWA 10 PPM;STEL 25 PPM JAN93
OEL-UNITED KINGDOM:TWA 10 PPM (65 MG/M3);STEL 20 PPM;SKIN JAN93
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO CARBON TETRACHLORIDE-AIR:CA STEL 2 PPM/60M
NIOSH* DHHS #92-100,92
NOHS 1974: HZD 17490; NIS 73; TNF 5152; NOS 56; TNE 64009
NOES 1983: HZD 17490; NIS 77; TNF 6629; NOS 72; TNE 104174; TFE 20699
ATSDR TOXICOLOGY PROFILE (NTIS** PB/90/168196/AS)
EPA GENETOX PROGRAM 1988, POSITIVE: CARCINOGENICITY-MOUSE/RAT; S CEREVISIAE GENE CONVERSION
EPA GENETOX PROGRAM 1988, POSITIVE: S CEREVISIAE-HOMOZYGOSIS; S CEREVISIAE-REVERSION
EPA GENETOX PROGRAM 1988, NEGATIVE: HISTIDINE REVERSION-AMES TEST; SPERM MORPHOLOGY-MOUSE
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, APRIL 1996
NIOSH ANALYTICAL METHOD, 1994: HYDROCARBONS, HALOGENATED, 1003
NTP 7TH ANNUAL REPORT ON CARCINOGENS, 1992 : ANTICIPATED TO BE CARCINOGEN

U.S. INFORMATION
THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.
CALIFORNIA PROPOSITION 65:
THIS PRODUCT IS OR CONTAINS CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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SIGMA Aldrich Fluka SUPELCO SIGMA DIAGNOSTICS SAFC SIGMA-ALDRICH RESEARCH

CHLOROBENZENE

Material Safety Data Sheet

Mallinckrodt Chemical, Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 05-14-92 Supersedes 08-27-85

PRODUCT IDENTIFICATION:

Synonyms: Monochlorobenzene; Chlorobenzol

Formula CAS No.: 108-90-7 Molecular Weight: 112.56

Hazardous Ingredients: Chlorobenzene Chemical Formula: C6H5Cl

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION.

Keep away from heat, sparks and flame.
Avoid breathing vapor.
Keep container closed.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.

EMERGENCY FIRST AID

If swallowed, get medical attention immediately. Never give anything by mouth to an unconscious person. 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. In all cases call a physician.
SEE SECTION 5.

SECTION 1

Physical Data

Appearance: Clear, colorless liquid.

Odor: Faint, almond like odor.

Solubility: 0.049 g/100 g water @ 25 C (77 F)

Boiling Point: 132 C (270 F)

Vapor Density (Air=1): (air=1) 3.9

Melting Point: -45 C (-49 C)

Vapor Pressure (mm Hg): 11.8 @ 25 C (77 F)

Specific Gravity: 1.10

Evaporation Rate: (n-BuAc=1): 1.0

NFPA Ratings: Health: 2 Flammability: 3 Reactivity: 0

SECTION 2

Fire and Explosion Information

Fire: Flammable liquid. Flashpoint: 28.9 C (84 F) (closed cup) Autoignition temperature: 638 C (1180 F) Flammable limits in air, % by volume: lel:1.3, uel:7.1.

Explosion: Vapors can flow along surfaces to distant ignition source and flash back. Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Reactions with incompatibilities may pose an explosion hazard.

Fire Extinguishing Media: Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool. A layer of water can be used to extinguish the fire.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. This highly flammable liquid must be kept from sparks, open flame, hot surfaces, and all sources of heat and ignition.

Reactivity Data — SECTION 3

Stability: Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products: Emits toxic fumes of hydrogen chloride, phosgene, and carbon monoxide when heated to decomposition.

Hazardous Polymerization: This substance does not polymerize.

Incompatibilities: Oxidizing agents, dimethyl sulfoxide, silver perchlorate.

Leak/Spill Disposal Information — SECTION 4

Ventilate area of leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Contain and recover liquid when possible. Collect as hazardous waste and atomize in a suitable RCRA approved combustion chamber, or absorb with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!
Reportable Quantity (RQ)(CWA/CERCLA) : 100 lbs.
Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Central nervous system depressant. May cause irritation to the nose and respiratory tract followed by headache, depression, dizziness, drowsiness, incoordination, and unconsciousness.

Ingestion: May cause abdominal pain, headache, nausea. May be followed by paleness, cyanosis, and coma, which may be delayed several hours.

Skin Contact: May cause irritation, redness, and pain.

Eye Contact: Vapors may cause irritation: splashes may cause severe irritation, redness, and pain to the cornea.

Chronic Exposure: Prolonged or repeated skin exposure may cause dermatitis or skin burns. Prolonged or repeated exposure through ingestion or inhalation may cause liver, kidney, or lung damage, headache, dizziness, drowsiness, and disturbed digestion.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this

substance.

B. FIRST AID

Inhalation:	Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:	Get medical attention immediately. Never give anything by mouth to an unconscious person.
Skin Exposure:	Remove any contaminated clothing. Wash skin with plenty of water for at least 15 minutes. If irritation develops, get medical attention.
Eye Exposure:	Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1992)

Oral rat LD50: 2290 mg/kg; investigated as a tumorign, mutagen, reproductive effector.

Occupational Control Measures — SECTION 6

Airborne Exposure Limits:	-OSHA Permissible Exposure Limit (PEL): 75 ppm (TWA) -ACGIH Threshold Limit Value (TLV): 10 ppm (TWA)
Ventilation System:	A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.
Personal Respirators (NIOSH Approved)	If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.
Skin Protection:	Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:	Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information — SECTION 7

Protect against physical damage. Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Storage and use areas should be No Smoking areas. Containers should be bonded and grounded for transfers to avoid static sparks.

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Mallinckrodt provides the information contained herein in good faith but makes

no representation as to its comprehensiveness or accuracy. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT MAKES NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****

CHLBZ

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
must include a copy of this addendum

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X	X		

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
CHLOROBENZENE (108-90-7)	No	No	Yes	No	No	No

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Enviromental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards or toxic under 40 CFR 261.33

CHLOROFORM

Material Safety Data Sheet

Mallinckrodt Chemical, Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 04-19-95 Supersedes 11-27-89

PRODUCT IDENTIFICATION:

Synonyms: Trichloromethane

Formula CAS No.: 67-66-3 Molecular Weight: 119.38

Hazardous Ingredients: Chloroform Chemical Formula: CHCl3

PRECAUTIONARY MEASURES

DANGER! MAY BE FATAL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY EFFECT CENTRAL NERVOUS SYSTEM, CARDIOVASCULAR SYSTEM, LIVER AND KIDNEYS. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

Do not breathe vapor.
Do not get in eyes, on skin, or on clothing.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

EMERGENCY FIRST AID

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. 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. In all cases call a physician. SEE SECTION 5.

Physical Data — SECTION 1

Appearance: Clear colorless liquid.

Odor: Characteristic, ethereal.

Solubility: 0.8g/100g water @ 20 C (68 F).

Boiling Point: 61.3 C (142 F).

Vapor Density (Air=1):4.1

Melting Point: -63.5 C (-82 F).

Vapor Pressure (mm Hg):100 @ 10.4 C (51 F).

Specific Gravity: 1.49

Evaporation Rate:(BuAc=1): 11.6

NFPA Ratings: Health: 2 Flammability: 0 Reactivity: 0

Fire and Explosion Information — SECTION 2

Fire: Slight fire hazard when exposed to high heat; otherwise, practically not flammable.

Explosion: Not considered to be an explosion hazard.

Fire Extinguishing Media: Use any means suitable for extinguishing surrounding fire.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Reactivity Data — SECTION 3

Stability: Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products: Toxic gases and vapors such as hydrogen chloride, chlorine, phosgene, and carbon monoxide may be released upon heating to decomposition.

Hazardous Polymerization: Will not occur.

Incompatibilities: Strong caustics and chemically active metals such as aluminum, magnesium powder, sodium, or potassium; acetone, fluorine, methanol, sodium methoxide, dinitrogen tetroxide, tert-butoxide, triisopropylphosphine.

Leak/Spill Disposal Information — SECTION 4

Ventilate area of leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Contain and recover liquid when possible. Collect as hazardous waste and atomize in a suitable RCRA approved combustion chamber, or absorb with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!
Reportable Quantity (RQ)(CWA/CERCLA) : 10 lbs.
Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Acts as a relatively potent anesthetic. Irritates respiratory tract and causes central nervous stystem effects, including headache, drowsiness, dizziness. Higher and unconsciousness. Prolonged exposure may lead to death due to irregular heart beat and kidney and liver disorders.

Ingestion: Causes severe burning in mouth and throat, pain in the chest and vomiting. Large quantities may cause symptoms similar to inhalation.

Skin Contact: Causes skin irritation resulting in redness and pain. Removes natural oils. May be absorbed through skin.

Eye Contact: Vapors causes pain and irritation to eyes. Splashes may cause severe irritation and possible eye damage.

Chronic Exposure: Prolonged or repeated exposure to vapors may cause damage to liver and kidneys. Contact with liquid has defatting effect and may cause chronic irritation of skin with cracking and drying, and corresponding dermatitis. Chloroform is a suspected human carcinogen.

Aggravation of

Pre-existing Conditions: Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion: Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconcious person.

Skin Exposure: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1994)

Oral rat LD50: 908 mg/kg; skin rabbit LD50: > 20 gm/kg; inhalation rat LC50: 47702 mg/m3/4H; irritation data: skin rabbit 10 mg/24H open mild; eye rabbit: 20 mg/24H moderate; investigated as a tumorigen, mutagen, reproductive effector; Cancer Status: IARC Category 2B, NTP Listed Carcinogen.

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 2 ppm (TWA) -ACGIH Threshold Limit Value (TLV): 10 ppm (TWA), Listed as A2 suspected human carcinogen

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators (NIOSH Approved) If the TLV is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or self-contained breathing apparatus.

Skin Protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information SECTION 7

Keep in a tightly closed container. Protect from physical damage. Store in a cool,dry, ventilated area away from sources of heat, moisture and incompatibilities. Wear special protective equipment (Sec. 6) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer

clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.Odor threshold: 250 mg/m3. The odor theshold only serves as a warning of exposure; not smelling it does not mean you are not being exposed.

****

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****

OFORM

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
must include a copy of this addendum

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X			

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
CHLOROFORM Chloroform (67-66-3) 100% Listed on the TSCA Inventory.	10	10,000	Yes	No	10	U044

PROPOSITION 65 Warning!
This product contains a chemical known to the state of California to cause cancer.

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:

Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Environmental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards or toxic under 40 CFR 261.33

OFORM

CHLOROFORM

Use Web Browser "Back" key to return to previous topic

ACC96324

****** MATERIAL SAFETY DATA SHEET **** **** MATERIAL SAFETY DATA SHEET ******

1,2-Dichlorobenzene, 99%
96324

****** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ******

MSDS Name: 1,2-Dichlorobenzene, 99%

```
Company Identification:  Acros Organics N.V.
                         Janssen Pharmaceuticalaan 3a
                         2440 Geel, Belgium
For information in North America, call:   800-ACROS-01
For information in Europe, call:          0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call:     0032(0) 14575299
```

****** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ******

CAS#	Chemical Name	%	EINECS
95-50-1	O-DICHLOROBENZENE	>98	202-425

Hazard Symbols: XN N

****** SECTION 3 - HAZARDS IDENTIFICATION ******

EMERGENCY OVERVIEW

Appearance: Not available. Flash Point: 67°C.
Warning! Combustible liquid. Light sensitive. This substance has caused adverse reproductive and fetal effects in animals. May cause central nervous system depression. Harmful if swallowed. Causes eye and skin irritation. Causes digestive and respiratory tract irritation.
Target Organs: Kidneys, central nervous system, liver.

Potential Health Effects

Eye:

Contact produces irritation, tearing, and burning pain. Vapors cause eye irritation.

Skin:

Causes irritation with burning pain, itching, and redness.

Ingestion:

Harmful if swallowed. May cause central nervous system depression, kidney damage, and liver damage. May cause liver and kidney damage Exposure to substance has caused changes in organ weights (includi kidney, liver, heart, lung, and brain).

Inhalation:
May cause respiratory tract irritation. May cause liver and kidney damage. May cause drowsiness, unconsciousness, and central nervous system depression.
Chronic:
Prolonged or repeated exposure may cause adverse reproductive effects. May cause liver and kidney damage. May cause fetal effect

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Immediately flush eyes with plenty of water for at least 15 minute occasionally lifting the upper and lower lids. Get medical aid.
Skin:
Immediately flush skin with plenty of soap and water for at least minutes while removing contaminated clothing and shoes. Get medica aid if irritation develops or persists.
Ingestion:
If victim is conscious and alert, give 2-4 cupfuls of milk or wate Get medical aid immediately.
Inhalation:
Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician:
Treat symptomatically and supportively.
Antidote:
No specific antidote exists.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Combustion generates toxic fumes.
Extinguishing Media:
For small fires, use water spray, dry chemical, carbon dioxide or chemical foam.
Autoignition Temperature: 640°C (1,184.00°F)
Flash Point: 67°C (152.60°F)
NFPA Rating: health-2; flammability-2; reactivity-0
Explosion Limits, Lower: 2.20 vol %
Upper: 12.00 vol %

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indica in Section 8.
Spills/Leaks:
Remove all sources of ignition. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:

Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Avoid contact wi skin and eyes. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, sparks or open flames. Keep container tightly closed. Avoid ingest and inhalation.

Storage:

Keep away from sources of ignition. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final P
O-DICHLOROBENZENE	25 ppm ; 150 mg/m3; 50 ppm STEL; 301 mg/m3 STEL; C 50 ppm; C 301 mg/m3	C 50 ppm; C 300 mg/m3	C 50 ppm; C 30 mg/m3

OSHA Vacated PELs:

O-DICHLOROBENZENE:
C 50 ppm; C 300 mg/m3

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:

Wear appropriate gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29CFR 1910.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Appearance:	Not available.
Odor:	Aromatic.
pH:	Not available.
Vapor Pressure:	1.15 mm Hg @ 20C
Vapor Density:	5.05 (air=1)
Evaporation Rate:	<1 (butyl acetate=1)
Viscosity:	Not available.
Boiling Point:	179.0 - 180.0°C @ 760.00mm Hg
Freezing/Melting Point:	-15.0°C

Decomposition Temperature: Not available.
Solubility: IN WATER: 0.13 G/L (20°C)
Specific Gravity/Density: 1.3060g/cm3
Molecular Formula: C6H4Cl2
Molecular Weight: 147.00

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable at room temperature in closed containers under normal stora and handling conditions.
Conditions to Avoid:
High temperatures, incompatible materials.
Incompatibilities with Other Materials:
Oxidizing agents, aluminum.
Hazardous Decomposition Products:
Hydrogen chloride, chlorine, carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 95-50-1: CZ4500000
LD50/LC50:
CAS# 95-50-1: Oral, mouse: LD50 = 4386 mg/kg; Oral, rabbit: LD50 = 500 mg/kg; Oral, rat: LD50 = 500 mg/kg.
Carcinogenicity:
O-DICHLOROBENZENE -
IARC: Group 3 carcinogen
Epidemiology:
No information available.
Teratogenicity:
Specific Developmental Abnormalities: Musculoskeletal, inhalation-rat TCLo=200ppm/6H.
Reproductive Effects:
Paternal Effects: Spermatogenesis, intraperitoneal-rat TDLo=50mg/k
Neurotoxicity:
No information available.
Mutagenicity:
No information available.
Other Studies:
None.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
No information available.
Environmental Fate:
On soil, substance can be adsorbed to a significant extent. Leachi to groundwater can occur. In water, substance will adsorb to sediment. In air, substance will exist in the vapor phase and will react with photochemically-produced hydroxyl radicals.
Physical/Chemical:
No information available.
Other:
Please refer to the Handbook of Environmental Fate and Exposure Da (vol. I) for additional information.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations

RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: waste number U070
This material is banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: O-DICHLOROBENZENE
Hazard Class: 6.1
UN Number: UN1591
Packing Group: III
IMO
Shipping Name: O-DICHLOROBENZENE
Hazard Class: 6.1
UN Number: 1591
Packing Group: III
IATA
Shipping Name: O-DICHLOROBENZENE
Hazard Class: 6.1
UN Number: 1591
Packing Group: III
RID/ADR
Shipping Name: O-DICHLOROBENZENE
Dangerous Goods Code: 6.1(15C)
UN Number: 1591
Canadian TDG
Shipping Name: O-DICHLOROBENZENE
Hazard Class: 6.1(9.2)
UN Number: UN1591

**** SECTION 15 - REGULATORY INFORMATION ****

FEDERAL
TSCA
CAS# 95-50-1 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
CAS# 95-50-1: Testing required by: manufacturers; processors (40 C
Section 12b
CAS# 95-50-1: export notification required - Section 4
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
final RQ = 100 pounds (45.4 kg)
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 95-50-1: acute, chronic, flammable.
Section 313
This material contains O-DICHLOROBENZENE (CAS# 95-50-1, >98%),whic
is subject to the reporting requirements of Section 313 of SARA Ti
III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:
CAS# 95-50-1 is listed as a Hazardous Substance under the CWA.
CAS# 95-50-1 is listed as a Priority Pollutant under the Clean Wat Act.
CAS# 95-50-1 is listed as a Toxic Pollutant under the Clean Water Act.
OSHA:
None of the chemicals in this product are considered highly hazard by OSHA.

STATE
O-DICHLOROBENZENE can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level:
None of the chemicals in this product are listed.

INTERNATIONAL
European Labeling in Accordance with EC Directives
Hazard Symbols: XN N
Risk Phrases:
Safety Phrases:
S 23 Do not inhale gas/fumes/vapour/spray.
S 60 This material and/or its container must be disposed of as hazardous waste.
S 61 Avoid release to the environment. Refer to special instructions/Safety data sheets.

Canada
CAS# 95-50-1 is listed on Canada's DSL/NDSL List.
CAS# 95-50-1 is listed on Canada's Ingredient Disclosure List.
Exposure Limits:
CAS# 95-50-1:. OEL-AUSTRALIA:TWA 50 ppm (300 mg/m3). OEL-AUSTRIA: 50 ppm (300 mg/m3). OEL-BELGIUM:STEL 50 ppm (301 mg/m3);Skin. OEL-ARK:STEL 50 ppm (300 mg/m3). OEL-FINLAND:TWA 50 ppm (300 mg/m3);ST 5 ppm (450 mg/m3);Skin. OEL-FRANCE:STEL 50 ppm (300 mg/m3). OEL-GE Y:TWA 50 ppm (300 mg/m3);Skin. OEL-HUNGARY:TWA 50 mg/m3;STEL 100 m ;Skin JAN9. OEL-JAPAN:STEL 50 ppm (300 mg/m3). OEL-THE NETHERLANDS 50 ppm (300 mg/m3). OEL-THE PHILIPPINES:TWA 50 ppm (300 mg/m3). OE OLAND:TWA 20 mg/m3. OEL-RUSSIA:STEL 50 mg/m3. OEL-SWEDEN:STEL 50 p 300 mg/m3). OEL-SWITZERLAND:TWA 50 ppm (300 mg/m3);STEL 100 ppm (6 g/m3). OEL-THAILAND:TWA 50 ppm (300 mg/m3). OEL-TURKEY:TWA 50 ppm mg/m3). OEL-UNITED KINGDOM:TWA 50 ppm (300 mg/m3);STEL 50 ppm. OEL BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV. OEL IN NEW ZEAL , SINGAPORE, VIETNAM check ACGI TLV

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:
No additional information available.
MSDS Creation Date: 2/01/1996 Revision #0 Date: Original.

The information above is believed to be accurate and represents the bes information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect such information, and we assume no liability resulting from its use. Us should make their own investigations to determine the suitability of th information for their particular purposes. In no way shall Fisher be li for any claims, losses, or damages of any third party or for lost profi or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

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ACC83933

****** MATERIAL SAFETY DATA SHEET **** **** MATERIAL SAFETY DATA SHEET ******

1,1-Dichloroethane,99+%, stabilized with nitromethane
83933

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: 1,1-Dichloroethane,99+%, stabilized with nitromethane

```
     Ethylidene chloride
Company Identification:  Acros Organics N.V.
                         Janssen Pharmaceuticalaan 3a
                         2440 Geel, Belgium
For information in North America, call:   800-ACROS-01
For information in Europe, call:          0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call:     0032(0) 14575299
```

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS
75-34-3	1,1-Dichloroethane, 99+%, stabilized with nitromethane		200-863

Hazard Symbols: XN F

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: clear colourless to very light yellow liquid.

Target Organs: None.

Potential Health Effects

The toxicological properties of this material have not been investigated. Use appropriate procedures to prevent opportunities for direct contact with the skin or eyes and to prevent inhalation.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Immediately flush e with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid immediately.
Skin:
Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Remove contaminated clothing and shoes.
Ingestion:
If victim is conscious and alert, give 2-4 cupfuls of milk or wate Get medical aid immediately. DO NOT induce vomiting. Allow the vic to rinse his mouth and then to drink 2-4 cupfuls of water, and see medical advice.
Inhalation:
Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician:
Treat symptomatically.
Antidote:
None reported.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Flammable Liquid.
Extinguishing Media:
In case of fire, use water, dry chemical, chemical foam, or alcohol-resistant foam. Use agent most appropriate to extinguish fire.
Autoignition Temperature: 660°C (1,220.00°F)
Flash Point: -10°C (32.00°F)
NFPA Rating: health-2; flammability-3; reactivity-0
Explosion Limits, Lower: .16 vol %
Upper: .06 vol %

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indica in Section 8.
Spills/Leaks:
Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Clean up spills immediately observing precautions in the Protective Equipment section.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Empty containers retain product residue, (liquid and/or vapor), an can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, sparks or open flames. Avoid contact with heat, sparks and flame.
Storage:
Keep away from heat, sparks, and flame. Flammables-area.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits. Use process enclosure, local exhaust ventilation, or other engineering control to control airborne levels.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final P
1,1-Dichloroethane, 99+%, stabilized with nitromethane	100 ppm ; 405 mg/m3; (250) ppm STEL; (1010) mg/m3 STEL	100 ppm TWA; 400 mg/m3 TWA	100 ppm TWA; 4 mg/m3 TWA

OSHA Vacated PELs:
1,1-Dichloroethane, 99+%, stabilized with nitromethane:
100 ppm TWA; 400 mg/m3 TWA

Personal Protective Equipment

Eyes:
Wear chemical goggles. Wear safety glasses and chemical goggles if splashing is possible.

Skin:
Wear appropriate protective gloves and clothing to prevent skin exposure. Wear appropriate protective gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to minimize contact with skin.

Respirators:
A respiratory protection program that meets OSHA's 29 CFR ¦1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use. Wear a NIOSH/MSHA-approved (or equivalent) full-facepiece airline respirator in the positive pressure mode with emergency escape provisions.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Not available.
Appearance:	Clear colourless to very light yellow liquid
Odor:	None reported.
pH:	Not available.
Vapor Pressure:	244 mbar @ 20 C
Vapor Density:	Not available.
Evaporation Rate:	Not available.
Viscosity:	Not available.
Boiling Point:	57°C @ 760.00mm Hg
Freezing/Melting Point:	-97°C
Decomposition Temperature:	Not available.
Solubility:	0.5g/100ml
Specific Gravity/Density:	1.1770g/cm3
Molecular Formula:	C2H4Cl2
Molecular Weight:	98.96

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:

Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, strong oxidants.
Incompatibilities with Other Materials:
Oxidizing agents.
Hazardous Decomposition Products:
Hydrogen chloride, phosgene, carbon monoxide, irritating and toxic fumes and gases, carbon dioxide.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 75-34-3: KI0175000
LD50/LC50:
CAS# 75-34-3: Inhalation, rat: LC50 =13000 ppm/4H; Oral, rat: LD50 725 mg/kg.
Carcinogenicity:
1,1-Dichloroethane, 99+%, stabilized with nitromethane -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: waste number U076
This material is banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: 1,1-DICHLOROETHANE
Hazard Class: 3
UN Number: UN2362
Packing Group: II
IMO
Shipping Name: 1,1-DICHLOROETHANE
Hazard Class: 3.2
UN Number: 2362
Packing Group: II
IATA
Shipping Name: 1,1-DICHLOROETHANE
Hazard Class: 3
UN Number: 2362
Packing Group: II
RID/ADR
Shipping Name: 1,1-DICHLOROETHANE
Dangerous Goods Code: 3(3B)
UN Number: 2362
Canadian TDG
Shipping Name: 1,1-DICHLOROETHANE
Hazard Class: 3
UN Number: UN2362

Other Information: FLASHPOINT -10 C

**** SECTION 15 - REGULATORY INFORMATION ****

FEDERAL

TSCA

CAS# 75-34-3 is listed on the TSCA inventory.

Health & Safety Reporting List

CAS# 75-34-3: Effective Date: June 1, 1987

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Ru

Section 12b

CAS# 75-34-3: export notification required - Section 4

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

final RQ = 1000 pounds (454 kg)

Section 302 (TPQ)

None of the chemicals in this product have a TPQ.

Section 313

This chemical is not at a high enough concentration to be reportab under Section 313.

No chemicals are reportable under Section 313.

Clean Air Act:

CAS# 75-34-3 is listed as a hazardous air pollutant (HAP).

This material does not contain any Class 1 Ozone depletors.

This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.

CAS# 75-34-3 is listed as a Priority Pollutant under the Clean Wat Act.

None of the chemicals in this product are listed as Toxic Pollutan under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazard by OSHA.

STATE

1,1-Dichloroethane, 99+%, stab can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level:

CAS# 75-34-3: no significant risk level = 100 ug/day

INTERNATIONAL

European Labeling in Accordance with EC Directives

Hazard Symbols: XN F

Risk Phrases:

Safety Phrases:

S 16 Keep away from sources of ignition - No smoking.

S 23 Do not inhale gas/fumes/vapour/spray.

S 61 Avoid release to the environment. Refer to special instructions/Safety data sheets.

Canada

CAS# 75-34-3 is listed on Canada's DSL/NDSL List.

CAS# 75-34-3 is listed on Canada's Ingredient Disclosure List.

Exposure Limits:

CAS# 75-34-3:. OEL-ARAB Republic of Egypt. OEL-AUSTRALIA:TWA 200 (810 mg/m3);STEL 250 pp (1010 mg/m3). OEL-AUSTRIA:TWA 100 ppm (400 m3). OEL-BELGIUM:TWA 200 ppm (810 mg/m3);STEL 250 ppm (1010 mg/m3)

L-DENMARK:TWA 100 ppm (400 mg/m3). OEL-FINLAND:TWA 100 ppm (400 mg ;STEL 250 ppm (1000 mg/m3). OEL-FRANCE:TWA 200 ppm (810 mg/m3). OE RMANY:TWA 100 ppm (400 mg/m3). OEL-JAPAN:TWA 100 ppm (400 mg/m3). THE NETHERLANDS:TWA 200 ppm (820 mg/m3). OEL-THE PHILIPPINES:TWA 1 pm (400 mg/m3). OEL-RUSSIA:TWA 100 ppm. OEL-SWITZERLAND:TWA 100 pp 00 mg/m3);STEL 200 ppm (800 mg/m3). OEL-THAILAND:TWA 50 ppm;STEL 1 pm. OEL-TURKEY:TWA 100 ppm (400 mg/m3). OEL-UNITED KINGDOM:TWA 200 (810 mg/m3);STEL 400 ppm. OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA eck ACGIH TLV. OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI T

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:
No additional information available.
MSDS Creation Date: 8/11/1990 Revision #1 Date: 3/04/1996

The information above is believed to be accurate and represents the bes information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect such information, and we assume no liability resulting from its use. Us should make their own investigations to determine the suitability of th information for their particular purposes. In no way shall Fisher be li for any claims, losses, or damages of any third party or for lost profi or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

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ATTN: SAFETY DIRECTOR
PROCESS TECHNOLOGY INC
PO BOX 476
BOISE ID 83701-0476

DATE: 04/20/94
CUST#: 942742
PO#: 041594AR

MATERIAL SAFETY DATA SHEET

SECTION 1. - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

PRODUCT #: 16302-3 NAME: VINYLIDENE CHLORIDE, 99%

(1,1-dichloroethylene)

ECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #:75-35-4
MF: C2H2CL2

DDITIONAL INFORMATION
CONTAINS 4-METHOXYPHENOL (HYDROQUINONE MONOMETHYL ETHER, MEHQ),
CHEMICAL ABSTRACTS REGISTRY NUMBER 150-76-5.

SYNONYMS
CHLORURE DE VINYLIDENE (FRENCH) * 1,1-DCE * 1,1-DICHLOROETHENE (9CI) * 1,1-DICHLOROETHYLENE * ETHENE, 1,1-DICHLORO- * NCI-C54262 * RCRA WASTE NUMBER U078 * SCONATEX * UN1303 (DOT) * VDC * VINYLIDENE CHLORIDE * VINYLIDENE CHLORIDE (II) * VINYLIDENE CHLORIDE (ACGIH,OSHA) * VINYLIDENE CHLORIDE, INHIBITED (DOT) * VINYLIDENE DICHLORIDE * VINYLIDINE CHLORIDE *

SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

ABEL PRECAUTIONARY STATEMENTS
FLAMMABLE (USA DEFINITION)
EXTREMELY FLAMMABLE (EUROPEAN DEFINITION)
TOXIC
MAY CAUSE CANCER.
MAY CAUSE HERITABLE GENETIC DAMAGE.
TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
LACHRYMATOR.
TARGET ORGAN(S):
LIVER
KIDNEYS
KEEP AWAY FROM SOURCES OF IGNITION. NO SMOKING.
IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE (SHOW THE LABEL WHERE POSSIBLE).
TAKE OFF IMMEDIATELY ALL CONTAMINATED CLOTHING.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
AIR AND MOISTURE SENSITIVE
STORE UNDER NITROGEN.
REFRIGERATE.
MAY DEVELOP PRESSURE.
NOTE CLOUDINESS OR PRECIPITATION IS UNAVOIDABLE

CONTINUED ON NEXT PAGE

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CUST#: 942742
PO#: 041594AR

PRODUCT #: 163023 NAME: VINYLIDENE CHLORIDE, 99%
MF: C2H2CL2

AND SHOULD NOT AFFECT USE.

SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
REMOVE AND WASH CONTAMINATED CLOTHING PROMPTLY.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.
WATER SPRAY.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
EXTREMELY FLAMMABLE.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
WEAR DISPOSABLE COVERALLS AND DISCARD THEM AFTER USE.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS

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PRODUCT #: 163023 NAME: VINYLIDENE CHLORIDE, 99%
MF: C2H2 CL2

USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - -
REFER TO SECTION 8.

ADDITIONAL INFORMATION
INHIBITED WITH 200 PPM HYDROQUINONE MONOMETHYL ETHER (MEHQ). VINYLIDENE CHLORIDE MAY EVAPORATE AND THE INHIBITOR MAY ACCUMULATE. MEHQ CAUSES IRRITATION DEPENDING UPON THE INTENSITY AND DURATION OF EXPOSURE. EFFECTS MAY VARY FROM MILD IRRITATION TO SEVERE IRRITATION. WITH THE INHIBITOR REMOVED, VINYLIDENE CHLORIDE MAY FORM EXPLOSIVE PEROXIDES ON CONTACT WITH AIR OR MAY UNDERGO HAZARDOUS POLYMERIZATION.

SECTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CARCINOGEN.
MUTAGEN.
TOXIC.
LACHRYMATOR.
IRRITANT.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
HANDLE WITH CARE.
FORMS EXPLOSIVE PEROXIDES ON PROLONGED STORAGE.

ECTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -

APPEARANCE AND ODOR
SLIGHTLY HAZY COLORLESS LIQUID

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PO#: 041594AR

PRODUCT #: 163023 NAME: VINYLIDENE CHLORIDE, 99%
MF: C2H2CL2

BOILING POINT: 30 C TO 32 C
MELTING POINT: -122 C
FLASHPOINT -9 F
- 22C
AUTOIGNITION TEMPERATURE: 968 F 519C
UPPER EXPLOSION LEVEL: 15.5%
LOWER EXPLOSION LEVEL: 6.5%
VAPOR PRESSURE: 9.68PSI 20 C 31.01PSI 55 C
VAPOR DENSITY: 3.46
SPECIFIC GRAVITY: 1.213

SECTION 10. - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -

INCOMPATIBILITIES
OXIDIZING AGENTS
AIR SENSITIVE
MOISTURE SENSITIVE
COPPER
ALUMINUM
AND THEIR ALLOYS.
PEROXIDES
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
PHOSGENE GAS

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
CAUSES SKIN IRRITATION.
VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
CAN CAUSE CNS DEPRESSION.
CHRONIC EFFECTS

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CUST#: 942742
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PRODUCT #: 163023 NAME: VINYLIDENE CHLORIDE, 99%
MF: C2H2CL2

CARCINOGEN.
MAY ALTER GENETIC MATERIAL.
DAMAGE TO THE LIVER
DAMAGE TO THE KIDNEYS
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

RTECS NO: KV9275000
ETHYLENE, 1,1-DICHLORO-

TOXICITY DATA
ORL-RAT LD50:200 MG/KG NTIS** PB85-143766
IHL-RAT LC50:6350 PPM/4H TXAPA9 18,168,71
ORL-MUS LD50:194 MG/KG BJCAAI 37,411,78

TARGET ORGAN DATA
BEHAVIORAL (GENERAL ANESTHETIC)
LUNGS, THORAX OR RESPIRATION (TUMORS)
GASTROINTESTINAL (TUMORS)
LIVER (OTHER CHANGES)
LIVER (TUMORS)
KIDNEY, URETER, BLADDER (OTHER CHANGES)
KIDNEY, URETER, BLADDER (KIDNEY TUMORS)
BLOOD (TUMORS)
BLOOD (LEUKEMIA)
BLOOD (LYMPHOMA INCLUDING HODGKIN'S DISEASE)
SKIN AND APPENDAGES (TUMORS)
EFFECTS ON FERTILITY (FEMALE FERTILITY INDEX)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (OTHER MEASURES OF FERTILITY)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
TUMORIGENIC (CARCINOGENIC BY RTECS CRITERIA)
TUMORIGENIC (EQUIVOCAL TUMORIGENIC AGENT BY RTECS CRITERIA)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - - -
DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - - -

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PRODUCT #: 153023 NAME: VINYLIDENE CHLORIDE, 99%
MF: C2H2CL2

BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -

TLV AND SOURCE
FOR 4-METHOXYPHENOL (MEHQ):
ACGIH TLV-TWA: 5 MG/M3.
OSHA PEL: 8H TWA 5 MG/M3.

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 5 PPM; STEL 20 PPM 85INA8 5,628,86
IARC CANCER REVIEW:ANIMAL LIMITED EVIDENCE IMEMDT 39,195,86
IARC CANCER REVIEW:HUMAN INADEQUATE EVIDENCE IMEMDT 39,195,86
IARC CANCER REVIEW:GROUP 3 IMSUDL 7,376,87
OSHA PEL FINAL:8H TWA 1 PPM (4 MG/M3)
FEREAC 54,2923,89
OEL-AUSTRALIA:TWA 5 PPM (20 MG/M3);STEL 20 PPM (80 MG/M3) JANUARY 1993
OEL-AUSTRIA:TWA 2 PPM (8 MG/M3) JANUARY 1993
OEL-BELGIUM:TWA 5 PPM (20 MG/M3);STEL 20 PPM (79 MG/M3) JANUARY 1993
OEL-DENMARK:TWA 5 PPM (20 MG/M3) JANUARY 1993
OEL-FINLAND:TWA 10 PPM (40 MG/M3);STEL 20 PPM (80 MG/M3);CARCINOGEN JANUARY 1993
OEL-FRANCE:TWA 5 PPM (20 MG/M3) JANJARY 1993
OEL-GERMANY:TWA 2 PPM (8 MG/M3);CARCINOGEN JANUARY 1993
OEL-THE NETHERLANDS:TWA 5 PPM (20 MG/M3) JANUARY 1993
OEL-POLAND:TWA 50 MG/M3 JANUARY 1993
OEL-RUSSIA:STEL 50 MG/M3 JANUARY 1993
OEL-SWEDEN:TWA 5 PPM (20 MG/M3);STEL 10 PPM (40 MG/M3) JANUARY 1993
OEL-SWITZERLAND:TWA 2 PPM (8 MG/M3);STEL 4 PPM (16 MG/M3) JANUARY 1993
OEL-UNITED KINGDOM:TWA 10 PPM (40 MG/M3) JANUARY 1993
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA, NEW ZEALAND, SINGAPORE,

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PO#: 041594AR

PRODUCT #: 163023 NAME: VINYLIDENE CHLORIDE, 99%
MF: C2H2CL2

VIETNAM CHECK ACGIH TLV
NIOSH REL TO VINYLIDENE CHLORIDE-AIR:CA LOWEST FEASIBLE CONC.
NIOSH* DHHS #92-100,92
NOHS 1974: HZD 83011; NIS 22; TNF 879; NOS 23; TNE 10947
NOES 1983: HZD 83011; NIS 2; TNF 97; NOS 13; TNE 2679; TFE 291
ATSDR TOXICOLOGY PROFILE (NTIS** PB/90/182114/AS)
EPA GENETOX PROGRAM 1988, POSITIVE: HISTIDINE REVERSION-AMES TEST
EPA GENETOX PROGRAM 1988, POSITIVE/LIMITED: CARCINOGENICITY-MOUSE/RAT
EPA GENETOX PROGRAM 1988, NEGATIVE: RODENT DOMINANT LETHAL
EPA TSCA CHEMICAL INVENTORY, JUNE 1993
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0979-0310
ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, SEPTEMBER 1993
NIOSH CURRENT INTELLIGENCE BULLETIN 28, 1978
NIOSH ANALYTICAL METHODS: SEE VINYLIDENE CHLORIDE, 1015
OSHA ANALYTICAL METHOD #19
THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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ACC62420

****** MATERIAL SAFETY DATA SHEET **** **** MATERIAL SAFETY DATA SHEET ******

trans-1,2-Dichloroethylene, 99.7% (gc), stabilized
62420

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: trans-1,2-Dichloroethylene, 99.7% (gc), stabilized

trans-Acetylene dichloride
Company Identification: Acros Organics N.V.
Janssen Pharmaceuticalaan 3a
2440 Geel, Belgium
For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS
156-60-5	TRANS-1,2-DICHLOROETHYLENE	99.7%	205-860

Hazard Symbols: XN F

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Not available.
Appearance: Clear liquid (15 apha max.). Flash Point: 6°C.
Not available.
Target Organs: Central nervous system, respiratory system, eyes.

Potential Health Effects
Eye:
Causes moderate eye irritation.
Skin:
Causes moderate skin irritation.
Ingestion:
Harmful if swallowed. May cause nausea and vomiting.
Inhalation:
Harmful if inhaled. May cause narcotic effects.

Chronic:
Not available.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid.
Skin:
Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion:
Get medical aid. Wash mouth out with water.
Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxyge Get medical aid.
Notes to Physician:
Treat symptomatically and supportively.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Vapors can travel to a source of ignition and fla back. Will burn if involved in a fire.
Extinguishing Media:
Use water spray to cool fire-exposed containers. In case of fire u water spray, dry chemical, carbon dioxide, or chemical foam.
Autoignition Temperature: 440°C (824.00°F)
Flash Point: 6°C (42.80°F)
NFPA Rating: Not published.
Explosion Limits, Lower: 9.70 vol %
Upper: 12.80 vol %

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indica in Section 8.
Spills/Leaks:
Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Remove all sources of ignition. Use a spark-proof tool.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Use spark-proof tools and explosion proof equipment. Avoid breathi dust, vapor, mist, or gas. Avoid contact with skin and eyes. Use o in a chemical fume hood.
Storage:
Keep away from sources of ignition. Store in a cool, dry place. Store in a tightly closed container. Flammables-area.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final P
TRANS-1,2-DICHLOROETHYLENE	none listed	none listed	none listed

OSHA Vacated PELs:
TRANS-1,2-DICHLOROETHYLENE:
No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:
Wear appropriate protective gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to prevent skin exposure.

Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Appearance:	Clear liquid (15 apha max.)
Odor:	Pleasant odor
pH:	Not available.
Vapor Pressure:	710 hPa @ 38°C
Vapor Density:	Not available.
Evaporation Rate:	Not available.
Viscosity:	Not available.
Boiling Point:	48°C @ 760.00mm Hg
Freezing/Melting Point:	-50°C
Decomposition Temperature:	Not available.
Solubility:	immiscible
Specific Gravity/Density:	1.2600g/cm3
Molecular Formula:	C2H2Cl2
Molecular Weight:	96.94

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, light, ignition sources, exposure to air, exposure to moist air or water.
Incompatibilities with Other Materials:
Oxidizing agents,alkalies, bases.
Hazardous Decomposition Products:
Hydrogen chloride, phosgene, carbon monoxide, carbon dioxide.
Hazardous Polymerization: Will not occur.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 156-60-5: KV9400000
LD50/LC50:
CAS# 156-60-5: Oral, mouse: LD50 = 2122 mg/kg; Oral, rat: LD50 = 1235 mg/kg; Skin, rabbit: LD50 = >5 gm/kg.
Carcinogenicity:
TRANS-1,2-DICHLOROETHYLENE -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No data available.
Teratogenicity:
No data available.
Reproductive Effects:
See actual entry in RTECS for complete information.
Neurotoxicity:
No data available.
Mutagenicity:
See actual entry in RTECS for complete information.
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Invertebrate toxicity:
ppm Microtox test.
Environmental Fate:
Not available.
Physical/Chemical:
Not available.
Other:
Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: waste number U079
This material is banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
No information available
IMO
Shipping Name: DICHLOROETHYLENE
Hazard Class: 3.2
UN Number: 1150
Packing Group: II
IATA
Shipping Name: 1,2-DICHLOROETHYLENE
Hazard Class: 3
UN Number: 1150
Packing Group: II
RID/ADR
Shipping Name: 1,2-DICHLOROETHYLENE
Dangerous Goods Code: 3(3B)
UN Number: 1150

Canadian TDG
Shipping Name: DICHLOROETHYLENE
Hazard Class: 3
UN Number: UN1150

**** SECTION 15 - REGULATORY INFORMATION ****

FEDERAL
TSCA
CAS# 156-60-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Ru
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
None of the chemicals in this material have an RQ.
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 156-60-5: acute, chronic, flammable.
Section 313
No chemicals are reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 156-60-5 is listed as a Priority Pollutant under the Clean Wa Act.
None of the chemicals in this product are listed as Toxic Pollutan under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazard by OSHA.
STATE
TRANS-1,2-DICHLOROETHYLENE can be found on the following state right to know lists: California, Florida, Pennsylvania, Massachusetts.
California No Significant Risk Level:
None of the chemicals in this product are listed.
INTERNATIONAL
European Labeling in Accordance with EC Directives
Hazard Symbols: XN F
Risk Phrases:
Safety Phrases:
S 16 Keep away from sources of ignition - No smoking.
S 29 Do not empty into drains.
S 7 Keep container tightly closed.
S 61 Avoid release to the environment. Refer to special instructions/Safety data sheets.
Canada
CAS# 156-60-5 is listed on Canada's DSL/NDSL List.
CAS# 156-60-5 is not listed on Canada's Ingredient Disclosure List
Exposure Limits:

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:
No additional information available.
MSDS Creation Date: 3/01/1994 Revision #1 Date: 9/27/1996

The information above is believed to be accurate and represents the bes information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect such information, and we assume no liability resulting from its use. Us should make their own investigations to determine the suitability of th information for their particular purposes. In no way shall Fisher be li for any claims, losses, or damages of any third party or for lost profi or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Use Web Browser "Back" key to return to previous topic

ACC00596

****** MATERIAL SAFETY DATA SHEET **** **** MATERIAL SAFETY DATA SHEET ******

Ethylbenzene, 99%
00596

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Ethylbenzene, 99%

```
Company Identification:  Acros Organics N.V.
                         Janssen Pharmaceuticalaan 3a
                         2440 Geel, Belgium
For information in North America, call:   800-ACROS-01
For information in Europe, call:          0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call:     0032(0) 14575299
```

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS
100-41-4	ETHYLBENZENE	100	202-849

Hazard Symbols: XN F

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: Not available. Flash Point: 15°C.
Warning! Flammable liquid. Causes skin irritation. Causes eye irritation. May cause central nervous system depression. Aspiration hazard. Causes digestive and respiratory tract irritation.
Target Organs: Central nervous system.

Potential Health Effects

Eye:
Vapors may cause eye irritation. Contact produces irritation, tearing, and burning pain.

Skin:
Causes skin irritation. Prolonged and/or repeated contact may caus irritation and/or dermatitis.

Ingestion:
May cause gastrointestinal irritation with nausea, vomiting and

diarrhea. May cause central nervous system depression, characteriz by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma possible death due to respiratory failure. Aspiration of material into the lungs may cause chemical pneumonitis, which may be fatal.

Inhalation:

Inhalation of high concentrations may cause central nervous system effects characterized by headache, dizziness, unconsciousness and coma. Causes respiratory tract irritation.

Chronic:

Not available.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid.

Skin:

Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists.

Ingestion:

Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid.

Inhalation:

Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxyge Get medical aid.

Notes to Physician:

Treat symptomatically and supportively.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:

Containers can build up pressure if exposed to heat and/or fire. A in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Vapors may form an explosive mixture with air. Vapors can travel to a source of ignition and flash back. Flammabl Liquid. Can release vapors that form explosive mixtures at temperatures above the flashpoint.

Extinguishing Media:

For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam.

Autoignition Temperature: 432°C (809.60°F)
Flash Point: 15°C (59.00°F)
NFPA Rating: health-2; flammability-3; reactivity-0
Explosion Limits, Lower: 1.00 vol %
Upper: 7.80 vol %

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indica in Section 8.

Spills/Leaks:

Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Remove all sources of ignition.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Ground and bond containers when transferring material. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, sparks or open flames. K container tightly closed. Avoid contact with heat, sparks and flam Avoid ingestion and inhalation.

Storage:
Keep away from heat, sparks, and flame. Keep from contact with oxidizing materials. Store in a cool, dry, well-ventilated area aw from incompatible substances. Flammables-area.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final P
ETHYLBENZENE	100 ppm ; 434 mg/m3; 125 ppm STEL; 543 mg/m3 STEL	100 ppm TWA; 435 mg/m3 TWA; 125 ppm STEL; 545 mg/m3 STEL	100 ppm TWA; 4 mg/m3 TWA

OSHA Vacated PELs:
ETHYLBENZENE:
100 ppm TWA; 435 mg/m3 TWA; 125 ppm STEL; 545 mg/m3 STEL

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:
Wear appropriate protective gloves and clothing to prevent skin exposure.

Clothing:
Wear appropriate protective gloves and clothing to prevent skin exposure.

Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Appearance:	Not available.
Odor:	Aronmatic odor.
pH:	Not available.
Vapor Pressure:	7.1 mm Hg @ 20 C
Vapor Density:	3.7
Evaporation Rate:	<1 (butyl acetate=1)
Viscosity:	0.63 mPas 20°C

Boiling Point:	136°C @ 760.00mm Hg
Freezing/Melting Point:	-95°C
Decomposition Temperature:	Not available.
Solubility:	insoluble in ammonia
Specific Gravity/Density:	.8670g/cm3
Molecular Formula:	C8H10
Molecular Weight:	106.17

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, ignition sources, excess heat.
Incompatibilities with Other Materials:
Reacts vigorously with oxidizers.
Hazardous Decomposition Products:
Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 100-41-4: DA0700000
LD50/LC50:
CAS# 100-41-4: Oral, rat: LD50 = 3500 mg/kg; Skin, rabbit: LD50 = 17800 mg/kg.
Carcinogenicity:
ETHYLBENZENE -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Shrimp (mysidoposis bahia), LC50=87.6 mg/L/96hr. Sheepshead minnow LC50=275 mg/L/96hr. Fathead minnow LC50=42.3 mg/L/96hr in hard wat and 48.5 mg/L/96hr in softwater.
Environmental Fate:
Substance may absorb to sediment and bioconcentrate in fish.
Physical/Chemical:
Not available.
Other:
Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: Not listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: ETHYLBENZENE
Hazard Class: 3
UN Number: UN1175
Packing Group: II

IMO
Shipping Name: ETHYLBENZENE
Hazard Class: 3.2
UN Number: 1175
Packing Group: II
IATA
Shipping Name: ETHYLBENZENE
Hazard Class: 3
UN Number: 1175
Packing Group: II
RID/ADR
Shipping Name: ETHYLBENZENE
Dangerous Goods Code: 3(3B)
UN Number: 1175
Canadian TDG
Shipping Name: ETHYLBENZENE
Hazard Class: 3(9.2)
UN Number: UN1175
Other Information: FLASHPOINT 15 C

**** SECTION 15 - REGULATORY INFORMATION ****

FEDERAL
TSCA
CAS# 100-41-4 is listed on the TSCA inventory.
Health & Safety Reporting List
CAS# 100-41-4: Effective Date: June 19, 1987
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Ru
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
final RQ = 1000 pounds (454 kg)
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 100-41-4: acute, chronic, flammable.
Section 313
This material contains ETHYLBENZENE (CAS# 100-41-4, 100%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
CAS# 100-41-4 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 100-41-4 is listed as a Hazardous Substance under the CWA.
CAS# 100-41-4 is listed as a Priority Pollutant under the Clean Wa Act.
CAS# 100-41-4 is listed as a Toxic Pollutant under the Clean Water Act.
OSHA:
None of the chemicals in this product are considered highly hazard by OSHA.
STATE
ETHYLBENZENE can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level:
None of the chemicals in this product are listed.

INTERNATIONAL

European Labeling in Accordance with EC Directives

Hazard Symbols: XN F

Risk Phrases:

Safety Phrases:

S 16 Keep away from sources of ignition - No smoking.
S 24/25 Avoid contact with skin and eyes.
S 29 Do not empty into drains.

Canada

CAS# 100-41-4 is listed on Canada's DSL/NDSL List.
CAS# 100-41-4 is listed on Canada's Ingredient Disclosure List.

Exposure Limits:

CAS# 100-41-4:. OEL-AUSTRALIA:TWA 100 ppm (435 mg/m3);STEL 125 pp 45 mg/m3). OEL-BELGIUM:TWA 100 ppm (434 mg/m3);STEL 125 ppm (543 m). OEL-CZECHOSLOVAKIA:TWA 200 mg/m3;STEL 1000 mg/m3. OEL-DENMARK:T 0 ppm (217 mg/m3). OEL-FINLAND:TWA 100 ppm (435 mg/m3);STEL 150 pp 55 mg/m3). OEL-FRANCE:TWA 100 ppm (435 mg/m3). OEL-GERMANY:TWA 100 (440 mg/m3);Skin. OEL-HUNGARY:TWA 100 mg/m3;STEL 200 mg/m3;Skin. O JAPAN:TWA 100 ppm (430 mg/m3). OEL-THE NETHERLANDS:TWA 100 ppm (43 /m3). OEL-THE PHILIPPINES:TWA 100 ppm (435 mg/m3). OEL-POLAND:TWA mg/m3. OEL-RUSSIA:TWA 100 ppm;STEL 50 mg/m3. OEL-SWEDEN:TWA 50 ppm 0 mg/m3);STEL 100 ppm (450 mg/m3). OEL-SWITZERLAND:TWA 100 ppm (43 /m3);STEL 500 ppm. OEL-TURKEY:TWA 100 ppm (435 mg/m3). OEL-UNITED DOM:TWA 100 ppm (435 mg/m3);STEL 125 ppm. OEL IN BULGARIA, COLOMBI ORDAN, KOREA check ACGIH TLV. OEL IN NEW ZEALAND, SINGAPORE, VIETN heck ACGI TLV

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:

No additional information available.

MSDS Creation Date: 2/07/1996 Revision #0 Date: Original.

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SIGMA-ALDRICH

ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

ATTN: SAFETY DIRECTOR

EMERGENCY PHONE 1-414-273-3850

DATE 08/15/96
CUST#: 942742
PO#:

SEAN DILLON
PROCESS TECHNOLOGY INC
5383 W FRANKLIN ROAD
BOISE ID 83705-1112

M A T E R I A L S A F E T Y D A T A S H E E T

SECTION 1. - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

CATALOG #: 32630-5
NAME: FLUOROTRICHLOROMETHANE, 99.5+%, NMR GRADE

CFC 11

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #: 75-69-4
MF: CCL3F
EC NO: 200-892-3

SYNONYMS
ALGOFRENE TYPE 1 * ARCTON 9 * ELECTRO-CF 11 * ESKIMON 11 * F 11 * FC 11 * FLUOROCARBON NO. 11 * FLUOROTRICHLOROMETHANE (OSHA) * FLUOROTROJCHLOROMETAN (POLISH) * FREON 11 * FREON 11A * FREON 11B * FREON HE * FREON MF * FRIGEN 11 * GENETRON 11 * HALOCARBON 11 * ISCEON 131 * ISOTRON 11 * LEDON 11 * METHANE, FLUOROTRICHLORO- * MONOFLUOROTRICHLOROMETHANE * NCI-C04637 * REFRIGERANT 11 * TRICHLOROFLUOROMETHANE (ACGIH:OSHA) * TRICHLOROMONOFLUOROMETHANE * UCON FLUROCARBON 11 * UCON REFRIGERANT 11 *

SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

LABEL PRECAUTIONARY STATEMENTS
IRRITANT
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
TARGET ORGAN(S):
HEART
LUNGS
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING.
DO NOT BREATHE VAPOR.
REFRIGERATE.

SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

SECTION 5. - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

CONTINUED ON NEXT PAGE

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CATALOG #: 32630-5
NAME: FLUOROTRICHLOROMETHANE, 99.5+%, NMR GRADE

EXTINGUISHING MEDIA
APPROPRIATE FOAM.
USE WATER SPRAY OR FOG NOZZLE TO KEEP CYLINDER COOL. MOVE CYLINDER AWAY FROM FIRE IF THERE IS NO RISK.

SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

SHUT OFF ALL SOURCES OF IGNITION.
EVACUATE AREA AND KEEP PERSONNEL UPWIND.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY LIME OR SODA ASH, PICK UP, KEEP IN A CLOSED CONTAINER AND HOLD FOR WASTE DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -

REFER TO SECTION 8.

ADDITIONAL INFORMATION
INCOMPATIBLE WITH: COPPER, BRONZE, SILVER, BERYLLIUM, ALKALI AND ALKALINE EARTH METALS.

SECTION 8. - - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

CHEMICAL SAFETY GOGGLES.
COMPATIBLE CHEMICAL-RESISTANT GLOVES.
NIOSH/MSHA-APPROVED RESPIRATOR.
MECHANICAL EXHAUST REQUIRED.
SAFETY SHOWER AND EYE BATH.
AVOID BREATHING VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID CONTACT AND INHALATION.
WASH THOROUGHLY AFTER HANDLING.
IRRITANT.
KEEP TIGHTLY CLOSED.

SECTION 9. - - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - - -

APPEARANCE AND ODOR
COLORLESS LIQUID

PHYSICAL PROPERTIES

CONTINUED ON NEXT PAGE

CATALOG #: 32630-5
NAME: FLUOROTRICHLOROMETHANE, 99.5+%, NMR GRADE

BOILING POINT: 23.7 C
MELTING POINT: -111 C TO -110 C
FLASHPOINT NONE
VAPOR PRESSURE: 12.85PSI 20 C 39.17PSI 55 C
SPECIFIC GRAVITY: 1.494

ECTION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - - -

STABILITY
STABLE.

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
REACTS WITH:
SODIUM
POTASSIUM
MAGNESIUM
ALUMINUM
ZINC
STORE AWAY FROM HEAT AND DIRECT SUNLIGHT.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
PHOSGENE GAS
HYDROGEN FLUORIDE

HAZARDOUS POLYMERIZATION
WILL NOT OCCUR.

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - - -

ACUTE EFFECTS
MAY BE HARMFUL BY INHALATION, INGESTION, OR SKIN ABSORPTION.
VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
CAUSES SKIN IRRITATION.
CAN CAUSE RAPID SUFFOCATION.
PROLONGED OR REPEATED EXPOSURE TO SKIN CAUSES DEFATTING AND DERMATITIS.
EXPOSURE CAN CAUSE:
NAUSEA, DIZZINESS AND HEADACHE
STOMACH PAINS, VOMITING, DIARRHEA.
MAY CAUSE NERVOUS SYSTEM DISTURBANCES.
WEAKNESS
UNCONSCIOUSNESS
TARGET ORGAN(S):
HEART
LUNGS

CONTINUED ON NEXT PAGE

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SIGMA Σ Aldrich Fluka SUPELCO SIGMA DIAGNOSTICS SAF SIGMA-ALDRICH RESEARCH

CATALOG #: 32630-5
NAME: FLUOROTRICHLOROMETHANE, 99.5+%, NMR GRADE

LIVER
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

ADDITIONAL INFORMATION
EXPOSURE TO HIGH CONCENTRATIONS OF VAPOR MAY CAUSE LIGHT-HEADEDNESS DISORIENTATION, NAUSEA, VOMITING, NARCOSIS, CARDIAC DYSRYTHMIAS, HYPOTENSION AND DEATH. THE CARDIAC DYSRYTHMIAS ARE POTENTIALLY LETHAL BECAUSE OF SENSITIZATION OF MYOCARDIUM TO ENDOGENOUS EPINEPHRINE.

RTECS #: PB6125000
METHANE, TRICHLOROFLUORO-

TOXICITY DATA

IHL-RAT LC50:13 PPH/15M	HUTODJ 1,239,82
IHL-MUS LC50:10 PPH/30M	EJTXAZ 9,385,76
IPR-MUS LD50:1743 MG/KG	TOIZAG 18,363,71
IHL-RBT LC50:25 PPH/30M	EJTXAZ 9,385,76
IHL-GPG LC50:25 PPH/30M	EJTXAZ 9,385,76

TARGET ORGAN DATA
BEHAVIORAL (CONVULSIONS OR EFFECT ON SEIZURE THRESHOLD)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER. OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - -

EUROPEAN INFORMATION
IRRITANT
R 36/37/38
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
S 26
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
S 36

CONTINUED ON NEXT PAGE

SIGMA-ALDRICH

ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

CUST#: 942742

CATALOG #: 32630-5
NAME: FLUOROTRICHLOROMETHANE, 99.5+%, NMR GRADE

WEAR SUITABLE PROTECTIVE CLOTHING.
S 23
DO NOT BREATHE VAPOR.

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK
ACGIH TLV-CL 1000 PPM 85INA8 6,1619,91
EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION
FEREAC 54,7740,89
MSHA STANDARD-AIR:TWA 1000 PPM (5600 MG/M3)
DTLVS* 3,118,71
OSHA PEL (GEN INDU):8H TWA 1000 PPM (5600 MG/M3)
CFRGBR 29,1910.1000,94
OSHA PEL (CONSTRUC):8H TWA 1000 PPM (5600 MG/M3)
CFRGBR 29,1926.55,94
OSHA PEL (SHIPYARD):8H TWA 1000 PPM (5600 MG/M3)
CFRGBR 29,1915.1000,93
OSHA PEL (FED CONT):8H TWA 1000 PPM (5600 MG/M3)
CFRGBR 41,50-204.50,94
OEL-AUSTRALIA:TWA 1000 PPM (5600 MG/M3) JAN93
OEL-BELGIUM:STEL 1000 PPM (5620 MG/M3) JAN93
OEL-DENMARK:TWA 1000 PPM (5600 MG/M3) JAN93
OEL-FINLAND:TWA 1000 PPM (5600 MG/M3);STEL 1250 PPM (7000 MG/M3) JAN93
OEL-FRANCE:TWA 1000 PPM (5600 MG/M3) JAN93
OEL-GERMANY:TWA 1000 PPM (5600 MG/M3) JAN93
OEL-HUNGARY:STEL 40 MG/M3 JAN93
OEL-JAPAN:STEL 1000 PPM (5600 MG/M3) JAN93
OEL-THE NETHERLANDS:TWA 1000 PPM (5600 MG/M3) JAN93
OEL-THE PHILIPPINES:TWA 1000 PPM (5600 MG/M3) JAN93
OEL-POLAND:TWA 500 MG/M3 JAN93
OEL-RUSSIA:STEL 1000 PPM (1000 MG/M3) JAN93
OEL-SWEDEN:TWA 500 PPM (3000 MG/M3);STEL 750 PPM (4500 MG/M3) JAN93
OEL-SWITZERLAND:TWA 1000 PPM (5600 MG/M3) JAN93
OEL-TURKEY:TWA 1000 PPM (5600 MG/M3) JAN93
OEL-UNITED KINGDOM:TWA 1000 PPM (5600 MG/M3);STEL 1250 PPM JAN93
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO FLUOROTRICHLOROMETHANE-AIR:CL 1000 PPM
NIOSH* DHHS #92-100,92
NOHS 1974: HZD 33565; NIS 304; TNF 68187; NOS 173; TNE 785337
NOES 1983: HZD 33565; NIS 142; TNF 15107; NOS 119; TNE 267742; TFE 95886
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES
ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, APRIL 1996
NIOSH ANALYTICAL METHOD, 1994: FLUOROTRICHLOROMETHANE, 1006
NIOSH ANALYTICAL METHOD, 1994: TRICHLOROFLUOROMETHANE, 1006
NCI CARCINOGENESIS BIOASSAY (GAVAGE);NO EVIDENCE:MOUSE

CONTINUED ON NEXT PAGE

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ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

CUST#: 942742

CATALOG #: 32630-5
NAME: FLUOROTRICHLOROMETHANE, 99.5+%, NMR GRADE

NCITR* NCI-TR-106,78
NCI CARCINOGENESIS BIOASSAY (GAVAGE);INADEQUATE STUDIES:RAT
NCITR* NCI-TR-106,78

U.S. INFORMATION
THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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DUPONT CANADA INC.

MATERIAL SAFETY DATA SHEET

"FREON" 12

CEF00012 Revised 20-JAN-1994 Printed 2-MAR-1994

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

"FREON" is a registered trademark of DuPont.

Corporate MSDS Number : DU001065
Formula : CCl2F2

Product Use

Refrigerant

Tradenames and Synonyms

DICHLORODIFLUOROMETHANE

Company Identification

MANUFACTURER/DISTRIBUTOR

DuPont Canada, Inc.
P.O. BOX 2200
STREETSVILLE
MISSISSAUGA, ONTARIO L5M 2H3

PHONE NUMBERS

Product Information : 1-800-387-2122
Transport Emergency : 1-613-348-3616 (24 HOURS)
Medical Emergency : 1-613-348-3616 (24 HOURS)

COMPOSITION/INFORMATION ON INGREDIENTS

Components

Material	CAS Number	%
*METHANE, DICHLORODIFLUORO ("FREON" 12 FLUOROCARBON)	75-71-8	100

* Regulated as a Toxic Chemical under Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372.

NOTICE FROM DUPONT: The information on 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.

HAZARDS IDENTIFICATION

Potential Health Effects

Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Intentional misuse or deliberate inhalation may cause death without warning. Vapor reduces oxygen available for breathing and is heavier than air. Liquid contact can cause frostbite. May cause eye irritation.

HUMAN HEALTH EFFECTS:

Human health effects of overexposure by eye contact with the vapor may include eye irritation with discomfort, tearing, or blurring of vision. Skin contact with the liquid may cause frostbite. Inhalation of the vapors may cause temporary nervous system depression with anesthetic effects such as dizziness, headache, confusion, incoordination, and loss of consciousness; temporary alteration of the heart's electrical activity with irregular pulse, palpitations, or inadequate circulation, or the effects of exclusion of oxygen with grossly excessive exposures.

Individuals with preexisting diseases of the central nervous or cardiovascular system may have increased susceptibility to the toxicity of excessive exposures.

Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

FIRST AID MEASURES

First Aid

INHALATION
If high concentrations are inhaled, immediately remove to fresh air. Keep person calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT
In case of contact, flush skin with water. Treat for frostbite if necessary by gently warming affected area.

EYE CONTACT
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION

(FIRST AID MEASURES - Continued)

Ingestion is not considered a potential route of exposure.

Notes to Physicians

Because of a possible disturbance of cardiac rhythm, catecholamine drugs, such as epinephrine, should only be used with special caution in situations of emergency life support.

FIRE FIGHTING MEASURES

Flammable Properties

Flash Point	: Will not burn
Flammable limits in Air, % by Volume	
LEL	: Not applicable
UEL	: Not applicable
Autoignition	: >750 C (>1382 F)

Fire and Explosion Hazards:

Cylinders may rupture under fire conditions. Decomposition may occur.

Extinguishing Media

As appropriate for combustibles in area.

Fire Fighting Instructions

Use water spray or fog to cool containers. Self-contained breathing apparatus (SCBA) is required if cylinders rupture and contents are released under fire conditions.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Accidental Release Measures

Ventilate area, especially low or enclosed places where heavy vapors might collect. Remove open flames. Use self-contained breathing apparatus (SCBA) for large spills.

HANDLING AND STORAGE

Handling (Personnel)

Use with sufficient ventilation to keep employee exposure below recommended limits.

Storage

Clean, dry area. Do not heat above 52 deg C (125 deg F).

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Normal ventilation for standard manufacturing procedures is generally adequate. Local exhaust should be used when large amounts are released. Mechanical ventilation should be used in low or enclosed places.

Personal Protective Equipment

Impervious gloves and chemical splash goggles should be used when handling liquid. Under normal manufacturing conditions, no respiratory protection is required when using this product. Self-contained breathing apparatus (SCBA) is required if a large release occurs.

Exposure Guidelines

Applicable Exposure Limits

METHANE, DICHLORODIFLUORO

PEL	(OSHA)	: 1,000 ppm, 4,950 mg/m3, 8 Hr. TWA
TLV	(ACGIH)	: 1,000 ppm, 4,950 mg/m3, 8 Hr. TWA
AEL *	(Du Pont)	: None Established

* AEL is Du Pont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

PHYSICAL AND CHEMICAL PROPERTIES

Physical Data

Boiling Point	: -29.8 C (-21.6 F)
Vapor Pressure	: 94.5 psia at 25 deg C (77 deg F)
Vapor Density	: 4.26 (Air = 1.0) at 25 deg C (77 deg F)
% Volatiles	: 100 WT%
Solubility in Water	: 0.028 WT% @ 25 C (77 F) at 1 atm
pH	: Neutral

(PHYSICAL AND CHEMICAL PROPERTIES - Continued)

Odor	: Slight ethereal
Form	: Liquified gas
Color	: Clear, colorless
Density	: 1.315 g/cc at 25 deg C (77 deg F) - Liquid

STABILITY AND REACTIVITY

Chemical Stability

Material is stable. However, avoid open flames and high temperatures.

Incompatibility with Other Materials

Incompatible with alkali or alkaline earth metals- powdered Al, Zn, Be, etc.

Polymerization

Polymerization will not occur.

Other Hazards

Decomposition : Decomposition products are hazardous. "FREON" 12 can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrochloric and hydrofluoric acids, and possibly carbonyl halides.

TOXICOLOGICAL INFORMATION

Animal Data

Inhalation 30-minute LC50:	800,000 ppm in rats
Oral ALD	: >1,000 mg/kg in rats

Effects in animals from single high exposure by inhalation include anesthesia and irregular heartbeat (cardiac arrythmias). Repeated inhalation exposures produced altered respiratory function. Long-term studies showed no significant clinical, blood chemistry or pathological effects following repeated exposures. The effects in animals from long-term ingestion of this material include slight alterations in blood chemistry and body weight gain. No other clinical, biochemical or pathological signs of toxicity have been observed.

Tests in animals demonstrate no carcinogenic activity and no developmental or reproductive toxicity. The compound does not produce heritable genetic damage in animals or genetic

(TOXICOLOGICAL INFORMATION - Continued)

damage in bacterial and mammalian cell cultures.

ECOLOGICAL INFORMATION

No Information Available

DISPOSAL CONSIDERATIONS

Waste Disposal

Comply with Federal, State, and local regulations.
Reclaim by distillation or remove to a permitted waste facility.

TRANSPORTATION INFORMATION

Shipping Information

DOT

Proper Shipping Name	: DICHLORODIFLUOROMETHANE
Hazard Class	: NONFLAMMABLE GAS
I.D. No. (UN/NA)	: UN1028
DOT Label(s)	: NONFLAMMABLE GAS
DOT Placard	: NONFLAMMABLE GAS

DOT/IMO

Proper Shipping Name	: DICHLORODIFLUOROMETHANE
Hazard Class	: NONFLAMMABLE GAS, 2.2
UN No.	: UN1028
DOT/IMO Label	: NONFLAMMABLE GAS

Shipping Containers

Tank Cars.

Cylinders, Ton tanks

Reportable Quantity : 5,000 lbs./2,270 kg.

Shipping Information -- Canada

TDG

Proper Shipping Name	: DICHLORODIFLUOROMETHANE
PIN No.	: 1028
TDG Class	: 2.2

REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status : Reported/Included.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : Yes
Chronic : No
Fire : No
Reactivity : No
Pressure : Yes

LISTS:

Extremely Hazardous Substance - No
CERCLA Hazardous Substance - Yes
Toxic Chemicals - No

Canadian Regulations

CEPA Status : Compliant.

WHMIS Classification:

CLASS A Compressed Gas

This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

OTHER INFORMATION

NFPA, NPCA-HMIS

NPCA-HMIS Rating
Health : 1
Flammability : 0
Reactivity : 1

Personal Protection rating to be supplied by user depending on use conditions.

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.

Responsibility for MSDS

(Continued)

FLUOROPRODUCTS
DuPont Canada Inc.
Box 2200, Streetsville
Mississauga, Ontario, L5M 2H3
(905) 821-5925.

End of MSDS

...SION: 004 FREON (R) PCA

REVISION OF: 12/29/89

ORDER NO: 101640
PROD NO : 268420

CFC 113

PROCESS TECHNOLOGIES INC.
PO BOX 476
707 TROUTNER WAY

BOISE ,ID 837014969

AN WATERS & ROGERS , SUBSIDIARY OF UNIVAR (408)435-8700
1600 NORTON BUILDING , SEATTLE , WA 98104

EMERGENCY ASSISTANCE

FOR EMERGENCY ASSISTANCE INVOLVING CHEMICALS CALL - CHEMTREC
(800)424-9300

FOR PRODUCT AND SALES INFORMATION

CONTACT YOUR LOCAL VAN WATERS & ROGERS BRANCH OFFICE AT
VW&R NAMPA OFFICE 208-466-7006 NAMPA , ID

PRODUCT IDENTIFICATION

PRODUCT NAME: FREON (R) PCA
OMMON NAMES/SYNONYMS:
,,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE

CAS NO.: 76-13-1
VW&R CODE: P1110004

ORMULA: C2 CL3 F3
AZARD RATING (NFPA 704)
HEALTH: 1
FIRE: 1
REACTIVITY: 0
SPECIAL: NONE

DATE ISSUED: 08/89
SUPERCEDES: 06/89
HAZARD RATING SCALE:
0=MINIMAL 3=SERIOUS
1=SLIGHT 4=SEVERE
2=MODERATE

HAZARDOUS INGREDIENTS

		EXPOSURE LIMITS, PPM			
		OSHA	ACGIH	OTHER	
COMPONENT	%	PEL	TLV	LIMIT	HAZARD
FREON (R) PCA	>99	1000	1000	1250 STEL	OSHA / ACGIH LIST

(R) TRADEMARK OF DUPONT FOR ITS FLUOROCARBON COMPOUNDS

PHYSICAL PROPERTIES

...LING POINT, DEG F: 117.6
...TING POINT, DEG F: -31
...CIFIC GRAVITY (WATER=1): 1.57
APPEARANCE AND ODOR: CLEAR,

VAPOR PRESSURE, MM HG/25 DEG C: 334
VAPOR DENSITY (AIR=1): 6.9
WATER SOLUBILITY, %: NIL
EVAPORATION RATE (BUTYL ACETATE=1): >1

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COLORLESS LIQUID; SLIGHT
ETHEREAL ODOR

----------FIRST AID MEASURES----------

IF INHALED: REMOVE TO FRESH AIR. GIVE ARTIFICIAL RESPIRATION IF NOT BREATHING. GET IMMEDIATE MEDICAL ATTENTION.

IN CASE OF EYE CONTACT: IMMEDIATELY FLUSH EYES WITH LOTS OF RUNNING WATER FOR 15 MINUTES, LIFTING THE UPPER AND LOWER EYELIDS OCCASIONALLY. GET IMMEDIATE MEDICAL ATTENTION.

IN CASE OF SKIN CONTACT: IMMEDIATELY WASH SKIN WITH LOTS OF SOAP AND WATER. REMOVE CONTAMINATED CLOTHING AND SHOES; WASH BEFORE REUSE. GET MEDICAL ATTENTION IF IRRITATION PERSISTS AFTER WASHING.

IF SWALLOWED: DO NOT INDUCE VOMITING. IF CONSCIOUS, GIVE LOTS OF WATER OR MILK. GET IMMEDIATE MEDICAL ATTENTION. DO NOT GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS OR CONVULSING PERSON.

NOTE TO PHYSICIAN: BECAUSE OF A POSSIBLE INCREASED RISK OF ELICITING CARDIAC DYSRYTHMIAS, CATECHOLAMINE DRUGS, SUCH AS EPINEPHRINE, SHOULD BE CONSIDERED ONLY AS A LAST RESORT IN LIFE THREATENING EMERGENCIES.

----------HEALTH HAZARD INFORMATION----------

PRIMARY ROUTES OF EXPOSURE: INHALATION, SKIN OR EYE CONTACT.

SIGNS AND SYMPTOMS OF EXPOSURE

INHALATION: PROLONGED OR REPEATED EXPOSURE OR BREATHING VERY HIGH CONCENTRATIONS MAY CAUSE LIGHT-HEADEDNESS, GIDDINESS, SHORTNESS OF BREATH AND MAY LEAD TO NARCOSIS, CARDIAC IRREGULARITIES, UNCONSCIOUSNESS, OR DEATH. VAPORS ARE HEAVIER THAN AIR AND CAN CAUSE SUFFOCATION BY REDUCING OXYGEN AVAILABLE FOR BREATHING. IN SCREENING STUDIES WITH EXPERIMENTAL ANIMALS, EXPOSURE TO FREON (R) TF AT APPROXIMATELY 5000 PPM (V/V) AND ABOVE, FOLLOWED BY A LARGE INTRAVENOUS EPINEPHRINE CHALLENGE, HAS INDUCED SERIOUS CARDIAC IRREGULARITIES.

EYE CONTACT: LIQUID AND MIST MAY IRRITATE THE EYES.

SKIN CONTACT: NO IRRITATION IS LIKELY AFTER BRIEF CONTACT BUT MAY BE IRRITATING AFTER PROLONGED CONTACT.

SWALLOWED: SWALLOWING LARGE QUANTITIES MAY CAUSE NAUSEA AND VOMITING.

CHRONIC EFFECTS OF EXPOSURE: NO SPECIFIC INFORMATION AVAILABLE.

VERSION: 004 FREON (E: PCA REVISION OF: 12/29/89

ORDER NO: 101640
PROD NO : 268420

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: CARDIOVASCULAR DISEASE MAY BE AGGRAVATED.

TOXICITY DATA

ORAL: RAT LD50 = 43 G/KG

DERMAL: RABBIT 500 MG ON OPEN SKIN PRODUCED MILD IRRITATION.

INHALATION: RAT LC50 = 52,000 PPM / 4H

CARCINOGENICITY: THIS MATERIAL IS NOT CONSIDERED TO BE A CARCINOGEN BY THE NATIONAL TOXICOLOGY PROGRAM, THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER, OR THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

OTHER DATA: NONE

PERSONAL PROTECTION

VENTILATION: LOCAL MECHANICAL EXHAUST VENTILATION CAPABLE OF MAINTAINING EMISSIONS AT THE POINT OF USE BELOW THE PEL.

RESPIRATORY PROTECTION: WEAR A NIOSH-APPROVED SELF-CONTAINED BREATHING APPARATUS IN THE PRESSURE DEMAND MODE, OR A SUPPLIED-AIR RESPIRATOR IF USE CONDITIONS GENERATE VAPORS OR MISTS.

EYE PROTECTION: CHEMICAL GOGGLES UNLESS A FULL FACEPIECE RESPIRATOR IS ALSO WORN. IT IS GENERALLY RECOGNIZED THAT CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH CHEMICALS BECAUSE CONTACT LENSES MAY CONTRIBUTE TO THE SEVERITY OF AN EYE INJURY.

PROTECTIVE CLOTHING: LONG-SLEEVED SHIRT, TROUSERS, SAFETY SHOES, RUBBER GLOVES, AND RUBBER APRON.

OTHER PROTECTIVE MEASURES: AN EYEWASH AND SAFETY SHOWER SHOULD BE READY AND READY FOR USE.

FIRE AND EXPLOSION INFORMATION

FLASH POINT, DEG F: NONE FLAMMABLE LIMITS IN AIR, %
METHOD USED: N/A LOWER: N/A UPPER: N/A

EXTINGUISHING MEDIA: THIS MATERIAL IS NOT COMBUSTIBLE. USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE FIGHTING PROCEDURES: FIRE FIGHTERS SHOULD WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. USE WATER SPRAY TO COOL NEARBY CONTAINERS AND STRUCTURES EXPOSED TO FIRE.

UNUSUAL FIRE AND EXPLOSION HAZARDS: EXTINGUISH ALL NEARBY SOURCES OF IGNITION SINCE VAPORS DECOMPOSE TO HAZARDOUS PRODUCTS AT HIGH TEMPERATURES.

HAZARDOUS REACTIVITY

STABILITY: STABLE POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID: OPEN FLAMES, WELDING ARCS, OR OTHER HIGH TEMPERATURE SOURCES WHICH MAY INDUCE THERMAL DECOMPOSITION.

MATERIALS TO AVOID: ALKALIS, OXIDIZING MATERIALS, WATER, AND MOIST AIR. ALSO ALKALI OR ALKALINE EARTH METALS, AND POWDERED ALUMINUM OR ZINC.

HAZARDOUS DECOMPOSITION PRODUCTS: MAY LIBERATE CARBON MONOXIDE, CARBON DIOXIDE, HYDROGEN CHLORIDE, CHLORINE, PHOSGENE, OR HYDROGEN FLOURIDE.

SPILL, LEAK, AND DISPOSAL PROCEDURES

ACTION TO TAKE FOR SPILLS OR LEAKS: WEAR PROTECTIVE EQUIPMENT INCLUDING RUBBER BOOTS, RUBBER GLOVES, RUBBER APRON, AND A SELF-CONTAINED BREATHING APPARATUS IN THE PRESSURE DEMAND MODE OR A SUPPLIED-AIR RESPIRATOR. IF THE SPILL OR LEAK IS SMALL, A FULL FACEPIECE AIR-PURIFYING CARTRIDGE RESPIRATOR EQUIPPED FOR ORGANIC VAPORS MAY BE SATISFACTORY. IN ANY EVENT, ALWAYS WEAR EYE PROTECTION. EXTINGUISH ALL IGNITION SOURCES. FOR SMALL SPILLS OR DRIPS, MOP OR WIPE UP AND DISPOSE OF IN DOT-APPROVED WASTE CONTAINERS. FOR LARGE SPILLS, CONTAIN BY DIKING WITH SOIL OR OTHER NON-COMBUSTIBLE SORBENT MATERIAL AND THEN PUMP INTO DOT-APPROVED WASTE CONTAINERS; OR ABSORB WITH NON-COMBUSTIBLE SORBENT MATERIAL AND PLACE RESIDUE IN DOT-APPROVED WASTE CONTAINERS. KEEP OUT OF SEWERS, STORM DRAINS, SURFACE WATERS, AND SOIL. COMPLY WITH ALL APPLICABLE GOVERNMENTAL REGULATIONS ON SPILL REPORTING, AND HANDLING AND DISPOSAL OF WASTE.

DISPOSAL METHODS: DISPOSE OF CONTAMINATED PRODUCT AND MATERIALS USED IN CLEANING UP SPILLS OR LEAKS IN A MANNER APPROVED FOR THIS MATERIAL. CONSULT APPROPRIATE FEDERAL, STATE AND LOCAL REGULATORY AGENCIES TO ASCERTAIN PROPER DISPOSAL PROCEDURES.
NOTE: EMPTY CONTAINERS CAN HAVE RESIDUES, GASES AND MISTS AND ARE SUBJECT TO PROPER WASTE DISPOSAL, AS ABOVE.

SPECIAL PRECAUTIONS

STORAGE AND HANDLING PRECAUTIONS: STORE IN A COOL, DRY, WELL-VENTILATED PLACE. STORE AWAY FROM ALL OTHER CHEMICALS AND POTENTIAL SOURCES OF CONTAMINATION. KEEP CONTAINER TIGHTLY CLOSED WHEN NOT IN USE. DO NOT PRESSURE TO EMPTY CONTAINER. WASH THOROUGHLY AFTER HANDLING. DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING. DO NOT HEAT CLOSED CONTAINER ABOVE 125 DEG F.

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REPAIR AND MAINTENANCE PRECAUTIONS: DO NOT CUT, GRIND, WELD, OR DRILL ON OR NEAR THIS CONTAINER.

OTHER PRECAUTIONS: VAPORS OF THIS PRODUCT ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW PLACES, SUCH AS PITS OR DEGREASERS, OR OTHER POORLY VENTILATED AREAS. DO NOT ENTER PLACES WHERE VAPORS ARE SUSPECTED UNLESS SPECIAL RESPIRATORY PROTECTION IS WORN AND AN OBSERVER IS PRESENT.

OTHER PRECAUTIONS: CONTAINERS, EVEN THOSE THAT HAVE BEEN EMPTIED, WILL RETAIN PRODUCT RESIDUE AND VAPORS. ALWAYS OBEY HAZARD WARNINGS AND HANDLE EMPTY CONTAINERS AS IF THEY WERE FULL.

OTHER REGULATORY INFORMATION

DO NOT DETACH THIS SECTION FROM THE MSDS AND BE SURE TO INCLUDE THIS SECTION WHEN COPYING THE MSDS.

THIS PRODUCT CONTAINS THE FOLLOWING TOXIC CHEMICAL(S) SUBJECT TO THE REPORTING REQUIREMENTS OF SECTION 313 OF TITLE III OF THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 AND 40 CFR PART 372:

NAME	CAS NO.	%, WT
FREON 113	76-13-1	>99%

REVISIONS

6/86: CORRECTED VAPOR PRESSURE AND EVAPORATION RATE. ADDED NOTE TO PHYSICIAN. EXPANDED INHALATION HAZARDS AND AGGRAVATED MEDICAL CONDITIONS. REPORTED INHALATION TOXICITY DATA. REVISED RESPIRATORY AND EYE PROTECTION. REVISED FIRE AND EXPLOSION INFORMATION. EXPANDED SPILL/LEAK PROCEDURES AND HANDLING ADVICE.

REVISION

12/88: ADDED OTHER REGULATORY INFORMATION.

4/89: REVISED OTHER EXPOSURE LIMIT AND OTHER REGULATORY INFORMATION.

09/89: CHANGED HEADING AND CONTACT INFORMATION.

V SION: 004 PRIOR (C) PCA

REVISION DF: 12/29/89

ORDER NO: 101640
PROD NO : 268420

FOR ADDITIONAL INFORMATION

CONTACT: MSDS COORDINATOR VW&R NAMPA OFFICE
DURING BUSINESS HOURS, PACIFIC TIME (408)435-8700

11/12/90 09:49 PRODUCT: 268420 CUST NO: 144148 ORDER NO: 101640

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* * * E N D O F M S D S * * *

DICHLOROMETHANE

Material Safety Data Sheet

Mallinckrodt Chemical, Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 04-19-95 Supersedes 11-27-89

PRODUCT IDENTIFICATION:

Synonyms: Methylene chloride; methylene dichloride

Formula CAS No.: 75-09-2 Molecular Weight: 84.93

Hazardous Ingredients: Methylene chloride Chemical Formula: CH2Cl2

PRECAUTIONARY MEASURES

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. A CENTRAL NERVOUS SYSTEM DEPRESSANT. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

Do not breathe vapor.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
Do not get in eyes, on skin, or on clothing.

EMERGENCY FIRST AID

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. 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.
SEE SECTION 5.

Physical Data — SECTION 1

Appearance: Clear, colorless liquid.

Odor: Chloroform-like.

Solubility: 1.32 gm/100 gm water @ 20 C (68 F).

Boiling Point: 39.8 C (104 F).

Vapor Density (Air=1):2.9

Melting Point: -97 C (-142 F).

Vapor Pressure (mm Hg):350 @ 20 C (68 F).

Specific Gravity: 1.3

Evaporation Rate:(BuAc=1): 27.5

NFPA Ratings: Health: 2 Flammability: 1 Reactivity: 0

Fire and Explosion Information — SECTION 2

Fire: Flashpoint: None. Autoignition temperature: >556 C (1033 F). Flammable limits in air, % by volume: lel: 12, uel: 19 (in oxygen). Forms flammable vapor-air mixtures above 100 C (212 F).

Explosion: No explosion hazard under ordinary conditions, but will form explosive mixtures in atmospheres

having high oxygen content, in liquid oxygen, potassium, sodium sodium, potassium alloy, nitrogen dioxide.

Fire Extinguishing Media: Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Vapors can flow along surfaces to distant ignition source and flash back.

Reactivity Data — SECTION 3

Stability: Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products: Emits highly toxic fumes of phosgene when heated to decomposition. Decomposes in a flame or hot surface to form toxic gas phosgene and corrosive mists of hydrochloric acid.

Hazardous Polymerization: This substance does not polymerize.

Incompatibilities: Contact with strong oxidizers, strong caustics, and chemically active metals, such as aluminum and magnesium powder, sodium, potassium, and lithium. Avoid contact with open flames and electrical arcs.

Leak/Spill Disposal Information — SECTION 4

Ventilate area of leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Contain and recover liquid when possible. Collect as hazardous waste and atomize in a suitable RCRA approved combustion chamber, or absorb with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!

Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Higher exposures may result in unconsciousness and even death. May cause liver injury and blood disorders.

Ingestion: May cause irritation of the gastrointestinal tract with vomiting. If vomiting results in aspiration, chemical pneumonia could follow. Absorption through gastrointestinal tract may produce symptoms of central nervous system depression ranging from light headedness to unconsciousness.

Skin Contact: Causes redness, irritation or burns. Liquid degreases the skin. May be absorbed through skin.

Eye Contact: Vapors can cause eye irritation. Contact can produce pain and inflammation.

Chronic Exposure:	Can cause headache, mental confusion, depression, loss of appetite, nausea, cough, lack of balance, and visual disturbances. Can cause dermatitis upon prolonged skin contact.
Aggravation of Pre-existing Conditions:	Persons with pre-existing skin disorders, eye problems, impaired liver, kidney, respiratory or cardiovascular function may be more susceptible to the effects of this substance.

B. FIRST AID

Inhalation:	Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:	Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconcious person.
Skin Exposure:	In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.
Eye Exposure:	Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1994)

Oral rat LD50: 1600 mg/kg; inhalation rat LC50: 88 gm/m3/30M; investigated as a tumorigen, mutagen, reproductive effector; Cancer Status: IARC Category 2B, NTP Listed Carcinogen.

Occupational Control Measures SECTION 6

Airborne Exposure Limits:	-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA) 1000 ppm (ceiling) 2000 ppm/5m/2H (peak) -ACGIH Threshold Limit Value (TLV): 50 ppm (TWA) Listed as A2, suspected human carcinogen.
Ventilation System:	A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.
Personal Respirators (NIOSH Approved)	If the TLV is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or self-contained breathing apparatus.
Skin Protection:	Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:	Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information SECTION 7

Keep in a tightly closed container. Store in a cool, dry, ventilated area away from sources of heat or ignition. Protect against physical damage. Outside or detached storage is recommended. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Under normal conditions can be stored in galvanized iron, black iron or steel. Aluminum is not generally recommended. Wear special protective equipment (Sec. 6) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace.Odor Threshold: 205 - 307 ppm. The odor theshold only serves as a warning of exposure; not smelling it does not mean you are not being exposed.

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DICME

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
must include a copy of this addendum

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X			

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
DICHLOROMETHANE Methylene chloride (75-09-2) 100% Listed on the TSCA Inventory.	No	No	Yes	No	1000	U080

PROPOSITION 65 Warning!
This product contains a chemical known to the state of California to cause cancer.

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Environmental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards or toxic under 40 CFR 261.33

DICME

DICHLOROMETHANE

METHYL ETHYL KETONE

Material Safety Data Sheet

Mallinckrodt Chemical Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 04-06-89 Supersedes 07-13-87

PRODUCT IDENTIFICATION:

Synonyms: 2-Butanone; ethyl methyl ketone; MEK

Formula CAS No.: 78-93-3 Molecular Weight: 72.11

Hazardous Ingredients: Methyl ethyl ketone Chemical Formula: CH3COCH2CH3

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE LIQUID. HARMFUL IF SWALLOWED OR INHALED. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES EYE IRRITATION.

Keep away from heat, sparks and flame.
Keep container closed.
Use with adequate ventilation.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.

EMERGENCY FIRST AID

In all cases call a physician immediately. If swallowed, induce vomiting immediately by giving two glasses of water, or milk if available and sticking finger down throat. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes.
SEE SECTION 5.

Physical Data — SECTION 1

Appearance: Clear, colorless liquid.

Odor: Sharp mint-like odor.

Solubility: 29 g in 100 g of water.

Boiling Point: ca. 80 C (176 F) Vapor Density (Air=1):2.5

Melting Point: -86 C (-122 F) Vapor Pressure (mm Hg):100 at 25 C (77 F)

Specific Gravity: 0.805 Evaporation Rate:(Ether=1): 2.7

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

Fire and Explosion Information — SECTION 2

Fire: Flammable. Flashpoint: -6 C (21 F) (CC). Autoignition temperature: 516 C (961 F). Flammable limits in air, % by volume: lel = 1.8; uel = 11.5.

Explosion: Above flash point, vapor-air mixtures are explosive within flammable limits noted above.

Fire Extinguishing Media:	Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.
Special Information:	In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. This highly flammable liquid must be kept from sparks, open flame, hot surfaces, and all sources of heat and ignition. Vapors can flow along surfaces to distant ignition source and flash back.

Reactivity Data — SECTION 3

Stability:	Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:	Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:	This substance does not polymerize.
Incompatibilities:	Oxidizing materials, chloroform, chlorosulfonic acid, oleum, potassium-t-butoxide, heat or flame, hydrogen peroxide, nitric acid. Can attack many plastics, resins and rubber.

Leak/Spill Disposal Information — SECTION 4

Ventilate area of leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Dike and contain. Recover liquid when possible. Use non-sparking tools and equipment. Collect as hazardous waste and atomize in a suitable RCRA approved combustion chamber, or absorb with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!
Reportable Quantity (RQ)(CWA/CERCLA) : 5000 lbs.
Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation:	May cause irritation to the nose and throat. Concentrations above the TLV may cause headache, dizziness, nausea, shortness of breath, and vomiting. Higher concentrations may cause central nervous system depression and unconsciousness.
Ingestion:	May cause irritation to the digestive tract, with abdominal spasms, nausea, and vomiting. Larger doses may cause narcosis.
Skin Contact:	May cause irritation with skin discoloration.
Eye Contact:	Vapors are irritating to the eyes. Splashes may produce painful irritation and eye damage.
Chronic Exposure:	Prolonged skin contact may defat the skin and produce dermatitis.
Aggravation of Pre-existing Conditions:	Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be

more susceptible to the effects of the substance.

B. FIRST AID

Inhalation:	Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:	If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately. Keep patient's head below hips while vomiting.
Skin Exposure:	Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Exposure:	Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1986)

Oral rat LD50: 2737 mg/kg. Skin rabbit LD50: 12 G/Kg. Aquatic toxicity rating TLm 96: Over 1000 ppm. Reproductive effects data cited.

Occupational Control Measures SECTION 6

Airborne Exposure Limits:	-OSHA Permissible Exposure Limit (PEL): 200 ppm (TWA), 300 ppm (STEL) -ACGIH Threshold Limit Value (TLV): 200 ppm (TWA), 300 ppm (STEL)
Ventilation System:	A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details. Use explosion-proof equipment.
Personal Respirators (NIOSH Approved)	If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.
Skin Protection:	Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:	Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information SECTION 7

Keep in a tightly closed container. Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid

static sparks. Storage and use areas should be No Smoking areas. Spark-proof tools and explosion-proof equipment should be used in the storage and handling area.

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MEETH

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
must include a copy of this addendum

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X	X		

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
METHYL ETHYL KETONE (78-93-3)	No	No	Yes	No	No	No

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

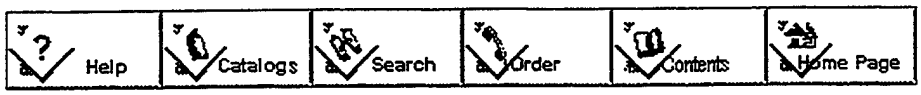
SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Enviromental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

MEETH

METHYL ETHYL KETONE



Use Web Browser "Back" key to return to previous topic

ACC96536

****** MATERIAL SAFETY DATA SHEET **** **** MATERIAL SAFETY DATA SHEET ******

Styrene, 99%, stab. with 10-15 ppm p-tert. -butylcatechol
96536

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Styrene, 99%, stab. with 10-15 ppm p-tert. -butylcatechol

Synonyms:
Ethenylbenzene
Company Identification: Acros Organics N.V.
Janssen Pharmaceuticalaan 3a
2440 Geel, Belgium
For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS
100-42-5	STYRENE	>99.0%	202-851

Hazard Symbols: XN

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: Not available. Flash Point: 32°C.
Warning! Flammable liquid. Light sensitive. Air sensitive. Cancer suspect agent. May cause central nervous system depression. Aspiration hazard. May cause eye and skin irritation. May cause respiratory and digestive tract irritation. May cause reproductive and fetal effects. May cause cancer based on animal studies.
Target Organs: Central nervous system.

Potential Health Effects
Eye:
Causes eye irritation.
Skin:
May be absorbed through the skin in harmful amounts. Prolonged

and/or repeated contact may cause defatting of the skin and dermatitis.

Ingestion:
May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nause Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. Aspiration of material into the lungs may cause chemical pneumonitis, which may be fatal.

Inhalation:
Aspiration may cause respiratory swelling and pneumonitis. Causes narcotic effects including headache, dizziness, weakness, unconsciousness, and possible death.

Chronic:
Not available.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Immediately flush eyes with plenty of water for at least 15 minute occasionally lifting the upper and lower lids. Get medical aid.

Skin:
Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists.

Ingestion:
Do NOT induce vomiting. Get medical aid immediately.

Inhalation:
Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Notes to Physician:
Treat symptomatically

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Vapors may form an explosive mixture with air. Flammable Liquid. Can release vapors that form explosive mixtures temperatures above the flashpoint. Containers may explode in the h of a fire.

Extinguishing Media:
This material is lighter than water and insoluble in water. The fi could easily be spread by the use of water in an area where the wa cannot be contained. In case of fire, use water fog, dry chemical, carbon dioxide, or regular foam.

Autoignition Temperature: 490°C (914.00°F)
Flash Point: 32°C (89.60°F)
NFPA Rating: health-2; flammability-3; reactivity-2
Explosion Limits, Lower: 1.10 vol %
Upper: 6.10 vol %

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indica in Section 8.

Spills/Leaks:
Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Use a spark-proof tool.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well ventilated area. Ground and bond containers when transferring material. Use spark-proof tools explosion proof equipment. Avoid contact with skin and eyes. Empty containers retain product residue, (liquid and/or vapor), and can dangerous. Do not pressurize, cut, weld, braze, solder, drill, gri or expose such containers to heat, sparks or open flames. Take precautionary measures against static discharges. Avoid ingestion and inhalation. Wash clothing before reuse.

Storage:
Keep away from sources of ignition. Store in a cool place in the original container and protect from sunlight.
Refrigerator/flammables.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final P
STYRENE	50 ppm ; 213 mg/m3; 100 ppm STEL; 426 mg/m3 STEL	50 ppm TWA; 215 mg/m3 TWA; 100 ppm STEL; 425 mg/m3 STEL	100 ppm TWA; C 200 ppm; C 2 ppm

OSHA Vacated PELs:
STYRENE:
50 ppm TWA; 215 mg/m3 TWA; 100 ppm STEL; 425 mg/m3 STEL

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:
Wear appropriate protective gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to minimize contact with skin.

Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Appearance:	Not available.
Odor:	Pungent
pH:	Not available.
Vapor Pressure:	568 mm Hg

Vapor Density:	1.22 Kg/m3
Evaporation Rate:	0.5 (Butyl Acetate=1)
Viscosity:	Not available.
Boiling Point:	145 - 146°C @ 760.00mm Hg
Freezing/Melting Point:	-31°C
Decomposition Temperature:	Not available.
Solubility:	IN WATER: 0.03 G/100ML (20°C)
Specific Gravity/Density:	.9090g/cm3
Molecular Formula:	C8H8
Molecular Weight:	104.15

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, ignition sources.
Incompatibilities with Other Materials:
Vapor is explosive when exposed to heat or flame and reacts with oxygen at temperatures above 104 F, unhibited material may form explosive peroxides. Uninhibited material may polymerize which becomes self-sustaining at temperatures above 65 C. Exposure to butyllithium, dibenzoyl peroxide, azoisobutyronitrile or di-tert-butylperoxide may cause violent polymerization. Violent reaction with chlorosulfonic acid, oleum, sulfuric acid and oxidizers. Oxygen + heat is explosive.
Hazardous Decomposition Products:
Carbon monoxide, carbon dioxide.
Hazardous Polymerization: May occur.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 100-42-5: WL3675000
LD50/LC50:
CAS# 100-42-5: Inhalation, mouse: LC50 =9500 mg/m3/4H; Inhalation, rat: LC50 =24 gm/m3/4H; Oral, mouse: LD50 = 316 mg/kg; Oral, rat: LD50 = 2650 mg/kg.
Carcinogenicity:
STYRENE -
OSHA: Possible Select carcinogen
IARC: Group 2B carcinogen
Epidemiology:
There are conflicting reports between exposure and birth def ects and fetal loss. In one report, women who worked at th e most highly exposed jobs had offspring with lower bi rth weights than those of unexposed women.
Teratogenicity:
This chemical does not seem to be teratogenic in experimental animals.
Reproductive Effects:
RTECs reports reproductive effects in animals such as effects on weaning/lactation index, naternal effects, fetoxitity, stillbirth and post-implantation mortality.
Mutagenicity:
An increased incidence of mutations such as chromosome aberrations and micronuclei in peripheral lymphocytes has been reported in workers exposed occupationally. Some studies have found a slight increase in the incidence of sister chromatid exchanges while no increase has been found in several other studies.
Other Studies:

IARC has determined that there is inadequate evidence for carcinogenicity in humans. Three studies have sugg ested an association between leukaemia and lymph omas with exposure to styrene. Other studies have sh own no excess in mortality from cancer in humans. IARC has determined there is sufficient evidence of carcinogen icity in animals.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Not available.
Environmental Fate:
In water, substance will volatilize rapidly and may biodegrade. It not expected to hydrolyze.
Physical/Chemical:
In soil, substance will biodegrade and leach with a low to moderat soil mobility.
Other:
Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: Not listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: STYRENE MONOMER, INHIBITED
Hazard Class: 3
UN Number: UN2055
Packing Group: III
IMO
Shipping Name: STYRENE MONOMER, INHIBITED
Hazard Class: 3.3
UN Number: 2055
Packing Group: III
IATA
Shipping Name: STYRENE MONOMER, INHIBITED
Hazard Class: 3
UN Number: 2055
Packing Group: III
RID/ADR
Shipping Name: STYRENE MONOMER, INHIBITED
Dangerous Goods Code: 3(31C)
UN Number: 2055
Canadian TDG
Shipping Name: STYRENE MONOMER INHIBITED
Hazard Class: 3(9.2)
UN Number: UN2055
Other Information: FLASHPOINT 32 C

**** SECTION 15 - REGULATORY INFORMATION ****

FEDERAL

TSCA
CAS# 100-42-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Ru
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
final RQ = 1000 pounds (454 kg)
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 100-42-5: acute, chronic, flammable, reactive.
Section 313
This material contains STYRENE (CAS# 100-42-5, >99.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
CAS# 100-42-5 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 100-42-5 is listed as a Hazardous Substance under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutan under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazard by OSHA.

STATE
STYRENE can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level:
None of the chemicals in this product are listed.

INTERNATIONAL
European Labeling in Accordance with EC Directives
Hazard Symbols: XN
Risk Phrases:
Safety Phrases:
S 23 Do not inhale gas/fumes/vapour/spray.

Canada
CAS# 100-42-5 is listed on Canada's DSL/NDSL List.
CAS# 100-42-5 is listed on Canada's Ingredient Disclosure List.
Exposure Limits:
CAS# 100-42-5:. OEL-AUSTRALIA:TWA 50 ppm (215 mg/m3);STEL 100 ppm 5 mg/m3). OEL-BELGIUM:TWA 50 ppm (213 mg/m3);STEL 100 ppm (426 mg/ Skin. OEL-CZECHOSLOVAKIA:TWA 200 mg/m3;STEL 1000 mg/m3. OEL-DENMAR A 25 ppm (105 mg/m3). OEL-FINLAND:TWA 20 ppm (85 mg/m3);STEL 100 p 420 mg/m3). OEL-FRANCE:TWA 50 ppm (215 mg/m3). OEL-GERMANY:TWA 20 (85 mg/m3). OEL-HUNGARY:STEL 50 mg/m3;Carcinogen. OEL-JAPAN:TWA 50 (210 mg/m3). OEL-THE NETHERLANDS:TWA 100 ppm (420 mg/m3). OEL-THE LIPPINES:TWA 100 ppm (420 mg/m3). OEL-POLAND:TWA 100 mg/m3. OEL-SW :TWA 25 ppm (110 mg/m3);STEL 75 ppm (30 mg/m3);Skin. OEL-SWITZERLA WA 50 ppm (215 mg/m3);STEL 100 ppm (430 mg/m3). OEL-THAILAND:TWA 1 pm;STEL 200 ppm. OEL-TURKEY:TWA 100 ppm (420 mg/m3). OEL-UNITED KI

M:TWA 100 ppm (420 mg/m3);STEL 260 ppm. OEL IN BULGARIA, COLOMBIA, DAN, KOREA check ACGIH TLV. OEL IN NEW ZEALAND, SINGAPORE, VIETNAM ck ACGI TLV

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:
No additional information available.
MSDS Creation Date: 2/01/1996 Revision #0 Date: Original.

The information above is believed to be accurate and represents the bes information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect such information, and we assume no liability resulting from its use. Us should make their own investigations to determine the suitability of th information for their particular purposes. In no way shall Fisher be li for any claims, losses, or damages of any third party or for lost profi or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

TETRACHLOROETHYLENE

Material Safety Data Sheet

Mallinckrodt Chemical, Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 04-19-95 Supersedes 04-06-89

PRODUCT IDENTIFICATION:

Synonyms: tetrachloride ethylene; tetrachloroethene

Formula CAS No.: 127-18-4 Molecular Weight: 165.83

Hazardous Ingredients: Tetrachloroethylene Chemical Formula: C2Cl4

PRECAUTIONARY MEASURES

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

Do not get in eyes, on skin, or on clothing.
Do not breathe mist.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

EMERGENCY FIRST AID

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. 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. In all cases call a physician. SEE SECTION 5.

Physical Data — SECTION 1

Appearance: Clear, colorless liquid.

Odor: Ethereal.

Solubility: 0.015 g in 100 g of water.

Boiling Point: 119-121 C (246-250 F) Vapor Density (Air=1):5.83

Melting Point: -22 C (-8 F) Vapor Pressure (mm Hg):16 @ 22 C (72 F)

Density: 1.63 Evaporation Rate:(CCl*4=1) 0.27

NFPA Ratings: Health: 2 Flammability: 0 Reactivity: 0

Fire and Explosion Information — SECTION 2

Fire: Not considered to be a fire hazard but becomes hazardous in a fire situation because of vapor generation and possible degradation to phosgene (highly toxic) and hydrogen chloride (corrosive).

Explosion: Not considered to be an explosion hazard.

Fire Extinguishing Media: Use any means suitable for extinguishing

surrounding fire. Thermo-oxidative reactions can produce highly toxic phosgene or hydrogen chloride.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Reactivity Data — SECTION 3

Stability: Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products: Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization: This substance does not polymerize.

Incompatibilities: Strong oxidizers, strong alkalies, especially NaOH, KOH; finely divided metals, especially zinc.

Leak/Spill Disposal Information — SECTION 4

Ventilate area of leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Contain and recover liquid when possible. Collect as hazardous waste and atomize in a suitable RCRA approved combustion chamber, or absorb with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!
Reportable Quantity (RQ)(CWA/CERCLA) : 100 lbs.
Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Irritating to the upper respiratory tract. Giddiness, headache, intoxication, nausea and vomiting may follow the inhalation of large amounts while massive amounts can cause breathing arrest and death. Concentrations of 600 ppm and more can affect the central nervous system after a few minutes.

Ingestion: Not highly toxic by this route because of low water solubility. Used as an oral dosage for hookworm (1 to 4 ml). May cause abdominal pain, nausea, diarrhea, headache, and dizziness.

Skin Contact: Prolonged or repeated contact may produce irritation or dermatitis due to defatting the skin. Soreness or skin flaking can occur. Can be absorbed through the skin with toxic effects to follow.

Eye Contact: Pain and tearing will be experienced after contact with the liquid solvent or strong concentrations of vapors.

Chronic Exposure: May cause liver, kidney or central nervous system damage after repeated or prolonged exposures. Suspected cancer risk from animal studies.

Aggravation of

Pre-existing Conditions: Persons with pre-existing skin disorders or eye problems or impaired kidney function may be more susceptible to the effects of the substance. Use of alcoholic beverages enhances the toxic effects of exposure.

B. FIRST AID

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion: Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconcious person.

Skin Exposure: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1994)

Oral rat LD50: 2629 mg/kg; inhalation rat LC50: 34.2 g/m3/8H; investigated as a tumorigen, mutagen, reproductive effector; Cancer Status: IARC Category 2B, NTP Listed Carcinogen.

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 25 ppm (TWA) -ACGIH Threshold Limit Value (TLV): 25 ppm (TWA), 100 ppm (STEL); listed as A3, animal carcinogen

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators (NIOSH Approved): If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection: Wear protective gloves and clean body-covering clothing.

Eye Protection: Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information SECTION 7

Store in a cool, dry, ventilated area away from sources of heat or ignition. Isolate from flammable materials. Protect from direct sunlight. Wear special

protective equipment (Sec. 6) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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Mallinckrodt provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT MAKES NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

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TOROE

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
must include a copy of this addendum

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X			

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
TETRACHLOROETHYLENE Tetrachloroethylene (127-18-4) 100% Listed on the TSCA Inventory.	No	No	Yes	No	100	U210

PROPOSITION 65 Warning!
This product contains a chemical known to
the state of California to cause cancer.

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Environmental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards or toxic under 40 CFR 261.33

TOROE

TETRACHLOROETHYLENE

TOLUENE

Material Safety Data Sheet

Mallinckrodt Chemical, Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 03-23-95 Supersedes 11-24-92

PRODUCT IDENTIFICATION:

Synonyms: Methylbenzene; Toluol; Phenylmethane

Formula CAS No.: 108-88-3 Molecular Weight: 92.14

Hazardous Ingredients: Toluene Chemical Formula: CH3C6H5

PRECAUTIONARY MEASURES

DANGER! HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THRQUGH SKIN. VAPOR HARMFUL. FLAMMABLE! MAY AFFECT LIVER, KIDNEYS, BLOOD SYSTEM, OR CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

Keep away from heat, sparks and flame.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.

EMERGENCY FIRST AID

Aspiration hazard. If swallowed, do not induce vomiting. Call a physician immediately. If vomiting occurs, keep head below hips to prevent aspiration into lungs. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

Physical Data — SECTION 1

Appearance: Clear, colorless liquid.

Odor: Aromatic benzene-like.

Solubility: 0.05 gm/100gm water @ 20 C (68 F).

Boiling Point: 111 C (231 F).

Vapor Density (Air=1):3.14

Melting Point: -95 C (-139 F).

Vapor Pressure (mm Hg):22 @ 20 C (68 F).

Specific Gravity: 0.86

Evaporation Rate:2.24

NFPA Ratings: Health: 2 Flammability: 3 Reactivity: 0

Fire and Explosion Information — SECTION 2

Fire: Flammable. Vapors can flow along surfaces to distant ignition source and flash back. Flash Point: 4 C (40 F) (closed cup). Autoignition temperatures: 480 C (896 F). Flammable limits in air, % by volume: lel 1.27, uel 7.1.

Explosion: Above flash point, vapor-air mixtures are

explosive within flammable limits noted above. Contact with strong oxidizers may cause fire and explosions.

Fire Extinguishing Media: Dry chemical, foam or carbon dioxide. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Reactivity Data — SECTION 3

Stability: Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products: Toxic gases and vapors (e.g., carbon dioxide and monoxide) may be released in a fire involving toluene.

Hazardous Polymerization: Will not occur.

Incompatibilities: Heat, flame, strong oxidizers, acids nitric and sulfuric, nitrogen tetraoxide, will attack some forms of plastics, rubber, coatings.

Leak/Spill Disposal Information — SECTION 4

Remove all sources of ignition. Use non-sparking tools and equipment. Clean-up personnel require protective clothing and respiratory protection from flammable vapors. Small spills may be absorbed on paper towels and evaporated in a fume hood. Allow enough time for fumes to clear hood, then ignite paper in a suitable location away from combustible materials. Contain and recover liquid for reclamation when possible. Larger spills and lot sizes can be collected as hazardous waste and atomized in a suitable RCRA approved combustion chamber, or absorbed with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!
Reportable Quantity (RQ)(CWA/CERCLA) : 1000 lbs.
Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e.g. pins and needles) or numbness may be produced. Very high concentrations may cause unconsciousness and death.

Ingestion: Swallowing may cause abdominal spasms and other symptoms that parallel over-exposure from inhalation. Aspiration of material into the lungs can cause chemical pneumonitis, which may be fatal.

Skin Contact: May cause skin irritation. May be absorbed through the skin.

Eye Contact: May cause eye irritation, redness, tearing. Splashes have caused temporary corneal damage.

Chronic Exposure: Reports of chronic poisoning describe anemia,

decreased blood cell count and bone marrow hypoplasia. Liver and kidney damage may occur. Repeated or prolonged contact has a defatting action, causing drying, redness, dermatitis. Exposure to toluene may affect the developing fetus.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or impaired liver or kidney function may be more susceptible to the effects of this substance. Alcoholic beverage consumption can enhance the toxic effects of this substance.

B. FIRST AID

Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. CALL A PHYSICAN IMMEDIATELY.

Ingestion: Aspiration hazard. If swallowed, do not induce vomiting. Call a physician immediately. If vomiting occurs, keep head below hips to prevent aspiration into lungs.

Skin Exposure: Remove any contaminated clothing. Wipe off excess from skin. Wash skin with plenty of water for at least 15 minutes. Get medical attention promptly.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1994)

Oral rat LD50: 636 mg/kg; skin rabbit LD50: 12124 mg/kg; inhalation rat LC50: 49 gm/m3/4H; investigated as a tumorigen, mutagen, reproductive effector.

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 100 ppm (TWA), 150 ppm (STEL) -ACGIH Threshold Limit Value (TLV): 50 ppm (TWA) skin

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators (NIOSH Approved) If the TLV is exceeded, a half mask chemical cartridge respirator may be worn up to ten times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less.

Skin Protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and

quick-drench facilities in work area.

Storage and Special Information SECTION 7

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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Mallinckrodt provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT MAKES NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

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TOLUA

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
must include a copy of this addendum

Hazard Categories for SARA
Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X	X		

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
TOLUENE Toluene (108-88-3) 100% Listed on the TSCA Inventory.	No	No	Yes	No	1000	U220

PROPOSITION 65 Warning!
This product contains a chemical known to the state of California to cause birth defects and other reproductive harm.

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a

solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Environmental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards or toxic under 40 CFR 261.33

TOLUA

TOLUENE

SIGMA-ALDRICH

ALDRICH CHEMICAL COMPANY, INC.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201, USA

ATTN: SAFETY DIRECTOR

EMERGENCY PHONE 1-414-273-3850

DATE 08/15/96
CUST#: 942742
PO#:

SEAN DILLON
PROCESS TECHNOLOGY INC
5383 W FRANKLIN ROAD
BOISE ID 83705-1112

M A T E R I A L S A F E T Y D A T A S H E E T

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

CATALOG #: 29899-9
NAME: 1,1,1-TRICHLOROETHANE, ANHYDROUS, 99.5%

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #: 71-55-6
MF: C2H3CL3
EC NO: 200-756-3

SYNONYMS
AEROTHENE TT * CF 2 * CHLOROETENE * CHLOROETHENE * CHLOROETHENE NU * CHLOROFORM, METHYL- * CHLOROTHANE NU * CHLOROTHENE * CHLOROTHENE(INHIBITED) * CHLOROTHENE NU * CHLOROTHENE SM * CHLOROTHENE VG * CHLORTEN * ETHANA NU * ICI-CF 2 * INHIBISOL * METHYLCHLOROFORM * METHYL CHLOROFORM (ACGIH:DOT:OSHA) * METHYLTRICHLOROMETHANE * NCI-C04626 * RCRA WASTE NUMBER U226 * SOLVENT 111 * ALPHA-T * TAFCLEAN * 1,1,1-TCE * 1,1,1-TRICHLOORETHAAN (DUTCH) * 1,1,1-TRICHLORAETHAN (GERMAN) * TRICHLOROETHANE * TRICHLORO-1,1,1-ETHANE (FRENCH) * ALPHA-TRICHLOROETHANE * 1,1,1-TRICHLOROETHANE (DOT:OSHA) * 1,1,1-TRICLOROETANO (ITALIAN) * TRICHLOROMETHYLMETHANE * TRI-ETHANE * UN2831 (DOT) *

SECTION 3. - - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - - -

LABEL PRECAUTIONARY STATEMENTS
HARMFUL
HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
POSSIBLE RISK OF IRREVERSIBLE EFFECTS.
POSSIBLE MUTAGEN.
CAUSES SEVERE IRRITATION.
TARGET ORGAN(S):
NERVES
LIVER, KIDNEYS
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
TAKE OFF IMMEDIATELY ALL CONTAMINATED CLOTHING.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
HYGROSCOPIC
HANDLE AND STORE UNDER NITROGEN.

SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS

CONTINUED ON NEXT PAGE

We are committed to the success of our customers through science, technology and service.

SIGMA Aldrich Fluka SUPELCO SIGMA DIAGNOSTICS SAFC SIGMA-ALDRICH RESEARCH

CATALOG #: 29899-9
NAME: 1,1,1-TRICHLOROETHANE, ANHYDROUS, 99.5%

AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA
WATER SPRAY.
CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.

SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY LIME OR SODA ASH, PICK UP, KEEP IN A CLOSED CONTAINER AND HOLD FOR WASTE DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -

REFER TO SECTION 8.

SECTION 8. - - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
HARMFUL LIQUID.
SEVERE IRRITANT.
POSSIBLE MUTAGEN.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

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SIGMA-ALDRICH

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CUST#: 942742

CATALOG #: 29899-9
NAME: 1,1,1-TRICHLOROETHANE, ANHYDROUS, 99.5%

SECTION 9. - - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - - -

APPEARANCE AND ODOR
COLORLESS LIQUID

PHYSICAL PROPERTIES
BOILING POINT: 74 C TO 76 C
MELTING POINT: -35 C
FLASHPOINT NONE
EXPLOSION LIMITS IN AIR:
UPPER 15% 25 C
LOWER 7.5% 25 C
AUTOIGNITION TEMPERATURE: 998 F 536C
VAPOR PRESSURE: 100MM 20 C
SPECIFIC GRAVITY: 1.338
VAPOR DENSITY: 4.6

SECTION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - - -

ICOMPATIBILITIES
STRONG OXIDIZING AGENTS
ALUMINUM
AND ITS ALLOYS.
MAGNESIUM
AND ITS ALLOYS.
ZINC
STRONG BASES
REACTS VIOLENTLY WITH:
POTASSIUM
SODIUM

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
PHOSGENE GAS

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
CAUSES SEVERE IRRITATION.
HIGH CONCENTRATIONS ARE EXTREMELY DESTRUCTIVE TO TISSUES OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
EXPOSURE TO AND/OR CONSUMPTION OF ALCOHOL MAY INCREASE TOXIC EFFECTS.
PROLONGED EXPOSURE CAN CAUSE:

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NARCOTIC EFFECT
DERMATITIS

CHRONIC EFFECTS
LABORATORY EXPERIMENTS HAVE SHOWN MUTAGENIC EFFECTS.
DAMAGE TO THE LIVER
DAMAGE TO THE KIDNEYS
TARGET ORGAN(S):
LIVER, KIDNEYS
CENTRAL NERVOUS SYSTEM
CARDIOVASCULAR SYSTEM

RTECS #: KJ2975000
ETHANE, 1,1,1-TRICHLORO-

IRRITATION DATA

EYE-MAN 450 PPM/8H	BJIMAG 28,286,71
SKN-RBT 5 GM/12D-I MLD	AIHAAP 19,353,58
SKN-RBT 20 MG/24H MOD	85JCAE -,94,86
EYE-RBT 100 MG MLD	AIHAAP 19,353,58
EYE-RBT 2 MG/24H SEV	85JCAE -,94,86

TOXICITY DATA

ORL-RAT LD50:9600 MG/KG	GNAMAP 29,45,90
IHL-RAT LC50:18000 PPM/4H	28ZPAK -,28,72
IPR-RAT LD50:3593 MG/KG	ENVRAL 40,411,86
ORL-MUS LD50:6 GM/KG	GNAMAP 29,45,90
IHL-MUS LC50:3911 PPM/2H	SAIGBL 13,226,71
IPR-MUS LD50:2568 MG/KG	SAIGBL 8,371,66
SCU-MUS LD50:16 GM/KG	JPETAB 123,224,58
ORL-DOG LD50:750 MG/KG	FMCHA2 -,C310,91
IPR-DOG LD50:3100 MG/KG	TXAPA9 10,119,67
IHL-CAT LC50:24400 MG/M3	GISAAA 35(8),127,70
ORL-RBT LD50:5660 MG/KG	AIHAAP 19,353,58
ORL-GPG LD50:9470 MG/KG	AIHAAP 19,353,58

TARGET ORGAN DATA
SENSE ORGANS AND SPECIAL SENSES (CONJUNCTIVA IRRITATION)
BEHAVIORAL (HALLUCINATIONS, DISTORTED PERCEPTIONS)
BEHAVIORAL (CHANGE IN MOTOR ACTIVITY)
BEHAVIORAL (IRRITABILITY)
BEHAVIORAL (CHANGE IN PSYCHOPHYSIOLOGICAL TESTS)
GASTROINTESTINAL (HYPERMOTILITY, DIARRHEA)
GASTROINTESTINAL (NAUSEA OR VOMITING)
GASTROINTESTINAL (OTHER CHANGES)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (CARDIOVASCULAR SYSTEM)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

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DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - - -

DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER. OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - - -

EUROPEAN INFORMATION
EC INDEX NO: 602-013-00-2
HARMFUL
R 20
HARMFUL BY INHALATION.
R 59
DANGEROUS FOR THE OZONE LAYER.
S 24/25
AVOID CONTACT WITH SKIN AND EYES.
S 59
REFER TO MANUFACTURER/SUPPLIER FOR INFORMATION ON RECOVERY/RECYCLING.
S 61
AVOID RELEASE TO THE ENVIRONMENT. REFER TO SPECIAL INSTRUCTIONS/ SAFETY DATA SHEETS.

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK
ACGIH TLV-TWA 350 PPM; STEL 450 PPM 85INA8 6,958,91
IARC CANCER REVIEW:ANIMAL INADEQUATE EVIDENCE IMEMDT 20,515,79
IARC CANCER REVIEW:HUMAN NO ADEQUATE DATA IMEMDT 20,515,79
IARC CANCER REVIEW:GROUP 3 IMSUDL 7,56,87
EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION FEREAC 54,7740,89
MSHA STANDARD-AIR:TWA 350 PPM (1900 MG/M3) DTLVS* 3,161,71
OSHA PEL (GEN INDU):8H TWA 350 PPM (1900 MG/M3) CFRGBR 29,1910.1000,94
OSHA PEL (CONSTRUC):8H TWA 350 PPM (1900 MG/M3) CFRGBR 29,1926.55,94
OSHA PEL (SHIPYARD):8H TWA 350 PPM (1900 MG/M3) CFRGBR 29,1915.1000,93
OSHA PEL (FED CONT):8H TWA 350 PPM (1900 MG/M3) CFRGBR 41,50-204.50,94
OEL-AUSTRALIA:TWA 125 PPM (680 MG/M3) JAN93

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OEL-BELGIUM:TWA 350 PPM (1910 MG/M3);STEL 450 PPM (2460 MG/M3) JAN93
OEL-CZECHOSLOVAKIA:TWA 500 MG/M3;STEL 2000 MG/M3 JAN93
OEL-DENMARK:TWA 100 PPM (540 MG/M3) JAN93
OEL-FINLAND:TWA 100 PPM (540 MG/M3);STEL 250 PPM (1400 MG/M3) JAN93
OEL-FRANCE:TWA 300 PPM (1650 MG/M3);STEL 450 PPM (2500 MG/M3) JAN93
OEL-GERMANY:TWA 200 PPM (1080 MG/M3) JAN93
OEL-HUNGARY:TWA 100 MG/M3;STEL 300 MG/M3;SKIN JAN93
OEL-JAPAN:TWA 200 PPM (1100 MG/M3) JAN93
OEL-THE NETHERLANDS:TWA 200 PPM (1080 MG/M3);STEL 500 PPM JAN93
OEL-THE PHILIPPINES:TWA 350 PPM (1900 MG/M3) JAN93
OEL-RUSSIA:TWA 200 PPM;STEL 20 MG/M3 JAN93
OEL-SWEDEN:TWA 50 PPM (300 MG/M3);STEL 90 PPM (500 MG/M3) JAN93
OEL-SWITZERLAND:TWA 200 PPM (1080 MG/M3);STEL 1000 PPM JAN93
OEL-TURKEY:TWA 350 PPM (1900 MG/M3) JAN93
OEL-UNITED KINGDOM:TWA 350 PPM (1900 MG/M3);STEL 450 PPM JAN93
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO 1,1,1-TRICHLOROETHANE-AIR:CL 350 PPM/15M
NIOSH* DHHS #92-100,92
NOHS 1974: HZD 46970; NIS 412; TNF 109850; NOS 205; TNE 1511801
NOES 1983: HZD 46970; NIS 417; TNF 120527; NOS 243; TNE 2528300; TFE 762399
EPA GENETOX PROGRAM 1988, POSITIVE: CELL TRANSFORM.-RLV F344 RAT EMBRYO
EPA GENETOX PROGRAM 1988, NEGATIVE: SPERM MORPHOLOGY-MOUSE
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: CARCINOGENICITY-MOUSE/RAT; MAMMALIAN MICRONUCLEUS
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY
EPA TSCA 8(A) PRELIMINARY ASSESSMENT INFORMATION, FINAL RULE FEREAC 47,26992,82
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES
ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, APRIL 1996
NIOSH CURRENT INTELLIGENCE BULLETIN 27, 1978
NIOSH ANALYTICAL METHOD, 1994: HYDROCARBONS, HALOGENATED, 1003
NCI CARCINOGENESIS BIOASSAY (GAVAGE);INADEQUATE STUDIES:MOUSE,RAT NCITR* NCI-TR-3,77
NTP CARCINOGENESIS STUDIES; TEST COMPLETED (PEER REVIEW), FEBRUARY 1996
NTP CARCINOGENESIS STUDIES; TEST COMPLETED (POST PEER REVIEW), FEBRUARY 1996
OSHA ANALYTICAL METHOD #14

U.S. INFORMATION
THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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DATE: 02/01/95
CUST#: 942742
PO#: 013195/AR

MATERIAL SAFETY DATA SHEET

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

PRODUCT #: 25140-2 NAME: TRICHLOROETHYLENE, 99.5+%, A.C.S. REAGENT

SECTION 2. - - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #:79-01-6
MF: C2HCL3

SYNONYMS
ACETYLENE TRICHLORIDE * ALGYLEN * ANAMENTH * BENZINOL * BLACOSOLV * BLANCOSOLV * CECOLENE * CHLORILEN * 1-CHLORO-2,2-DICHLOROETHYLENE * CHLORYLEN * CIRCOSOLV * CRAWHASPOL * DENSINFLUAT * 1,1-DICHLORO-2-CHLOROETHYLENE * DOW-TRI * DUKERON * ETHINYL TRICHLORIDE * ETHYLENE TRICHLORIDE * FLECK-FLIP * FLOCK FLIP * FLUATE * GERMALGENE * LANADIN * LETHURIN * NARCOGEN * NARKOSOID * NCI-C04546 * NIALK * PERM-A-CHLOR * PERM-A-CLOR * PETZINOL * PHILEX * RCRA WASTE NUMBER U228 * THRETHYLEN * THRETHYLENE * TRETHYLENE * TRI * TRIAD * TRIAL * TRIASOL * TRICHLOORETHEEN (DUTCH) * TRICHLOORETHYLEEN, TRI (DUTCH) * TRICHLORAETHEN (GERMAN) * TRICHLORAETHYLEN, TRI (GERMAN) * TRICHLORAN * TRICHLOREN * TRICHLORETHENE (FRENCH) * TRICHLORETHYLENE * TRICHLORETHYLENE, TRI (FRENCH) * TRICHLOROETHENE * TRICHLOROETHYLENE * 1,1,2-TRICHLORODETHYLENE * 1,2,2-TRICHLOROETHYLENE * TRICHLOROETHYLENE (ACGIH,DOT,OSHA) * TRI-CLENE * TRICLORETENE (ITALIAN) * TRICLOROETILENE (ITALIAN) * TRIELENE * TRIELIN * TRIELINA (ITALIAN) * TRIELINE * TRILEN * TRILENE * TRILINE * TRIMAR * TRIOL * TRI-PLUS * TRI-PLUS M * UN1710 (DOT) * VESTROL * VITRAN * WESTROSOL *

SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

LABEL PRECAUTIONARY STATEMENTS
TOXIC
MAY CAUSE CANCER.
MAY CAUSE HERITABLE GENETIC DAMAGE.
HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
CAUSES SEVERE IRRITATION.
TARGET ORGAN(S):
CENTRAL NERVOUS SYSTEM
LIVER, KIDNEYS
HEART
LUNGS
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF

CONTINUED ON NEXT PAGE

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CUST#: 942742
PO#: 013195/AR

PRODUCT #: 251402 NAME: TRICHLOROETHYLENE, 99.5+%, A.C.S. REAGENT
MF: C2HCL3

WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
PROTECT FROM LIGHT.

SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN IMMEDIATELY.
DISCARD CONTAMINATED CLOTHING AND SHOES.

CTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -

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CUST#: 942742
PO#: 013195/AR

PRODUCT #: 251402 NAME: TRICHLOROETHYLENE, 99.5+%, A.C.S. REAGENT
MF: C2HCL3

REFER TO SECTION 8.

SECTION 8. - - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
SEVERE IRRITANT.
HARMFUL VAPOR.
CARCINOGEN.
MUTAGEN.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -

APPEARANCE AND ODOR
COLORLESS LIQUID
BOILING POINT: 86.7 C
MELTING POINT: -84.8 C
FLASHPOINT NONE
AUTOIGNITION TEMPERATURE: 770 F 409C
UPPER EXPLOSION LEVEL: 10.5% 25 C
LOWER EXPLOSION LEVEL: 8% 25 C
VAPOR PRESSURE: 61MM 20 C
VAPOR DENSITY: 4.5
SPECIFIC GRAVITY: 1.463

SECTION 10. - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -

INCOMPATIBILITIES
OXIDIZING AGENTS

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CUST#: 942742
PO#: 013195/AR

PRODUCT #: 251402 NAME: TRICHLOROETHYLENE, 99.5+%, A.C.S. REAGENT
MF: C2HCL3

REDUCING AGENTS
STRONG BASES
ALUMINUM
MAGNESIUM
SENSITIVE TO LIGHT

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
PHOSGENE GAS

SECTION 11. ---------- TOXICOLOGICAL INFORMATION ----------

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
CAUSES SEVERE IRRITATION.
HIGH CONCENTRATIONS ARE EXTREMELY DESTRUCTIVE TO TISSUES OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
EXPOSURE TO AND/OR CONSUMPTION OF ALCOHOL MAY INCREASE TOXIC EFFECTS.
EXPOSURE CAN CAUSE:
GASTROINTESTINAL DISTURBANCES
DAMAGE TO THE KIDNEYS
NAUSEA, DIZZINESS AND HEADACHE
NARCOTIC EFFECT
PROLONGED CONTACT CAN CAUSE:
DERMATITIS

CHRONIC EFFECTS
CARCINOGEN.
MAY ALTER GENETIC MATERIAL.
TARGET ORGAN(S):
CENTRAL NERVOUS SYSTEM
LIVER, KIDNEYS
HEART
LUNGS

RTECS NO: KX4550000
ETHYLENE, TRICHLORO-

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PO#: 013195/AR

PRODUCT #: 251402 NAME: TRICHLOROETHYLENE, 99.5+%, A.C.S. REAGENT
MF: C2HCL3

IRRITATION DATA

SKN-RBT 2 MG/24H SEV	85JCAE -,106,86
EYE-RBT 20 MG/24H MOD	85JCAE -,106,86

TOXICITY DATA

ORL-HMN LDLO:7 GM/KG	ARTODN 35,295,76
IHL-MAN LCLO:2900 PPM	NZMJAX 50,119,51
ORL-RAT LD50:5650 MG/KG	ATDAEI 1,713,92
IPR-RAT LD50:1282 MG/KG	ENVRAL 40,411,86
ORL-MUS LD50:2402 MG/KG	NTIS** AD-A080-636
IHL-MUS LC50:8450 PPM/4H	APTOA6 9,303,53
SCU-MUS LD50:16 GM/KG	JPETAB 123,224,58
IVN-MUS LD50:33900 UG/KG	CBCCT* 6,141,54
IPR-DOG LD50:1900 MG/KG	TXAPA9 10,119,67
SKN-RBT LD50:>20 GM/KG	NTIS** AD-A062-138

TARGET ORGAN DATA
SENSE ORGANS AND SPECIAL SENSES (OTHER EYE EFFECTS)
BEHAVIORAL (SOMNOLENCE)
BEHAVIORAL (HALLUCINATIONS, DISTORTED PERCEPTIONS)
VASCULAR (TUMORS)
LUNGS, THORAX OR RESPIRATION (TUMORS)
GASTROINTESTINAL (OTHER CHANGES)
LIVER (JAUNDICE, OTHER OR UNCLASSIFIED)
LIVER (LIVER FUNCTION TESTS IMPAIRED)
LIVER (TUMORS)
BLOOD (LYMPHOMA INCLUDING HODGKIN'S DISEASE)
SKIN AND APPENDAGES (TUMORS)
PATERNAL EFFECTS (SPERMATOGENESIS)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (CENTRAL NERVOUS SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (UROGENITAL SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (OTHER DEVELOPMENTAL ABNORMALITIES)
TUMORIGENIC (CARCINOGENIC BY RTECS CRITERIA)
TUMORIGENIC (EQUIVOCAL TUMORIGENIC AGENT BY RTECS CRITERIA)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -
DATA NOT YET AVAILABLE.

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CUST#: 942742
PO#: 013195/AR

PRODUCT #: 251402 NAME: TRICHLOROETHYLENE, 99.5+%, A.C.S. REAGENT
MF: C2HCL3

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER. OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - -

REVIEWS, STANDARDS, AND REGULATIONS

ACGIH TLV-TWA 50 PPM; STEL 200 PPM	85INA8 6,1611,91
IARC CANCER REVIEW:ANIMAL LIMITED EVIDENCE	IMEMDT 20,545,79
IARC CANCER REVIEW:HUMAN INADEQUATE EVIDENCE	IMEMDT 20,545,79
IARC CANCER REVIEW:GROUP 3	IMSUDL 7,364,87

MSHA STANDARD-AIR:TWA 100 PPM (535 MG/M3)
DTLVS* 3,263,71
OSHA PEL:8H TWA 100 PPM;CL 200;PK 300/5M/2H
FEREAC 54,2923,89
OSHA PEL FINAL:8H TWA 50 PPM (270 MG/M3);STEL 200 PPM (1080 MG/M3)
FEREAC 54,2923,89
OEL-AUSTRALIA:TWA 50 PPM (270 MG/M3);STEL 200 PPM (1080 MG/M3) JAN93
OEL-BELGIUM:TWA 50 PPM (269 MG/M3);STEL 200 PPM (1070 MG/M3) JAN93
OEL-CZECHOSLOVAKIA:TWA 250 MG/M3;STEL 1250 MG/M3 JAN93
OEL-DENMARK:TWA 30 PPM (160 MG/M3) JAN93
OEL-FINLAND:TWA 30 PPM (160 MG/M3);STEL 45 PPM (240 MG/M3);SKIN JAN93
OEL-FRANCE:TWA 75 PPM (405 MG/M3);STEL 200 PPM (1080 MG/M3) JAN93
OEL-GERMANY:TWA 50 PPM (270 MG/M3);CARCINOGEN JAN93
OEL-HUNGARY:TWA 10 MG/M3;STEL 40 MG/M3 JAN93
OEL-JAPAN:TWA 50 PPM (270 MG/M3) JAN93
OEL-THE NETHERLANDS:TWA 35 PPM (190 MG/M3);STEL 100 PPM JAN93
OEL-THE PHILIPPINES:TWA 100 PPM (535 MG/M3) JAN93
OEL-POLAND:TWA 50 MG/M3 JAN93
OEL-RUSSIA:TWA 50 PPM;STEL 10 MG/M3 JAN93
OEL-SWEDEN:TWA 10 PPM (50 MG/M3);STEL 25 PPM (140 MG/M3) JAN93

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PRODUCT #: 251402 NAME: TRICHLORDETHYLENE, 99.5+%, A.C.S. REAGENT
MF: C2HCL3

OEL-THAILAND:TWA 100 PPM;STEL 200 PPM JAN93
OEL-TURKEY:TWA 100 PPM (535 MG/M3) JAN93
OEL-UNITED KINGDOM:TWA 100 PPM (535 MG/M3);STEL 150 PPM;SKIN JAN93
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO TRICHLORDETHYLENE-AIR:10H CA TWA 25 PPM;CL 2 PPM/1H
NIOSH* DHHS #92-100,92
NIOSH REL TO WASTE ANESTHETIC GASES AND VAPORS-AIR:CL 2 PPM/1H
MMWR** 37(S-7),28,88
NOHS 1974: HZD 73790; NIS 251; TNF 37699; NOS 141; TNE 446588
NOES 1983: HZD 73790; NIS 189; TNF 22994; NOS 143; TNE 398494; TFE 174142
ATSDR TOXICOLOGY PROFILE (NTIS** PB/90/127523/AS)
EPA GENETOX PROGRAM 1988, POSITIVE: CELL TRANSFORM.-RLV F344 RAT EMBRYO; HOST-MEDIATED ASSAY
EPA GENETOX PROGRAM 1988, POSITIVE: MOUSE SPOT TEST; SPERM MORPHOLOGY-MOUSE
EPA GENETOX PROGRAM 1988, POSITIVE: S CEREVISIAE GENE CONVERSION; S CEREVISIAE-HOMOZYGOSIS
EPA GENETOX PROGRAM 1988, POSITIVE: S CEREVISIAE-REVERSION
EPA GENETOX PROGRAM 1988, POSITIVE/LIMITED: CARCINOGENICITY-MOUSE/RAT
EPA GENETOX PROGRAM 1988, NEGATIVE: D MELANOGASTER SEX-LINKED LETHAL
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: HISTIDINE REVERSION-AMES TEST
EPA TSCA CHEMICAL INVENTORY, JUNE 1993
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0680-0345;8EHQ-0982-0457;8EHQ-0979-0310
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0578-0146
ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JULY 1994
NIOSH CURRENT INTELLIGENCE BULLETIN 2, 1975
NIOSH ANALYTICAL METHODS: SEE TRICHLORDETHYLENE, 1022; TRICHLORDETHYLENE BY PORTABLE GC, 3701
NCI CARCINOGENESIS BIOASSAY (GAVAGE):CLEAR EVIDENCE:MOUSE
NCITR* NCI-TR-2,76
NTP CARCINOGENESIS STUDIES (GAVAGE):CLEAR EVIDENCE:MOUSE
NTPTR* NTP-TR-243,83
NCI CARCINOGENESIS BIOASSAY (GAVAGE):NO EVIDENCE:RAT
NCITR* NCI-TR-2,76
NTP CARCINOGENESIS STUDIES (GAVAGE);INADEQUATE STUDY:RAT
NTPTR* NTP-TR-273,88
NCI CARCINOGENESIS STUDIES (GAVAGE); INADEQUATE STUDIES:RAT

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PRODUCT #: 251402 NAME: TRICHLOROETHYLENE, 99.5+%, A.C.S. REAGENT
MF: C2HCL3

NTPTR* NTP-TR-243,83
THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

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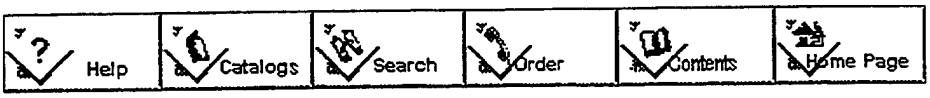

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ACC73581

****** MATERIAL SAFETY DATA SHEET **** **** MATERIAL SAFETY DATA SHEET ******

1,2,4-Trimethylbenzene, 98%
73581

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: 1,2,4-Trimethylbenzene, 98%

Pseudocumene
Company Identification: Acros Organics N.V.
Janssen Pharmaceuticalaan 3a
2440 Geel, Belgium
For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS
95-63-6	1,2,4-TRIMETHYLBENZENE		202-436

Hazard Symbols: XN

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Not available.
Target Organs: Central nervous system.

Potential Health Effects

Eye:
Causes eye irritation. Causes redness and pain.

Skin:
Causes skin irritation. May be absorbed through the skin. Causes redness and pain.

Ingestion:
Aspiration of material into the lungs may cause chemical pneumonitis, which may be fatal. May cause central nervous system depression.

Inhalation:

Harmful if inhaled. Causes respiratory tract irritation. May cause drowsiness, unconsciousness, and central nervous system depression

Chronic:

Prolonged or repeated skin contact may cause dermatitis. May cause anemia and other blood cell abnormalities. Prolonged exposure may produce a narcotic effect. Prolonged or repeated exposure may caus nausea, dizziness, and headache.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid.

Skin:

Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion:

Do NOT induce vomiting. Get medical aid. Wash mouth out with water

Inhalation:

Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxyge Get medical aid.

Notes to Physician:

Treat symptomatically and supportively.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Will burn if involved in a fire. Flammable Liquid

Extinguishing Media:

Use water spray to cool fire-exposed containers. In case of fire u water spray, dry chemical, carbon dioxide, or chemical foam.

Autoignition Temperature: 500°C (932.00°F)

Flash Point: 48°C (118.40°F)

NFPA Rating: health-0; flammability-2; reactivity-0

Explosion Limits, Lower: .90 vol %
Upper: 6.40 vol %

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indica in Section 8.

Spills/Leaks:

Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Remove all sources of ignition. Use a spark-proof tool. Provide ventilation.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:

Use only in a well ventilated area. Use spark-proof tools and explosion proof equipment. Avoid breathing dust, vapor, mist, or gas. Avoid contact with skin and eyes. Take precautionary measures against static discharges.

Storage:

Keep away from sources of ignition. Store in a cool, dry place. Store in a tightly closed container. Flammables-area.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final P
1,2,4-TRIMETHYLBENZENE	none listed	none listed	none listed

OSHA Vacated PELs:
1,2,4-TRIMETHYLBENZENE:
No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:
Wear appropriate protective gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to prevent skin exposure.

Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Appearance:	Clear colourless liquid
Odor:	Aromatic
pH:	Not available.
Vapor Pressure:	2.1 mbar @ 20°C
Vapor Density:	4.15 (air=1)
Evaporation Rate:	Not available.
Viscosity:	Not available.
Boiling Point:	168°C @ 760.00mm Hg
Freezing/Melting Point:	-44°C
Decomposition Temperature:	Not available.
Solubility:	6 MG/100ML (20°C)
Specific Gravity/Density:	.8890g/cm3
Molecular Formula:	C9H12
Molecular Weight:	120.19

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Not available.
Conditions to Avoid:
Incompatible materials, ignition sources.
Incompatibilities with Other Materials:
Strong oxidizing agents.
Hazardous Decomposition Products:
Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 95-63-6: DC3325000
LD50/LC50:
CAS# 95-63-6: Inhalation, rat: LC50 =18 gm/m3/4H; Oral, rat: LD50 5 gm/kg.
Carcinogenicity:
1,2,4-TRIMETHYLBENZENE -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No data available.
Teratogenicity:
No data available.
Reproductive Effects:
No data available.
Neurotoxicity:
No data available.
Mutagenicity:
EPA:
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Invertebrate toxicity:
spp. 0.1 mol/m^a/24H
effects" for complete information (editor : M.L. Richardson)
Environmental Fate:
See "The dictionary of substances and their effects" for complete information (editor : M.L.Richardson)
Physical/Chemical:
Not available.
Other:
Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: Not listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: FLAMMABLE LIQUIDS, N.O.S. (1,2,4-TRIMETHYLBENZENE)
Hazard Class: 3
UN Number: UN1993
Packing Group: III
IMO
Shipping Name: FLAMMABLE LIQUID, N.O.S.
Hazard Class: 3.3
UN Number: 1993
Packing Group: III
IATA

Shipping Name: FLAMMABLE LIQUID, N.O.S.*
Hazard Class: 3
UN Number: 1993
Packing Group: III
RID/ADR
Shipping Name: FLAMMABLE LIQUID, N.O.S.
Dangerous Goods Code: 3(31C)
UN Number: 1993
Canadian TDG
Shipping Name: COMBUSTIBLE LIQUID NOS (TRIMETHYLBENZENE)
Hazard Class: 3
UN Number: UN1993
Other Information: FP 48 C

**** SECTION 15 - REGULATORY INFORMATION ****

FEDERAL
TSCA
CAS# 95-63-6 is listed on the TSCA inventory.
Health & Safety Reporting List
CAS# 95-63-6: Effective Date: April 29, 1983
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Ru
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA
Section 302 (RQ)
None of the chemicals in this material have an RQ.
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 95-63-6: acute, chronic, flammable.
Section 313
This chemical is not at a high enough concentration to be reportab
under Section 313.
No chemicals are reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous
Substances under the CWA.
None of the chemicals in this product are listed as Priority
Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutan
under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazard
by OSHA.
STATE
1,2,4-TRIMETHYLBENZENE can be found on the following state right to
know lists: New Jersey, Pennsylvania, Massachusetts.
California No Significant Risk Level:
None of the chemicals in this product are listed.
INTERNATIONAL
European Labeling in Accordance with EC Directives
Hazard Symbols: XN
Risk Phrases:

Safety Phrases:
S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Canada
CAS# 95-63-6 is listed on Canada's DSL/NDSL List.
CAS# 95-63-6 is listed on Canada's Ingredient Disclosure List.
Exposure Limits:

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:
No additional information available.
MSDS Creation Date: 3/01/1994 Revision #1 Date: 9/27/1996

The information above is believed to be accurate and represents the bes information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect such information, and we assume no liability resulting from its use. Us should make their own investigations to determine the suitability of th information for their particular purposes. In no way shall Fisher be li for any claims, losses, or damages of any third party or for lost profi or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

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ATTN: SAFETY DIRECTOR
PROCESS TECHNOLOGY INC
PO BOX 476
BOISE ID 83701-0476

DATE: 10/12/94
CUST#: 942742
PO#: 101194AR

MATERIAL SAFETY DATA SHEET

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

PRODUCT #: 38762-2 NAME: VINYL CHLORIDE, 99.5+%

SECTION 2. - - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #: 75-01-4
MF: C2H3CL

SYNONYMS
CHLORETHENE * CHLORETHYLENE * CHLOROETHENE * CHLOROETHYLENE * CHLOROETHYLENE (OSHA) * CHLORURE DE VINYLE (FRENCH) * CLORURO DI VINILE (ITALIAN) * ETHENE, CHLORO- * ETHYLENE MONOCHLORIDE * MONOCHLOROETHENE * MONOCHLOROETHYLENE * RCRA WASTE NUMBER U043 * TROVIDUR * UN1086 (DOT) * VC * VCM * VINILE (CLORURO DI) (ITALIAN) * VINYLCHLORID (GERMAN) * VINYL CHLORIDE * VINYL CHLORIDE (ACGIH,OSHA) * VINYL CHLORIDE, INHIBITED (DOT) * VINYL CHLORIDE MONOMER * VINYLE(CHLORURE DE) (FRENCH) * VINYL C MONOMER * WINYLU CHLOREK (POLISH) *

SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

LABEL PRECAUTIONARY STATEMENTS
FLAMMABLE (USA DEFINITION)
HIGHLY FLAMMABLE (EUROPEAN DEFINITION)
TOXIC
MAY CAUSE CANCER.
MAY CAUSE HERITABLE GENETIC DAMAGE.
TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
REPRODUCTIVE HAZARD.
CAUSES SEVERE IRRITATION.
TARGET ORGAN(S):
LIVER
BLOOD
BRAIN
CENTRAL NERVOUS SYSTEM
KEEP AWAY FROM SOURCES OF IGNITION. NO SMOKING.
TAKE PRECAUTIONARY MEASURES AGAINST STATIC DISCHARGES.
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
DO NOT BREATHE FUMES.

SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -

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FAX: (414) 273-4979

CUST#: 942742
PO#: 101194AR

PRODUCT #: 387522 NAME: VINYL CHLORIDE, 99.5+%
MF: C2H3CL

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
DISCARD CONTAMINATED CLOTHING AND SHOES.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.
SPECIAL FIREFIGHTING PROCEDURES
DO NOT EXTINGUISH BURNING GAS IF FLOW CANNOT BE SHUT OFF IMMEDIATELY.
USE WATER SPRAY OR FOG NOZZLE TO KEEP CYLINDER COOL. MOVE CYLINDER AWAY FROM FIRE IF THERE IS NO RISK.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.
FLAMMABLE GAS.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

EVACUATE AREA AND KEEP PERSONNEL UPWIND.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SHUT OFF LEAK IF THERE IS NO RISK.
VENTILATE THE SPILL SITE THOROUGHLY BEFORE REENTERING.

SECTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - -

REFER TO SECTION 8.

CONTINUED ON NEXT PAGE

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CUST#: 942742
PO#: 101194AR

PRODUCT #: 337622 NAME: VINYL CHLORIDE, 99.5+%
MF: C2H3CL

SECTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

SELF-CONTAINED BREATHING APPARATUS.
CHEMICAL SAFETY GOGGLES.
FACE SHIELD (8-INCH MINIMUM).
COMPATIBLE CHEMICAL-RESISTANT GLOVES.
IMPERVIOUS PROTECTIVE CLOTHING.
AVOID ALL CONTACT.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CARCINOGEN.
MUTAGEN.
TOXIC.
REPRODUCTIVE HAZARD.
SEVERE IRRITANT.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
LIGHT SENSITIVE
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -

APPEARANCE AND ODOR
COLORLESS GAS
BOILING POINT: -13.4 C
MELTING POINT: -153.8 C
FLASHPOINT -78 F
- 61C
SPECIFIC GRAVITY: 0.911

SECTION 10. - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -

STABILITY
THIS MATERIAL IS STABILIZED.
CONDITIONS TO AVOID
STORE AWAY FROM HEAT.
PROTECT FROM AIR

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CUST#: 942742
PO#: 101194AR

PRODUCT #: 387622 NAME: VINYL CHLORIDE, 99.5+%
MF: C2H3CL

INCOMPATIBILITIES
MAY REACT WITH:
CHEMICALLY ACTIVE METALS
ALUMINUM
AND ITS ALLOYS.
COPPER
NITROGEN OXIDES
SENSITIVE TO LIGHT
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
PHOSGENE GAS
HAZARDOUS POLYMERIZATION
MAY UNDERGO AUTOPOLYMERIZATION.
CONDITIONS TO AVOID
MAY POLYMERIZE ON EXPOSURE TO LIGHT.
HEAT
OXIDIZING AGENTS
PEROXIDES
OXYGEN
MOISTURE

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
CAN CAUSE SEVERE FROSTBITE.
CAUSES SEVERE IRRITATION.
HIGH CONCENTRATIONS ARE EXTREMELY DESTRUCTIVE TO TISSUES OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
MAY BE READILY ABSORBED THROUGH SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
CHRONIC EFFECTS
CARCINOGEN.
MAY ALTER GENETIC MATERIAL.
MAY CAUSE REPRODUCTIVE DISORDERS.
TARGET ORGAN(S):

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CUST#: 942742
PO#: 101194AR

PRODUCT #: 387622 NAME: VINYL CHLORIDE, 99.5+%
MF: C2H3CL

LIVER
BLOOD
BRAIN
CENTRAL NERVOUS SYSTEM
RTECS NO: KU9625000
ETHYLENE, CHLORO-
TOXICITY DATA
ORL-RAT LD50:500 MG/KG DOWCC*
IHL-RAT LC50:18 PPH/15M HUTODJ 1,239,82
TARGET ORGAN DATA
SENSE ORGANS AND SPECIAL SENSES (TUMORS)
VASCULAR (TUMORS)
LUNGS, THORAX OR RESPIRATION (TUMORS)
GASTROINTESTINAL (TUMORS)
LIVER (TUMORS)
LIVER (ANGIOSARCOMA)
BLOOD (LYMPHOMA INCLUDING HODGKIN'S DISEASE)
SKIN AND APPENDAGES (TUMORS)
PATERNAL EFFECTS (TESTES, EPIDIDYMIS, SPERM DUCT)
EFFECTS ON FERTILITY (FEMALE FERTILITY INDEX)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (LITTER SIZE)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
TUMORIGENIC (CARCINOGENIC BY RTECS CRITERIA)
TUMORIGENIC (EQUIVOCAL TUMORIGENIC AGENT BY RTECS CRITERIA)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

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CUST#: 942742
PO#: 101194AR

PRODUCT #: 387622 NAME: VINYL CHLORIDE, 99.5+%
MF: C2H3CL

SECTION 14. - - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -

TLV AND SOURCE
FOR VINYL CHLORIDE:
ACGIH TLV-TWA: 5 PPM (13 MG/M3).
OSHA PEL: 8H TWA 1 PPM; CEILING LIMIT: 5 PPM.

REVIEWS, STANDARDS, AND REGULATIONS

ACGIH TLV-CONFIRMED HUMAN CARCINOGEN	85INA8 6,1693,91
ACGIH TLV-TWA 5 PPM	85INA8 6,1693,91
IARC CANCER REVIEW:HUMAN SUFFICIENT EVIDENCE	IMEMDT 19,377,79
IARC CANCER REVIEW:ANIMAL SUFFICIENT EVIDENCE	IMEMDT 19,377,79
IARC CANCER REVIEW:GROUP 1	IMSUDL 7,373,87

MSHA STANDARD-AIR:TWA 200 PPM (510 MG/M3)
DTLWS* 3,31,73
OSHA-CANCER SUSPECT AGENT
CFRGBR 29,1910.1017,87
OEL-ARAB REPUBLIC OF EGYPT:TWA 2.5 MG/M3 JAN93
OEL-AUSTRALIA:TWA 5 PPM (10 MG/M3);CARCINOGEN JAN93
OEL-BELGIUM:TWA 5 PPM (13 MG/M3);CARCINOGEN JAN93
OEL-CZECHOSLOVAKIA:TWA 10 MG/M3;STEL 30 MG/M3 JAN93
OEL-DENMARK:TWA 1 PPM (3 MG/M3);CARCINOGEN JAN93
OEL-FINLAND:TWA 5 PPM (15 MG/M3);STEL 10 PPM (30 MG/M3);CAR JAN93
OEL-FRANCE:TWA 1 PPM (3 MG/M3);CARCINOGEN JAN93
OEL-GERMANY:CARCINOGEN JAN93
OEL-HUNGARY:STEL 10 MG/M3;CARCINOGEN JAN93
OEL-JAPAN:STEL 2.5 PPM;CARCINOGEN JAN93
OEL-THE NETHERLANDS JAN93
OEL-THE PHILIPPINES:TWA 50 PPM (100 MG/M3) JAN93
OEL-POLAND:TWA 30 MG/M3 JAN93
OEL-RUSSIA:TWA 1 MG/M3;STEL 2.5 PPM (5 MG/M3) JAN93
OEL-SWEDEN:TWA 1 PPM (2.5 MG/M3);STEL 5 PPM (13 MG/M3);SKIN;CAR JAN93
OEL-SWITZERLAND:TWA 2 PPM (5.2 MG/M3);CARCINOGEN JAN93
OEL-THAILAND:TWA 1 PPM (2.8 MG/M3) JAN93
OEL-TURKEY:TWA 500 PPM (1300 MG/M3) JAN93
OEL-UNITED KINGDOM:TWA 7 MG/M3 JAN93

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CUST#: 942742
PO#: 101194AR

PRODUCT #: 387622 NAME: VINYL CHLORIDE, 99.5+%
MF: C2H3CL

OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO VINYL CHLORIDE-AIR:CA LOWEST FEASIBLE CONCENTRATION
NIOSH* DHHS #92-100,92
NOHS 1974: HZD 76445; NIS 22; TNF 1459; NOS 36; TNE 29836
NOES 1983: HZD 76445; NIS 20; TNF 927; NOS 34; TNE 25364; TFE 11755
ATSDR TOXICOLOGY PROFILE (NTIS** PB/90/103870/AS)
EPA GENETOX PROGRAM 1988, POSITIVE: CARCINOGENICITY-MOUSE/RAT
EPA GENETOX PROGRAM 1988, POSITIVE: IN VIVO CYTOGENETICS-HUMAN LYMPHOCYTE; E COLI POLA WITH S9
EPA GENETOX PROGRAM 1988, POSITIVE: HISTIDINE REVERSION-AMES TEST
EPA GENETOX PROGRAM 1988, POSITIVE: D MELANOGASTER SEX-LINKED LETHAL
EPA GENETOX PROGRAM 1988, POSITIVE: S CEREVISIAE GENE CONVERSION; S POMBE-FORWARD MUTATION
EPA GENETOX PROGRAM 1988, NEGATIVE: D MELANOGASTER-RECIPROCAL TRANSLOCATION
EPA GENETOX PROGRAM 1988, NEGATIVE: RODENT DOMINANT LETHAL; MOUSE SPOT TEST
EPA GENETOX PROGRAM 1988, NEGATIVE: S CEREVISIAE-HOMOZYGOSIS
EPA TSCA CHEMICAL INVENTORY, JUNE 1993
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0680-0345;8EHQ-0982-0457;8EHQ-0378-0104
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0986-0629
ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1994
NIOSH CURRENT INTELLIGENCE BULLETIN 28, 1978
NIOSH ANALYTICAL METHODS: SEE VINYL CHLORIDE, 1007
NTP 7TH ANNUAL REPORT ON CARCINOGENS, 1992 : KNOWN TO BE CARCINOGENIC
OSHA ANALYTICAL METHOD #04
THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

SECTION 16. - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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MATERIAL SAFETY DATA SHEET

CUST#: 942742
PO#: 101194AR

PRODUCT #: 387622 NAME: VINYL CHLORIDE, 99.5+%
MF: C2H3CL

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XYLENE

Material Safety Data Sheet

Mallinckrodt Chemical Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 07-17-91 Supersedes 02-16-89

PRODUCT IDENTIFICATION:

Synonyms: Dimethyl benzene, xylol

Formula CAS No.: 1330-20-7

Molecular Weight: 106.17

Chemical Formula: C8H10

Hazardous Ingredients:
Xylene isomers p,m,o 100-41-4 Ethyl benzene (17%)

PRECAUTIONARY MEASURES

DANGER! HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. VAPOR HARMFUL. FLAMMABLE! AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION.

Keep away from heat, sparks and flame.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.

EMERGENCY FIRST AID

Aspiration hazard. If swallowed, do not induce vomiting. Call a physician immediately. 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. In all cases call a physician.
SEE SECTION 5.

Physical Data — SECTION 1

Appearance: Clear, colorless liquid.

Odor: Characteristic odor.

Solubility: Insoluble in water.

Boiling Point: 137-140 C (279-284 F)

Vapor Density (Air=1):3.7

Melting Point: -25 C (-13 F)

Vapor Pressure (mm Hg):8 @ 20 C (68 F)

Specific Gravity: 0.86

Evaporation Rate:(Butylacetate = 1) 0.7

NFPA Ratings: Health: 2 Flammability: 3 Reactivity: 0

Fire and Explosion Information — SECTION 2

Fire: Flammable. Flashpoint: 26.2 C (79 F)(TCC)(Minimum) Autoignition: ca. 463.8 C (867 F). Flammable limits in air, volume % (1.0-7.0).

Explosion: Above flash point, vapor-air mixtures are explosive within flammable limits noted above.

Fire Extinguishing Media: Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Vapors can flow along surfaces to distant ignition source and flash back.

Reactivity Data — SECTION 3

Stability: Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products: Involvement in a fire causes formation of carbon monoxide and unidentified organic components.

Hazardous Polymerization: This substance does not polymerize.

Incompatibilities: Strong oxidizers, heat and sources of ignition.

Leak/Spill Disposal Information — SECTION 4

Ventilate area of leak or spill. Remove all sources of ignition. Handling equipment must be grounded to prevent sparking. Clean-up personnel require protective clothing and respiratory protection from vapors. Dike spill. Contain and recover liquid when possible. Disposal: Collect as hazardous waste and atomize in a suitable RCRA approved combustion chamber, or absorb with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!
Reportable Quantity (RQ)(CWA/CERCLA) : 1000 lbs.
Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Inhalation of vapors maybe irritating to the nose and throat. Inhalation of high concentrations may result in nausea, vomiting, headache, ringing in the ears, and severe breathing difficulties which may be delayed in onset. Substernal pain, cough, and hoarseness are also reported. High vapor concentrations are anesthetic and central nervous system depressants.

Ingestion: Ingestion causes burning sensation in mouth and stomach, nausea, vomiting and salivation. Minute amounts aspirated into the lungs can produce a severe hemorrhagic pneumonitis with severe pulmonary injury or death.

Skin Contact: Skin contact results in loss of natural oils and often results in a characteristic dermatitis.

Eye Contact: Vapors can cause irritation. Splashes are toxic to eye tissue. Hemorrhagic inflamatory lesions may develop.

Chronic Exposure: Chronic inhalation can cause headache, loss of appetite, nervousness and pale skin. Repeated or prolonged skin contact may cause a skin rash. Repeated exposure of the eyes to high

concentrations of vapor may cause reversible eye damage.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion: Aspiration hazard. If swallowed, get immediate medical attention. Vomiting may occur spontaneously, but DO NOT INDUCE! If vomiting occurs, keep head below hips to prevent aspiration into lungs.

Skin Exposure: Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1986)

Xylene:Oral rat LD50: 4300 mg/kgInhalation rat LC50: 5000 ppm/4HIrritation eye rabbit: 87 mg mildSkin rabbit 500 mg/24 moderatereproductive effects cited.Ethyl benzene: Oral rat LD50: 3500 mg/KgSkin rabbit LD50: 17800 mg/Kgmutation data citedreproduction data cited.

SECTION 6

Occupational Control Measures

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 100 ppm (TWA) 150 ppm (STEL) xylene 100 ppm (TWA) 125 ppm (STEL) ethyl benzene -ACGIH Threshold Limit Value (TLV): 100 ppm (TWA) 150 ppm (STEL) xylene 100 ppm (TWA) 125 ppm (STEL) ethyl benzene

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators (NIOSH Approved) If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn up to the maximum use concentration specified by the respirator supplier. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn. Use explosion-proof equipment.

Skin Prctection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this

material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information SECTION 7

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. EMPTY CONTAINERS: Can contain explosive vapors. Do Not attempt to clean since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

****

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****

XYLE1

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS must include a copy of this addendum

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X	X		

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
XYLENE						
Xylenes (1330-20-7) 83%	No	No	Yes	No	No	No
Ethyl benzene (100-41-4) 17%	No	No	Yes	No	No	No

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Enviromental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

XYLE1

XYLENE

APPENDIX B

SECTION 2 PTI DEMONSTRATION SYSTEM MSDS SHEET INDEX

2.1 Reactant Panel Chemicals
- 2.1.1 Alumina
- 2.1.2 Calcium Carbonate
- 2.1.3 Calcium Chloride
- 2.1.4 Calcium Hydroxide
- 2.1.5 Calcium Oxide
- 2.1.6 Calcium Sulfate
- 2.1.7 Fiber Glass
- 2.1.8 Fondue Cement
- 2.1.9 Portland Cement

2.2 Scrubber Solution Chemicals
- 2.2.1 Liquid Caustic Soda
- 2.2.2 Sodium Carbonate
- 2.2.3 Sodium Chloride
- 2.2.4 Sodium Hydroxide
- 2.2.5 Sodium Hypochlorite

2.3 Potential Reactor Created Chemicals
- 2.3.1 Carbon Dioxide
- 2.3.2 Carbon Monoxide
- 2.3.3 Carbonyl Chloride (Phosgene)
- 2.3.4 Chlorine
- 2.3.5 Germicidal Ultraviolet Lamps including Ozone Generation
- 2.3.6 Hydrogen Chloride
- 2.3.7 Hydrochloric Acid

2.4 Other Chemicals
- 2.4.1 Antifoam Agent
- 2.4.2 Compressed Nitrogen
- 2.4.3 Isopropyl Alcohol Cleaning Solution

C-E Minerals
901 East Eighth Avenue
King of Prussia, PA 19406
Phone: 215-265-6880
FAX: 215-337-7163
TWX: 510-660-2058
Cable: SAMRAK

FUSED WHITE ALPHA ALUMINA

MANUFACTURER: C-E Minerals
ADDRESS: P.O. Box 37
Andersonville, GA 31711
Phone: 912-924-7170

SECTION I, MATERIAL IDENTIFICATION

MATERIAL NAME: FUSED WHITE ALPHA ALUMINA
TYPES: Sizes range from 2" X Down to Powders.
DESCRIPTION: Fused White Alpha Alumina generally contains 99%+ alumina.

SECTION II, INGREDIENTS AND HAZARDS

INGREDIENT NAME	CAS#	%	Listed as a Carcinogen in NTP IARC or OSHA 1910(z) specify
ALPHA ALUMINA	1344-28-1	>99%	NO

The PEL(OSHA) for this material is 5.0 mg/m3 respirable dust.
The TLV(ACGIH) for this material is 10.0 mg/m3 total dust.

Remaining components not determined hazardous.

SECTION III, PHYSICAL DATA

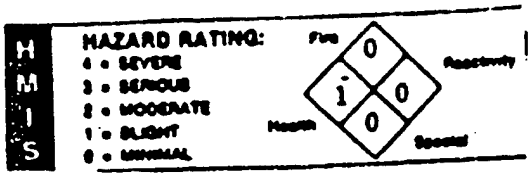
Appearance and odor: White in color. No odor.

Boiling Point:	NA	Evaporation Rate:	NA
Vapor Pressure:	NA	Specific Gravity (water=1)	3.9
Water Solubility (%):	SLIGHT	Melting Point:	+3600 DEG. F.
Vapor Density (Air=1):	NA	% Volatile by Wt:	NA
LD50/LC50:	NA	PH (10% Sol.):	NA

SECTION IV, FIRE AND EXPLOSION DATA

Unusual fire or explosion hazard: NONE
This product is non-combustible. Use extinguishing media appropriate to the surrounding area.

NA - NOT AVAILABLE - NOT APPLICABLE



SECTION V, REACTIVITY DATA

This material is stable under ordinary conditions. Incompatible with Chlorine Trifluoride.

SECTION VI, HEALTH HAZARD DATA

ROUTES OF ENTRY: Inhalation
ACUTE HEALTH EFFECTS: Transitory upper respiratory physical irritation.
CHRONIC HEALTH EFFECTS: Excessive inhalation (above PEL/TLV) of product dusts over long periods of time may cause industrial bronchitis, reduce breathing capacity, and lead to increased susceptibility to other respiratory disease.
MEDICAL CONDITIONS THAT MAY BE AGGRAVATED: Pre-existing chronic lung conditions such as, but not limited to, bronchitis, emphesema and asthma.
INHALATION: Congestion of the throat, nasal passages and upper respiratory system.
EYES: Temporary physical irritation. INGESTION: N/A
SKIN CONTACT: N/A
FIRST AID/EMERGENCY PROCEDURES
INHALATION: Remove to fresh air. EYES: Flush with water.
INGESTION: N/A SKIN CONTACT: N/A

SECTION VII, SPILL, LEAK AND DISPOSAL

In case of major spills, provide ventilation. Cleanup personnel need protection against eye contact, inhalation of dust and prolonged skin contact. Pick up spills taking care to avoid raising dust clouds (use vacuum where necessary).
DISPOSAL: Non-Biodegradable - Use solid waste disposal common to landfill type operation or similar disposal.

SECTION VIII, SPECIAL PROTECTION INFORMATION

Provide adequate general and local exhaust ventilation to meet PEL requirements. Provide workers with dust respirators for use in emergency or non-routine situations where dust levels may exceed PEL. A NIOSH approved half face piece respirator can be used for exposures up to 10X PEL. For exposure up to 100X PEL use full face piece respirator with replaceable dust filter. Higher exposures need an approved air supplied respirator.

SECTION IX, SPECIAL PRECAUTIONS & COMMENTS

Keep dust in work area at a minimum and maintain air concentration of dust as far below PEL as feasible. Use good housekeeping techniques, such as vacuuming and wet sweeping to remove collected dust and prevent formation of dust clouds. Avoid inhalation of dust. Avoid eye contact with materials.

Although reasonable care has been taken in the preparation of the information contained herein, C-E Minerals, Inc. extends no warranties, makes no representation and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.

CALCIUM CARBONATE

Material Safety Data Sheet

Mallinckrodt Chemical Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 04-06-89 Supersedes 11-20-85

PRODUCT IDENTIFICATION:

Synonyms: Carbonic acid calcium salt; calcite; aragonite

Formula CAS No.: 471-34-1 Molecular Weight: 100.09

Hazardous Ingredients: Calcium carbonate Chemical Formula: CaCO3

PRECAUTIONARY MEASURES

CAUTION! NUISANCE DUST.

Avoid prolonged exposure to dust.
As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

EMERGENCY FIRST AID

SEE SECTION 5.

SECTION 1

Physical Data

Appearance: Fine white powder.

Odor: Odorless.

Solubility: 0.001 gm in 100 ml water, soluble in dilute acids.

Boiling Point: Not applicable.

Vapor Density (Air=1): No information found.

Melting Point: Decomposes @ 825 C

Vapor Pressure (mm Hg): No information found.

Specific Gravity: 2.7 - 2.95

Evaporation Rate: No information found.

SECTION 2

Fire and Explosion Information

Fire: Not considered to be a fire hazard.

Explosion: Not considered to be an explosion hazard.

Fire Extinguishing Media: Use any means suitable for extinguishing surrounding fire.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Reactivity Data — SECTION 3

~~ability: Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products: When heated to decomposition (825 C), emits calcium oxide fumes and liberates carbon dioxide.

Hazardous Polymerization: Will not occur.

Incompatibilities: Acids, fluorine, magnesium with hydrogen.

Leak/Spill Disposal Information — SECTION 4

Ventilate area of leak or spill. Clean-up personnel may require respiratory protection from dust. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal. Disposal: Whatever cannot be saved for reclamation may be delivered to an approved waste disposal facility.

Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Excessive concentrations of a nuisance dust may cause nuisance condition such as coughing, sneezing, and nasal irritation.

gestion: Non-toxic.

Skin Contact: Not expected to be a hazard.

Eye Contact: No information found, but presumed to cause mechanical irritation.

Chronic Exposure: Excessive oral doses may produce alkalosis.

Aggravation of Pre-existing Conditions: No information found.

B. FIRST AID

Inhalation: Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion: If large amounts were swallowed, give water to drink and get medical advice.

Skin Exposure: Wash exposed area with soap and water. Get medical advice if irritation develops.

Eye Exposure: Wash thoroughly with running water. Get medical advice if irritation develops.

C. TOXICITY (RTECS, 1986)

No LD50/LC50 information found relating to normal routes of occupational :posure.

Occupational Control Measures — SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 15 mg/m3 total dust, 5 mg/m3 respirable dust -ACGIH

	Threshold Limit Value (TLV): 10 mg/m3 total dust containing no asbestos and < 1% crystalline silica
V lation System:	A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.
Personal Respirators (NIOSH Approved)	If the TLV is exceeded, a half mask chemical cartridge respirator may be worn up to ten times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less.
Skin Protection:	Gloves and lab coat, apron or coveralls.
Eye Protection:	Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information — SECTION 7

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage.

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LCCAR

Addendum to Material Safety Data Sheet

REGULATORY STATUS

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X				

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
CALCIUM CARBONATE (471-34-1)	No	No	No	No	No	No

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Enviromental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

LCCAR

CALCIUM CARBONATE

MALLINCKRODT

Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

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Emergency Telephone Number: 314-982-5000

CALCIUM CHLORIDE

PRODUCT IDENTIFICATION:

Synonyms: Calplus; calcium dichloride; calcium chloride anhydrous; Caltac; Dowflake

Formula CAS No.: 10043-52-4

Molecular Weight: 110.98

Chemical Formula: $CaCl_2$

Hazardous Ingredients: Calcium chloride

PRECAUTIONARY MEASURES

WARNING! CAUSES IRRITATION. MAY BE HARMFUL IF SWALLOWED.

Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.

EMERGENCY/FIRST AID

If swallowed, give water or milk to drink as soon as possible. Call a physician immediately. Never give anything by mouth to an unconscious person. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. Call a physician.
SEE SECTION 5.

DOT Hazard Class: Not Regulated

RECEIVED
JUL 16 1996

SECTION 1 Physical Data

Appearance: White or gray-white granules.

Odor: Odorless.

Solubility: Freely soluble in water, exothermic.

Boiling Point: Over 1600°C (2912°F).

Melting Point: 772°C (1422°F).

Density: 2.15

Vapor Density (Air=1): No information found.

Vapor Pressure (mm Hg): No information found.

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not considered to be a fire hazard.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. At high temperatures or when moistened under fire conditions, calcium chloride may produce toxic or irritating fumes of calcium or hydrogen chlorides.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Substance will pick up moisture from the air and go into solution if exposed in open containers. A water solution of this material is acidic.

Hazardous Decomposition Products:
Emits toxic chlorine fumes when heated to decomposition. May form hydrogen chloride in presence of sulfuric or phosphoric acids or with water at elevated temperatures.

Hazardous Polymerization:
This substance does not polymerize.

Incompatibilities:
Methyl vinyl ether, water, zinc, bromine trifluoride, mixtures of lime and boric acid, barium chloride, and 2-furan percarboxylic acid. Metals will slowly corrode in aqueous calcium chloride solutions. Aluminum (and alloys) and yellow brass will be attached by calcium chloride.

SECTION 4 Leak/Spill Disposal Information

Sweep, scoop or pick up spilled material. Collected waste may be transferred to a closed, water-proof non-metal container and sent to an approved waste disposal facility.

Ensure compliance with local, state and federal regulations.

MALLINCKRODT

Material Safety Data Sheet

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Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

Emergency Telephone Number: 314-982-5000

Addendum to Material Safety Data Sheet

REGULATORY STATUS

(Chem.Key: CACLA)

	Hazard Categories for SARA Section 311/312 Reporting				
	Acute	Chronic	Fire	Pressure	Reactive
	X				

Product or Components of Product:	SARA EHS Sect. 302 RQ (lbs.)	SARA EHS Sect. 302 TPQ (lbs.)	SARA Section 313 Chemicals Name List	SARA Section 313 Chemicals Chemical Category	CERCLA Sec.103 RQ (lbs.)	RCRA Sec. 261.33
CALCIUM CHLORIDE (10043-52-4)	No	No	No	No	No	No

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.
SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.
SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec. 103: Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4
RCRA: R ce Conservation and Reclamation Act. Commercial chemical product wast designated as acute hazards and toxic under 40 CFR 261.33

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Granular material does not present a serious inhalation hazard but dust may produce irritation of the upper respiratory tract.

Ingestion:
Low toxicity material but ingestion may cause serious irritation of the mucous membrane due to heat of hydrolysis. Large amounts can cause gastrointestinal upset, vomiting, abdominal pain.

Skin Contact:
Irritant. May cause burns on moist skin due to heat of hydrolysis.

Eye Contact:
Hazard may be either mechanical abrasion or, more serious, burns from heat of hydrolysis and chloride irritation.

Chronic Exposure:
No information found.

Aggrevation of Pre-existing Conditions:
Contact may aggravate any existing skin conditions.

B. FIRST AID

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion:
If swallowed, give water or milk to drink as soon as possible. Call a physician immediately. Never give anything by mouth to an unconscious person.

Skin Exposure:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1986)

Oral rat LD50: 1000 mg/kg. Mutation data cited.
Aquatic toxicity rating TLm 96: over 1000 ppm

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
Mallinckrodt recommends a Threshold Limit Value (TLV) of 5 mg/m^3 Time Weighted Average (TWA)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded, a dust/mist respirator with chemical goggles may be worn, in general, up to ten times the TLV. Consult respirator supplier for limitations. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection:
Wear protective gloves and clean body-covering clothing.

Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Moist calcium chloride and concentrated solutions can corrode steel. When exposed to the atmosphere, calcium chloride will absorb water and form a solution. Maintain good housekeeping in work area. Dust deposits on floors and other surfaces may pick up moisture and cause the surfaces to become slippery and present safety hazards.

Material Safety Data Sheet

for

Calcium Hydroxide

Section I - Identity

Manufacturer's name and address: Ash Grove Cement Company
8900 Indian Creek Parkway
P. O. Box 25900
Overland Park, KS 66225

Emergency Telephone Number: (913) 451-8900
Information Telephone Number: (913) 451-8900

Chemical Name and Synonyms: Calcium hydroxide, calcium dihydroxide, $Ca(OH)_2$, slaked lime, hydrated lime, lime, milk of lime, carboxide, caustic lime

Trade Name and Synonyms: Snowflake, Kemilime, Slik
CAS No. 001-305-620

Date Prepared/Reviewed: May, 1993

Section II - Chemical and Physical Data

Calcium hydroxide, $Ca(OH)_2$: Hydrated lime, is prepared by adding sufficient water to calcium oxide, CaO, to cause complete hydration of the oxide. Impurities are removed from the resulting dry power by air separators.

Chemical Family: Inorganic Base
Molecular Weight: 74.10
Boiling Point: Decomposes to calcium oxide above 580°C
Melting Point: ($-H_2O$) at 580°C; converts to calcium oxide
Vapor Pressure (mm Hg): N/A
Specific Gravity: 2.24
Vapor Density: (Air=1) 0 **Evaporation Rate:** N/A
Solubility in Water: 0.185 g/100 ml at 0°C
0.077 g/100 ml at 100°C
Appearance and Odor: Soft white powder; odorless

Section III - Hazardous Ingredients

	OSHA PEL	ACGIH TLV	MSHA TLV
Hydrated Lime, $Ca(OH)_2$	5 mg/m^3	5 mg/m^3	5 mg/m^3

ACGIH American Conference of Governmental Industrial Hygienists
MSHA Mine Safety and Health Administration
OSHA Occupational Safety and Health Administration
PEL Permissible Exposure Limit
TLV Threshold Limit Value
TWA Time Weighted Average

Section IV - Fire and Explosion Hazard Data

Flash Point (method used): NA; calcium hydroxide is noncombustible and not explosive.

Flammable or Explosive Limits: **LEL:** NA; **UEL:** NA

Extinguishing Media: NA

Special Fire Fighting Procedures: Hydrated lime is incombustible.

Firefighting Media: Dry chemical, carbon dioxide, water spray or foam. For larger fires, use water spray or fog.

CAUTION: Saturated water solutions of hydrated lime can have pH of 12-12.5. See Section VII for appropriate precautions.

Unusual Fire and Explosion Hazards: None

Section V - Reactivity Data

Stability: Stable under normal temperatures and pressures. Calcium hydroxide will gradually absorb carbon dioxide when exposed to air, forming calcium carbonate.

Section V - Reactivity Data (Cont'd.)

Incompatibility (materials to avoid): maleic anhydride, Nitroparaffins, nitromethane, nitroethane, and nitropropane; all can form explosive salts with calcium hydroxide.

Phosphorous, when boiled with alkaline hydroxides, yields mixed phosphines which may ignite spontaneously in air.

Hazardous Polymerization: Will not occur.

Water: Calcium hydroxide forms a corrosive solution, pH 12-12.5, with water.

Hazardous Decomposition or By-Products: When heated above 580°C., calcium hydroxide loses water to form calcium oxide, quicklime.

Conditions to Avoid: NA

Section VI - Health Hazard Data

Route(s) of Entry: Inhalation; skin; eyes; ingestion

1. **Inhalation:** corrosive
   a. **Acute exposure:** Inhalation of low concentrations may cause sore throat, coughing, choking, dyspnea, and variable symptoms of headache, dizziness, and weakness. Intense exposures may result in tightness in the chest and delayed pulmonary edema. The solubility of the substance allows further penetration that may continue for several days.
   b. **Chronic exposure:** Bronchial irritation with chronic cough are common.
   c. **First aid:** Remove from exposure; move to fresh air immediately. If breathing has stopped, give artificial respiration. Keep affected person warm and at rest. Get medical attention.
2. **Skin contact:** corrosive
   a. **Acute exposure:** The substance can penetrate the skin slowly, producing soft, necrotic, deeply penetrating areas on contact. The solubility may allow further penetration that may continue for several days. The extent of damage depends on duration of contact.
   b. **Chronic exposure:** A chronic dermatitis may follow repeated contact.

Section VI - Health Hazard Data - Cont'd.

c. **First aid:** Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (approximately 15-20 minutes). In the case of chemical burns, cover the affected areas with sterile, dry dressing. Bandage securely, but not too tightly. Get medical attention.

3. **Eye contact:** corrosive
   a. **Acute exposure:** Direct contact with the solid or aqueous solutions may cause conjunctival edema and corneal destruction; can lead to and may cause blindness.
   b. **Chronic exposure:** Prolonged contact may cause conjunctivitis.
   c. **First aid:** Wash eyes immediately with large amounts of water, occasionally lifting the upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately. Administration of drugs to the eyes should be performed by qualified medical personnel.
4. **Ingestion:** corrosive. If ingested, consult a physician immediately.

Section VII - Precautions for Safe Handling and Use

Precautions for safe handling, storage, and use:

Handling: Use protective equipment as described in Section VIII.

Storing: Protect against physical damage and store in dry place away from water or moisture (NFPA 40, HAZARDOUS CHEMICALS DATA, 1975).

Section VIII - Control Measures

Respiratory Protection: A NIOSH-MSHA approved respirator must be used to control below PELs and TLVs.

Firefighting: Self-contained breathing apparatus with a full facepiece operated in pressure-demand or positive-pressure mode.

Ventilation: Process enclosure or local exhaust ventilation. Use mechanical ventilation to vent dust to collector.

Section VIII - Control Measures (Cont'd.)

Protective Gloves: Gauntlet type work gloves.

Eye Protection: Tight fitting goggles.

Other Protective Equipment: Long sleeve shirt; long pants; can use protective cream on exposed skin areas.

Work/Hygienic Practices: Immediately after working with hydrated lime, workers should shower with soap and water.

This product neither contains nor is directly manufactured with any controlled ozone depleting substances, Class I and II.

MSDS

Material Safety Data Sheet

for

Calcium Oxide

Section I - Identity

Manufacturer's name and address: Ash Grove Cement Company
8900 Indian Creek Parkway
P. O. Box 25900
Overland Park, KS 66225

Emergency Telephone Number: (913) 451-8900
Information Telephone Number: (913) 451-8900

Chemical Name and Synonyms: Calcium oxide, CaO, quicklime, lime, unslaked lime

Trade Name and Synonyms: Pebble Quicklime, Cal-Max

CAS No. 1305-78-8

Date Prepared/Reviewed: May, 1993

Section II - Chemical and Physical Date

Calcium oxide, "Quicklime", is prepared by heating sized calcium carbonate stone, usually limestone, in kilns heated to greater than 900°C. At this temperature calcium carbonate loses carbon dioxide to form calcium oxide.

Chemical Family: Inorganic Base
Molecular Weight: 56.10
Boiling Point: 5162°C
Melting Point: 4737°F.
Specific Gravity: 3.2-3.4
Vapor Density: (Air=1) 0 **Evaporation Rate:** N/A
Solubility in Water: 0.131 g/100 ml at 10°C; 0.07 g/100 ml at 80°C
Appearance and Odor: White granular or powder; faint earthy odor

Section III - Hazardous Ingredients

	OSHA PEL	ACGIH TLV	MSHA TLV
Quicklime, CaO	5 mg/m³	2 mg/m³	5 mg/m³

Calcium oxide may contain quartz, free silica. Chronic exposure to the respirable dust of materials containing quartz; e.g., sand and gravel, has caused silicosis.

	ACGIH TLV (TLV-8 hr TWA) mg/m³	OSHA PEL	MSHA TLV (Adopts 1973 ACGIH TLV)
Quartz, free silica	0.1	0.1*	TLV = $\frac{10}{\% SiO_2 * + 2}$

*Respirable fraction

ACGIH	American Conference of Governmental Industrial Hygienists
MSHA	Mine Safety and Health Administration
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
TLV	Threshold Limit Value
TWA	Time Weighted Average

Section IV - Fire and Explosion Hazard Data

Flash Point: NA; calcium oxide is noncombustible and not explosive.

Flammable or Explosive Limits: NA **LEL:** NA **UEL:** NA

Extinguishing Media: NA

Special Fire Fighting Procedures: Calcium oxide in itself is incombustible. In contact with water, product will hydrate evolving heat. **Warning: Sufficient heat can be created during hydration to ignite paper, wood, rags or other combustible materials. CAUTION:** Saturated water solutions of calcium oxide can have pH of 12-12.5. See Section VII for appropriate precautions.

Section IV - Fire and Explosion Hazard Data - Cont'd.

Firefighting Media: Dry chemical, carbon dioxide, water spray or foam. For larger fires, use water spray, fog or alcohol foam.

CAUTION: Saturated water solutions of hydrated lime can have pH of 12-12.5. See Section VII for appropriate precautions.

Unusual Fire and Explosion Hazards: None

Section V - Reactivity Data

Stability: Unstable; will rapidly hydrate in contact with water with production of heat to form calcium hydroxide.

Will gradually react with the carbon dioxide in air to form calcium carbonate; stable in absence of moisture and carbon dioxide.

Conditions to avoid: Contact with water, acids.

Incompatibility (materials to avoid): May react violently and incandescently with boric oxide, hydrogen fluoride, phosphorous pentoxide, chlorine trifluoride, and fluorine. Reaction with interhalogens may cause ignition.

Hazardous Polymerization: Will not occur.

Hazardous Decomposition or By-Products: None.

Section VI - Health Hazard Data

Route(s) of Entry: Inhalation; skin; eyes; ingestion

1. **Inhalation:** corrosive
   a. **Acute exposure:** Inhalation of low concentrations may cause sore throat, coughing, choking, dyspnea, and variable symptoms of headache, dizziness, and weakness. Intense exposures may result in tightness in the chest and delayed pulmonary edema. The solubility of the substance allows further penetration that may continue for several days.
   b. **Chronic exposure:** Bronchial irritation with chronic cough are common.

Section VI - Health Hazard Data - Cont'd.

c. **First aid:** Remove from exposure; move to fresh air immediately. Keep affected person warm and at rest. Get medical attention.

2. **Skin contact:** corrosive
   a. **Acute exposure:** During prolonged skin contact the substance can penetrate the unprotected skin slowly, producing soft, necrotic, deeply penetrating areas on contact. The solubility allows further penetration that may continue for several days. The extent of damage depends on duration of contact.
   b. **Chronic exposure:** A chronic dermatitis may follow repeated contact.
   c. **First aid:** Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (approximately 15-20 minutes). In the case of chemical burns, cover the affected areas with sterile, dry dressing. Bandage securely, but not too tightly. Get medical attention.
3. **Eye contact:** corrosive
   a. **Acute exposure:** Direct contact with the solid or aqueous solutions may cause conjunctival edema and corneal destruction which can lead to and may cause blindness.
   b. **Chronic exposure:** Prolonged contact may cause conjunctivitis.
   c. **First aid:** Wash eyes immediately with large amounts of water, occasionally lifting the upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately. Administration of drugs to the eyes should be performed by qualified medical personnel.
4. **Ingestion:** corrosive. If ingested, consult a physician immediately.

OSHA regulated: Yes, PEL of 5 mg/m^3

Medical conditions generally aggravated by exposure: NA

Section VII - Precautions for Safe Handling and Use

Steps to be taken in case material is released or spilled:

Occupational Spill: Do not touch spilled material. Stop leak if possible without risk. For small spills, take up with absorbent material and place into containers for later disposal. For small dry spills, shovel material into clean, dry container and cover. Move containers from spill area. For large spills, dike far ahead

Section VII - Precautions for Safe Handling and Use - Cont'd.

of spill for later disposal.

Saturated solutions of calcium oxide ("Milk of Lime") can have pH of 12-12.5, corrosive to unprotected skin and eyes. Such solutions may be created during fire fighting. Tight fitting goggles and gloves, boots and other personal protective equipment (PPE) must be used to prevent skin and eye contact. PPE resistant to permeation and penetration by lime water must be chosen.

Waste Disposal Methods

1. May be used to neutralize acid wastes.
2. May be used agriculturally.
3. Controlled discharge into sewers with sewage plant's approval.

Handling: Use protective equipment as described above in this section.

Storage: Protect product against physical damage and store in a dry place away from water or moisture.

Section VIII - Control Measures

Ventilation: Enclose all dusty processes; use local exhaust ventilation; use ventilation to vent dust to collector.

Personal Protective Equipment (PPE): Use NIOSH-MSHA approved respirator for protection against dust.

Use gauntlet type work gloves and tight fitting goggles. Long sleeve shirts and long pants should be worn. Protective barrier creams may be used on exposed skin surfaces.

Refer to Section VII for protection against exposure to solutions of calcium oxide.

Work/Hygienic Practices: Immediately after working with calcium oxide, workers should shower with soap and water.

This product neither contains nor is directly manufactured with any controlled ozone depleting substances, Class I and II.

MALLINCKRODT

Material Safety Data Sheet

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Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

Emergency Telephone Number: 314-982-5000

CALCIUM SULFATE

PRODUCT IDENTIFICATION:

Synonyms: Calcium (II) sulfate dihydrate (1:1:2); gypsum; sulfuric acid, calcium salt (1:1), dihydrate

Formula CAS No.: 10101-41-4 (Dihydrate)

TSCA CAS No.: 7778-18-9 (Anhydrous)

Molecular Weight: 172.17

Chemical Formula: $CaSO_4\ 2H_2O$

Hazardous Ingredients:

Gypsum -ACGIH Listed as a nuisance dust.

PRECAUTIONARY MEASURES

CAUTION! NUISANCE DUST.

Use with adequate ventilation.

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

EMERGENCY/FIRST AID

SEE SECTION 5.

DOT Hazard Class: Not Regulated

SECTION 1 Physical Data

Appearance: White powder

Odor: Odorless.

Solubility: 0.24g in 100g of water.

Boiling Point: No information found.

Melting Point: Loses water above 120°C (248°F).

Specific Gravity: 2.32

Vapor Density (Air=1): No information found.

Vapor Pressure (mm Hg): No information found.

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not considered to be a fire hazard.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Toxic oxides of sulfur.

Hazardous Polymerization:
This substance does not polymerize.

Incompatibilities:
No incompatibility data found.

SECTION 4 Leak/Spill Disposal Information

Ventilate area of leak or spill. Clean-up personnel may require respiratory protection from dust.

Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

Disposal: Whatever cannot be saved for reclamation may be delivered to an approved waste disposal facility.

Ensure compliance with local, state and federal regulations.

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Hazard is that of a nuisance dust. Coughing, sneezing and labored breathing may occur in cases of severe inhalation.

Ingestion:
No adverse health effects expected.

Skin Contact:
No adverse health effects expected.

Eye Contact:
May cause mechanical irritation.

Chronic Exposure:
No adverse health effects expected.

Aggrevation of Pre-existing Conditions:
No adverse health effects expected.

B. FIRST AID

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.

Skin Exposure:
Wash exposed area with soap and water. Get medical advice if irritation develops.

Eye Exposure:
Wash thoroughly with running water. Get medical advice if irritation develops.

C. TOXICITY DATA (RTECS, 1986)

No LD50/LCS0 information found relating to normal routes of occupational exposure. Tumorigenic data cited. Aquatic toxicity rating TLm 96: over 1000 ppm.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):15 mg/m^3 total dust, 5 mg/m^3 respirable fraction
-ACGIH Threshold Limit Value (TLV):
10 mg/m^3 total dust containing no asbestos and < 1% free silica

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded, a dust/mist respirator may be worn up to ten times the TLV. Consult respirator supplier for details.

Skin Protection:
Wear protective gloves and clean body-covering clothing.

Eye Protection:
Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage.

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Material Safety Data Sheet

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Emergency Telephone Number: 314-982-5000

Addendum to Material Safety Data Sheet

REGULATORY STATUS

(Chem.Key: CASUL)

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X				

Product or Components of Product:	SARA EHS Sect. 302 RQ (lbs.)	SARA EHS Sect. 302 TPQ (lbs.)	SARA Section 313 Chemicals Name List	SARA Section 313 Chemicals Chemical Category	CERCLA Sec.103 RQ (lbs.)	RCRA Sec. 261.33
CALCIUM SULFATE (7778-18-9)	No	No	No	No	No	No

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.
SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.
SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec. 103: Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4
RCRA: Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

Material Safety Data Sheet

Vetrotex CertainTeed

DATE PREPARED: DECEMBER 20, 1995

MSDS Number: CT 2522-7

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

CHEMICAL PRODUCT IDENTIFICATION

Fiber Glass Reinforcements
- Chopped Strands
- Chopped Strand Mats
- Continuous Strand Rovings
- R099® Rovings
- STITCHMAT®
- WovenPLUS™
- Unifilo™ Continuous Strand Mat
- Woven Rovings
- Industrial Reinforcements Chopped Strands

Chemical Name:	Mixture
CAS No:	None Assigned
Common Name:	Fiber Glass Textile Fiber Glass Continuous Filament Glass Fibers
Product Use:	Reinforcements for various resin systems

MANUFACTURER INFORMATION

Vetrotex CertainTeed Corporation
P.O. Box 860
Valley Forge, PA USA
19482-0101

(610) 341-7000
9 am - 5 pm (Eastern Time - USA)

EMERGENCY TELEPHONE: CHEMTREC (800) 424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name:	Glass, Oxide, Chemicals
CAS No:	65997-17-3
Common Name:	Textile Fiber Glass: Continuous Filament Glass Fibers
Percent in Product:	Approx. 98% by weight (Except: Chopped Strand Mats: Approx. 90%; Unifilo: Approx. 92%)
LD_{50}:	N/A
LC_{50}:	N/A

Exposure Limits:

OSHA PEL	ACGIH TLV TWA	NIOSH REL
Total Nuisance Dust: 15 mg/m³ Respirable Nuisance Dust: 5 mg/m³	Total Glass Dust: 10 mg/m³	Total Glass Dust: 5 mg/m³ Respirable Fibers: 3 f/cc

Chemical Name:	Organic Polymer Solids (cured)		
CAS No:	None Assigned		
Common Name:	Size Materials-cured		
Percent in Product:	Approximately 2% by weight		
LD_{50}:	N/A		
LC_{50}:	N/A		
Exposure Limits:	**OSHA PEL**	**ACGIH TLV TWA**	**NIOSH REL**
	None	None	None

Chemical Name:	*For Chopped Strand Mat only, binder contains:* 2 Butenedioic Acid (E)-, Polymer with 1,2-Ethanediol and .α., .α.´-[(1-Methylethylidene) di-4, 1-Phenylene] bis [.ω.-Hydroxypoly[oxy (Methyl-1,2-Ethanediyl)]]		
CAS No:	39382-21-3		
Common Name:	Solid Unsaturated Polyester Resin		
Percent in Product:	Type 127 — up to 4% by weight Type 113 — up to 8% by weight		
LD_{50}:	N/A		
LC_{50}:	N/A		
Exposure Limits:	**OSHA PEL**	**ACGIH TLV TWA**	**NIOSH REL**
	None	None	None

Chemical Name:	*For Unifilo™ only, binder contains:* 2 Butenedioic Acid (E)-, Polymer with .α., .α.´-[(1-Methylethylidene) di-4, 1-Phenylene] bis [.ω.-Hydroxypoly[oxy (Methyl-1,2-Ethanediyl)]]		
CAS No:	39382-25-7		
Common Name:	None		
Percent in Product:	Up to 6% by weight		
LD_{50}:	N/A		
LC_{50}:	N/A		
Exposure Limits:	**OSHA PEL**	**ACGIH TLV TWA**	**NIOSH REL**
	None	None	None

Chemical Name:	*For Woven PLUS™ only, binder contains:* Polyester Resin-		
CAS No:	Proprietary (as determined by raw material manufacturer)		
Common Name:	None		
Percent in Product:	Up 4% by weight		
LD_{50}:	N/A		
LC_{50}:	N/A		
Exposure Limits:	**OSHA PEL**	**ACGIH TLV TWA**	**OTHER**
	None	None	None

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW

	Health	Fire	Reactivity
NFPA Rating:	0	0	0
HMIS Rating:	1	0	0

(see section 16 for acronyms)

Degree of Hazard
0 - Minimal (Insignificant)
1 - Slight
2 - Moderate
3 - Serious (High)
4 - Severe (Extreme)
* - Chronic Health Effect(s)

POTENTIAL HEALTH EFFECTS

Primary Routes of Entry: Inhalation, skin and eye contact.

Acute Inhalation: Temporary upper respiratory irritation.

Chronic Inhalation: None known.

3. HAZARD IDENTIFICATION (Continued)

Acute Skin Contact and Sensitization: Temporary skin irritation seen in certain individuals.

Chronic Skin Contact: None known.

Skin Absorption: None.

Acute Eye Contact: Temporary eye irritation.

Chronic Eye Contact: None known.

Acute Ingestion: Unlikely. Contact physician if unusual reaction is noted.

Chronic Ingestion: None known.

Medical Conditions Which May Be Aggravated: Pre-existing conditions which may be aggravated by mechanical irritants upon inhalation or skin contact.

Carcinogenicity:

Ingredient: Textile or Continuous Fibrous Glass
NTP: Not Listed
IARC: Not Classifiable – Group 3
OSHA: Not Listed

Mutagenicity: None.

Teratogenicity: None.

Reproductive Toxicity: None.

Toxicological Synergistic Products: None.

4. FIRST AID MEASURES

Inhalation: Remove from exposure. Get medical help if irritation persists.

Eye Contact: Flush well with running water for at least 15 minutes. Get medical help if irritation persists.

Skin Contact: Cleanse with soap and water. Get medical help if irritation persists.

Ingestion: Unlikely. Consult physician if unusual reaction is noted.

Fires: Remove to fresh air. Administer oxygen and get medical help.

Information for Medical Practitioners: Skin irritation responds well to mild hydrocortisone cream.

5. FIRE FIGHTING MEASURES

Flash Point (°F) and Method: Does not support combustion

Flammable Limits: **LEL:** N/A **UEL:** N/A

Autoignition Temperature: Does not support combustion

Extinguishing Media: Use that which is applicable to surrounding fire.

Special Fire Fighting Procedures: Fire fighters must wear full protective gear including eye protection and self-contained breathing apparatus.

Unusual Fire and Explosion Hazard: Size materials may thermally decompose or burn emitting toxic fumes and smoke including carbon dioxide and carbon monoxide.

6. ACCIDENTAL RELEASE MEASURES

Spills/Leaks: Vacuum dust deposits.

Accidental or Unplanned Releases: Clean area with vacuum or wet methods.

7. HANDLING AND STORAGE

Handling: When handling and/or applying this product:

- Wear long sleeves, gloves and cap.
- Wear eye protection (goggles, safety glasses or face mask).
- Use a NIOSH/MSHA approved dust respirator such as a 3M model #8710 or #9900 or equivalent.

After handling and/or applying this product:

- Bathe with soap and warm water.
- Wash work clothes separately and rinse washer after use.

Storage: Store under cover to protect product.

8. EXPOSURE CONTROL/PERSONAL PROTECTION

Personal Protective Equipment:

Respirators: Wear NIOSH/MSHA approved respirators when handling and applying fiber glass products in accordance with the following NIOSH based exposure guidelines:

Exposure	Respirator (or equivalent)
Less than 10 times NIOSH REL	3M 8710 or 3M 9900
Less than 50 times NIOSH REL	MSA Ultra Twin Full-Face Respirator with type H filter (HEPA)

Product Package Label:

CAUTION:
Skin Irritation: Fiber glass may cause temporary skin irritation. Wear long sleeves, gloves and eye protection when handling and applying material. Cleanse skin with soap and warm water after handling. Wash work clothes separately and rinse washer.

Dust Irritation: A disposable mask designed for nuisance type dusts must be used when handling and applying material in order to prevent irritation to the nose or throat due to dust and airborne particles.

Work Practices and Engineering Controls: Avoid spread of fiber glass dust. For some fabrication operations where dust is generated, provide general and/or local exhaust ventilation to control airborne dust levels below exposure limits.

Other: When glass fiber is used as a reinforcement in plastic materials, caution must also be exercised with the resin and curing catalysts employed and the mixing process used to disperse the fiber in the resin. When the glass fiber reinforced material is abraded or machined, control of the released dust must be established.

Additional respiratory protection may be necessary for protection from vapors and mists emitted from these resins and catalysts.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Solid
Boiling Point (°F): >1600°F
Melting Point (°F): >1600°F
Softening Point (°F): Approx. 1550°F
Freezing Point: None
Odor: None
Odor Threshold: None
Color: White

Vapor Density (Air=1): Not measurable
Specific Gravity (H_2O=1): Glass=2.6
Evaporative Rate (ethyl ether=1): Does not have vapor pressure
Vapor Pressure: Does not have vapor pressure
% Volatile by Volume (mmH_8@20°C): Not volatile
% Solubility (in water): Small
pH: Neutral
Coefficient of Water to Oil Distribution: None

Appearance: Fibers assembled into rovings, mats, yarns, fabrics, chopped strands.

10. REACTIVITY

Stability: Chemically stable

Corrosivity: Not corrosive

Reactivity: Not reactive

Reactivity with water: Not reactive

Incompatible Substances: Hydrofluoric Acid

11. TOXICOLOGICAL INFORMATION

Extensive medical-scientific research has been conducted regarding the health aspects of fiber glass over the past 50 years. The International Agency for Research on Cancer (IARC), an agency of the World Health Organization (WHO), at a meeting in June 1987, reviewed all of the significant research on the health effects attributed to fiber glass.

IARC determined that the data from both human and animal studies was inadequate to classify continuous filament glass fibers, such as used in our Fiber Glass Reinforcement products, as carcinogenic to humans.

IARC classified glass wool, which is used in some insulation products, as a category 2B, "possibly carcinogenic to humans." This classification was based largely on animal implantation experiments. For further information on glass wool products, refer to CertainTeed's fiber glass wool products Material Safety Data Sheets. These are available from the address cited on page 1.

12. ECOLOGICAL INFORMATION

This product is not manufactured with, nor does it contain any Class I Ozone depleting chemicals as defined by EPA in Title VI of the Clean Air Act Amendments of 1990 40 CFR Part 82, Protection of Stratospheric Ozone.

This product is not classified as a hazardous air pollutant in Title III Clean Air Act of 1990.

13. WASTE DISPOSAL CONSIDERATIONS

Scrap material should be disposed of in a sanitary landfill in accordance with federal, state and local regulations. Waste material is not considered hazardous as defined by RCRA (40 CFR Part 261).

14. TRANSPORTATION INFORMATION

National Motor Freight Classification (NMFC): 1714100, Rovings or yarn, glass fibre; or strand, glass fibre in continuous lengths or chopped; in packages.

15. REGULATORY INFORMATION

As this product is considered a mixture, each component is listed below identifying its status on specific regulatory lists.

CHEMICAL NAME	SARA Title III Section 313	SARA Title III Section 302	California Proposition 65	Canada DSL	Canada NDSL	Korea KECI	Europe EINECS	Japan MITI	Philippines PICCS	Australia AICS	USA TSCA
Fiber glass textile 65997-17-3	—	—	✓†	—	✓	✓	✓	✓	✓	✓	✓
2-Butenedioic Acid (E)-, Polymer with 1,2-... 39382-21-3	—	—	—	—	—	—	—	—	—	—	—
2-Butenedioic Acid (E)-, Polymer with .α.,.. 39382-25-7	—	—	—	✓	—	✓	—	✓	—	—	✓
Polyester resin CAS: proprietary	—	—	—	—	✓	?	✓	?	—	—	✓

† listed as glass wool fibers/airborne particulates of respirable size.

16. ADDITIONAL COMMENTS

Acronyms/definitions used in this MSDS:

ACGIH: American Conference of Governmental Industrial Hygenists
CAS No: Chemical Abstracts Service Number
EPA: Environmental Protection Agency
f/cc: Fibers per cubic centimeter
HEPA: High Efficiency Particulate Air (filter)
HMIS: Hazardous Material Identification System
IARC: International Agency for Research on Cancer
LC_{50}: The air concentration of a substance, when administered over a specified time period in an animal assay, is expected to cause the death of 50% of a defined animal population.
LD_{50}: The single dose of a substance that, when administered by a defined route in an animal assay, is expected to cause the death of 50% of a defined animal population.
LEL: Lower Explosive Limit
mg/m^3: Milligrams per cubic meter
MSHA: Mine Safety & Health Administration
N/A: Not Applicable
NFPA: National Fire Protection Association
NIOSH: National Institute for Occupational Safety and Health
NTP: National Toxicology Program
OSHA: Occupational Safety and Health Administration
PEL: Permissible Exposure Limit

16. ADDITIONAL COMMENTS (Continued)

RCRA:	Resource Conservation and Recovery Act
REL:	Recommended Exposure Limit
SARA:	Superfund Amendments and Reauthorization Act
Title III:	Emergency Planning and Community Right to Know Act Section 302 - Extremely Hazardous Substances Section 313 - Toxic Chemicals
TLV:	Threshold Limit Value
TSCA:	Toxic Substances Control Act (USA)
TWA:	Time Weighted Average
UEL:	Upper Explosive Limit
WHO:	World Health Organization

Australia AICS:	Australian Inventory of Chemical Substances
California Proposition 65:	California Title 22, Division 2, Chapter 3 Safe Drinking Water and Toxic Enforcement Act of 1986
Canada DSL:	Canadian Domestic Substance List
Canada NDSL:	Canadian Non-domestic Substance List
Europe EINECS:	European Inventory of Existing Commercial Chemical Substances
Japan MITI:	Ministry of International Trade and Industry
Korea KECI:	Korean Existing Chemicals Inventory
Philippines PICCS:	Philippine Inventory of Chemicals and Chemical Substances
Respirable Dust:	The respirable fraction of suspended airborne particulates
Respirable Fibers:	Suspended airborne particulates with diameters of 3 micrometers or less, lengths of 5 micrometers or more and 5:1 length-to-width aspect ratio (NIOSH 7400 method, B rules)
Total Dust:	Suspended airborne particles of "nuisance" dusts including those of non-respirable size
Total Glass Dust:	Suspended airborne particles of dust composed of glass only, including those of non-respirable size

LAFARGE CALCIUM ALUMINATES, INC.

MATERIAL SAFETY DATA SHEET

SECTION I NAME AND PRODUCT

MANUFACTURER'S NAME: LAFARGE CALCIUM ALUMINATES, INC.	CONTACT: Ray Racher or Steve Martin
ADDRESS (STREET, CITY, STATE AND ZIP CODE): FOOT OF OHIO STREET, CHESAPEAKE, VA 23324	EMERGENCY TELEPHONE NO.: 804-545-4643
TRADE NAME, COMMON NAME OR SPECIFICATION: FONDU CEMENT	APPROVED BY: G. Nevoret
CHEMICAL FAMILY OR PRODUCT TYPE:	DATE: 5/31/85

SECTION II COMPOSITION

CHEMICAL NAME	%	COMMON NAME	REG* (Y/N)	CAS #	OSHA PERMISSIVE EXPOSURE LIMIT	ACGIH TLV	CARCINOGEN (Y/N)
Aluminum Oxide	39	All of these components are combined as Calcium Aluminates, Calcium Alumino Ferrites, Calcium Alumino Silicates, & Calcium Titanate	Y	1344-28-1	15 mg/m³ total	10 mg/m³ total	N
Calcium Oxide	37½		Y	1305-78-8	"	"	N
Ferric Oxide	12		Y	1309-37-1	"	"	N
Ferrous Oxide	4		Y	1345-25-1	"	"	N
Silicon Dioxide	4		Y	7631-86-9	"	"	N
Titanium Dioxide	2½		Y	13463-67-7	"	"	N

*Regulated as per lists: OSHA 29CFR 1910, subpart Z; ACGIH, HHS/NTP; & IARC.

SECTION III PHYSICAL AND CHEMICAL DATA

BOILING POINT	NA	MELTING POINT	> 1300° C	SPECIFIC GRAVITY	3.2
VAPOR PRESSURE	NA	PERCENT VOLATILE BY VOL	None	VAPOR DENSITY	NA
EVAPORATION RATE	NA	SOLUBILITY IN WATER	Negligible	SOLUBILITY IN ALCOHOL	NA
SOLUBILITY IN OTHER SOLVENT: NA		APPEARANCE AND ODOR: GRAY ODORLESS POWDER			

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT	None	(METHOD USED)	FLAMMABLE LIMITS LEL UEL
EXTINGUISHING MEDIA	NA		
SPECIAL FIRE FIGHTING PROCEDURES	NA		
EXPLOSION POTENTIAL	NA		

SECTION V HEALTH, FIRST AID AND MEDICAL DATA

PRIMARY ROUTE(S) OF ENTRY	ACUTE AND CHRONIC HEALTH EFFECTS AND EFFECTS OF OVEREXPOSURE	FIRST AID AND MEDICAL INFORMATION
INHALATION	Nuisance Dust	Remove to dust-free area
INGESTION	None Known	NA
SKIN CONTACT & ABSORPTION	Abrasive	Wash area
EYE	Abrasive	Treat as particle in eye
OTHER POTENTIAL HEALTH RISKS	NAIF	NAIF

SECTION VI CORROSIVITY AND REACTIVITY DATA

STABILITY UNSTABLE ☐ STABLE ☒ POLYMERIZATION MAY OCCUR ☐ · WILL NOT OCCUR ☒

INCOMPATIBILITY (MATERIALS TO AVOID)

Inert

DECOMPOSITION PRODUCTS

Inert

CONDITIONS TO BE AVOIDED

None

SECTION VII STORAGE, HANDLING AND USE PROCEDURES

NORMAL STORAGE AND HANDLING

Treat as nuisance dust.

NORMAL USE

Treat as nuisance dust

STEPS TO BE TAKEN IN CASE OF LEAKS OR SPILLS

Treat as nuisance dust

WASTE DISPOSAL METHOD

No special precautions

SECTION VIII PERSONAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE)		Nuisance dust respirator
VENTILATION	LOCAL	Recommended
	MECHANICAL (GENERAL)	Recommended
	OTHER	NA
PROTECTIVE GLOVES		Recommended
EYE PROTECTION		Recommended
OTHER EQUIPMENT		NA

MEASURES TO BE TAKEN DURING REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT THAT HAS BEEN IN CONTACT WITH THIS MATERIAL

No special precautions

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE None.

OTHER PRECAUTIONS None

FOR COMPANY USE

The information and recommendations set forth herein are taken from sources believed to be accurate as of the date hereof; however, Lafarge Cal-Mat makes no warranty with respect to the accuracy of the information or the suitability of the recommendations, and assumes no liability to any user thereof.

Calum Aluminates

1.9

Material Safety Data Sheet

for

Portland Cement

Section I-Identity

Manufacturer's name and address: Ash Grove Cement Company

Emergency Telephone Number: (913) 451-8900

Chemical Name and Synonyms: Portland Cement (CAS #65997-15-1)
Type I, IA, II, III, V

Trade Name and Synonyms: Type I, IA, II, III, V

Revision Date: May, 1993

Section II-Chemical Data

Chemical Family: Calcium Salts

Formula: Portland cement consists of finely ground portland cement clinker mixed with a small amount of calcium sulfate to control set. Portland cement clinker is a sintered material produced by heating to high temperature (greater than 1200 degrees celsius) a mixture of substances such as limestone and shale from the earth's crust. The substances manufactured are essentially hydraulic calcium silicates contained in a crystalline mass, not separable into the individual components.

Substances similar to the following are known to be present in portland cement:

$3CaO.SiO_2$	(CAS # 12168-85-3)
$2CaO.SiO_2$	(CAS # 10034-77-2)
$3CaO.Al_2O_3$	(CAS # 12042-78-3)
$4CaO.Al_2O_3.Fe_2O_3$	(CAS # 12068-35-8)
$CaSO_4.XH_2O$	(CAS # 13397-24-5)

Small amounts of CaO, MgO, K_2SO_4, Na_2SO_4 may also be present.

Section III-Hazardous Ingredients

Ingredients: Portland cements are listed by OSHA in 29 CFR 1910.1000, Table Z-1-A, and require material safety data sheets (FR, January 19, 1989). MSHA (30 CFR 55.5.-1, Ref. 2, ACGIH TLV's for 1973, Appendix E) and ACGIH (TLV's for 1984-5, Appendix D) list

Section III-Hazardous Ingredients - Cont'd.

portland cements as nuisance dusts. Portland cements are NOT listed by NTP, IARC, or OSHA as carcinogens. However, since portland cement is manufactured from raw materials mined from the earth (limestone, marl, sand, shale, clay, etc.) and process heat is provided by burning fossil fuels, trace, but detectable, amounts of naturally occurring, and possibly harmful, elements may be found during chemical analysis. Under ASTM standards, portland cement may contain 0.75 percent insoluble residue. A fraction of these residues may be free crystalline silica.

Section IV-Physical Data

Boiling Point: Not applicable, portland cement is a powdered solid.

Vapor Pressure: Not applicable, portland cement is a powdered solid.

Vapor Density: Not applicable, portland cement is a powdered solid.

Solubility in Water: Slight (0.1-1.0%)

Specific Gravity: (H_2O=1) 3.15

Evaporation Rate: Not applicable, portland cement is a powdered solid.

Appearance and Odor: Gray or white powder; no odor.

Melting Point: Not applicable

Section V-Fire and Explosion Hazard Data

Flash Point: Portland cement is noncombustible and not explosive.

Flammable or Explosive Limits: Not applicable.

Extinguishing Media: Not applicable

Special Firefighting Procedures: Not applicable.

Unusual Fire and Explosion Hazards: Not applicable.

Section V-Fire and Explosion Hazard Data - Cont'd.

Lower Explosive Limit: Not applicable.

Upper Explosive Limit: Not applicable.

Section VI-Health Hazard Data

ACGIH Threshold Limit Value (1992-93): Total dust containing no asbestos and less than 1% silica - 10 mg/m³

OSHA PEL: Total dust - 10 mg/m³
Respirable Dust - 5 mg/m³

Effects of Overexposure:

Acute: Wet cement, especially as an ingredient in plastic (unhardened) concrete, mortar or slurries, can dry unprotected skin and cause mild to severe caustic burns. Direct contact with the eyes can cause effects ranging from mild irritation to severe burns. Inhalation can irritate the upper respiratory system.

Chronic: Cement dust can cause inflammation of the lining tissue of the interior of the nose and inflammation of the cornea. Hypersensitive individuals may develop an allergic dermatitis. [Cement may contain trace (less than 0.05%) amounts of chromium salts or compounds including hexavalent chromium, or other metals found to be hazardous or toxic in some chemical forms. These metals are mostly present as trace substitutions within the principal minerals.]

Emergency and First Aid Procedures: Irrigate eyes immediately and repeatedly with water and get prompt medical attention. Wash exposed skin areas with soap and water. Apply sterile dressings. If ingested, consult a physician immediately. Drink water.

Section VII-Reactivity Data

Stability: Product is stable. Keep dry until used.

Incompatibility: Aluminum powder and other alkali and alkaline earth elements will react in wet mortar or concrete, liberating hydrogen gas.

Section VII-Reactivity Data - Cont'd.

Hazardous Decomposition Products: None

Hazardous Polyermization: Will not occur.

Section VIII-Spill Procedures

Steps to be taken in case material is spilled: Use dry cleanup methods that do not disperse the dust into the air. Avoid breathing the dust. Emergency procedures are not required.

Disposal Method: Small amounts of material can be disposed of as common waste or returned to the container for later use if it is not contaminated. Large volumes may require special handling.

Section IX-Special Protection Information

Respiratory Protection: In dusty environments, the use of a MSHA/NIOSH-approved respirator is recommended.

Ventilation: Local exhaust can be used to control airborne dust levels.

Eye Protection: Use tight fitting goggles in dusty environments.

Skin Protection: Use barrier creams, impervious, abrasion- and alkali-resistant gloves, boots and protective clothing to protect the skin from prolonged contact with wet cement in plastic concrete, mortar or slurries. Immediately after working with cement or cement-containing materials, workers should shower with soap and water. Precautions must be taken. Cement burns with little warning - little heat is sensed.

Section X-Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ASTM	American Society for Testing and Materials
CAS	Chemical Abstract Service
CFR	Code of Federal Regulations
ft^3	Cubic foot
IARC	International Agency for Research on Cancer
m^3	Cubic meter

Section X-Abbreviations

mg	Milligram
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
TLVs	Threshold Limit Values

Note: This material safety data sheet attempts to describe as accurately as possible the potential exposures associated with normal cement use. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. Users have the responsibility to evaluate and use this product safely and to comply with all applicable laws and regulations.

This product neither contains nor is directly manufactured with any controlled ozone depleting substances, Class I and II.

2.4

PORT NUMBER: 703
DS NO: PZ0157
FECTIVE DATE: 05/13/93

VAN WATERS & ROGERS INC.
MATERIAL SAFETY DATA SHEET

PAGE: 001

VERSION: 001

ODUCT: LIQUID CAUSTIC SODA. 30%

ORDER NO: 150173
PROD NO : 237980

MCCLELLAN AFB
SITE S
NEAR BLDG 1093
PATROL ROAD
SACTO ,CA 95833

AN WATERS & ROGERS INC. , SUBSIDIARY OF UNIVAR (206)889-3400
100 CARILLON POINT , KIRKLAND , WA 98033

---------- EMERGENCY ASSISTANCE ----------

FOR EMERGENCY ASSISTANCE INVOLVING CHEMICALS CALL - CHEMTREC
(800)424-9300

RODUCT NAME:
IQUID CAUSTIC SODA, 30%

SDS #: PZ0157

- - LIQUID CAUSTIC SODA. 30%

ATE: 04/03/91
DITION: 005
HEM NAME/SYN: SODIUM HYDROXIDE

HEMICAL FAMILY:	ALKALI
ORMULA:	NAOH
AS NUMBER:	001310-73-2
.S. DOT SHIPPING NAME:	SODIUM HYDROXIDE, SOLUTION
.S. DOT HAZARD CLASS:	CORROSIVE MATERIAL
UBSIDIARY RISK:	N/A
.D. NUMBER:	UN1824
ACKING GROUP:	N/A
EPA TABLE QUANTITY:	1000 LBS./454 KG.

SECTION 1 - PHYSICAL DATA

RODUCT: LIQUID CAUSTIC SODA, 30%

ORDER NO: 150173
PROD NO : 237980

OILING POINT @ 760 MM HG: 240 F
APOR DENSITY (AIR=1): N/A
PECIFIC GRAVITY (H2O=1): 1.328 @ 68/68 F
H OF SOLUTIONS: STRONGLY BASIC
REEZING/MELTING POINT: 32 F
OLUBILITY (WEIGHT % IN WATER): COMPLETE

ULK DENSITY: 11.07 LBS/GAL @ 68 F
OLUME % VOLATILE: 70%
APOR PRESSURE: 1 MM HG
VAPORATION RATE: N/A
EAT OF SOLUTION: EXOTHERMIC
PPEARANCE AND ODOR:
WATER WHITE TO SLIGHTLY TURBID LIQUID; NO ODOR

SECTION 2 - INGREDIENTS

ATERIAL	PERCENT
ODIUM HYDROXIDE	30

SECTION 3 - FIRE/EXPLOSION HAZARD DATA

LASH POINT (METHOD USED):
NONE

LAMMABLE LIMITS IN AIR (% BY VOLUME)
LEL: N/A
UEL: N/A

XTINGUISHING MEDIA:
NOT APPLICABLE

PECIAL FIRE FIGHTING PROCEDURES:
NONE

NUSUAL FIRE AND EXPLOSION HAZARDS:
CONTACT WITH SOME METALS, PARTICULARLY MAGNESIUM, ALUMINUM, AND ZINC (GAL-
VANIZED), CAN GENERATE HYDROGEN RAPIDLY, WHICH IS EXPLOSIVE.

SECTION 4 - HEALTH HAZARD DATA

ODUCT: LIQUID CAUSTIC SODA, 30%

ORDER NO: 150173
PROD NO : 237980

XICITY DATA:

LC50 INHALATION:	SEE SECTION 5
LD50 DERMAL:	SEE SECTION 5
SKIN/EYE IRRITATION:	SEE SECTION 5
LD50 INGESTION:	SEE SECTION 5
FISH,LC50 (LETHAL CONCENTRATION):	UNKNOWN

ASSIFICATION:

INHALATION:	IRRITANT
SKIN:	SEE SECTION 5
SKIN/EYE:	SEE SECTION 5
INGESTION:	CORROSIVE
AQUATIC:	UNKNOWN

SECTION 5 - EFFECTS OF OVEREXPOSURE

S CHEMICAL LISTED AS A CARCINOGEN OR POTENTIAL CARCINOGEN?
TP - NO IARC - NO OSHA - NO

EDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:
NONE KNOWN

ERMISSIBLE EXPOSURE LIMITS:
OSHA: 2 MG/CU.M., CEILING; 29 CFR 1910.1000 (REV. 3/1/89).

ACUTE:
EYE CONTACT: CAUSES SEVERE BURNS; SMALL QUANTITIES CAN RESULT IN PERMANENT DAMAGE AND/OR LOSS OF VISION.

SKIN CONTACT: CORROSIVE ACTION CAUSES BURNS AND FREQUENTLY DEEP ULCERATION WITH SUBSEQUENT SCARRING. PROLONGED CONTACT DESTROYS TISSUE. MIST FROM SOLUTIONS CAN CAUSE IRRITANT DERMATITIS.

INGESTION: INGESTION CAN CAUSE VERY SERIOUS DAMAGE TO THE MOUTH, ESOPHAGUS, STOMACH, AND OTHER TISSUES WITH WHICH CONTACT IS MADE AND MAY BE FATAL.

INHALATION: INHALATION OF MISTS CAN CAUSE DAMAGE TO THE UPPER RESPIRATORY TRACT AND TO THE LUNG TISSUE DEPENDING ON EXTENT OF EXPOSURE. EFFECTS CAN RANGE FROM MILD IRRITATION OF MUCOUS MEMBRANES, SEVERE PNEUMONITIS, AND DESTRUCTION OF LUNG TISSUES.

CHRONIC:
THE EFFECTS OF LONG-TERM, LOW-LEVEL EXPOSURES TO THIS PRODUCT HAVE NOT BEEN DETERMINED. SAFE HANDLING OF THIS MATERIAL ON A LONG-TERM BASIS

SHOULD EMPHASIZE THE AVOIDANCE OF ALL EFFECTS FROM REPETITIVE ACUTE EXPOSURES.

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 PHYSICAN.

EYE OR SKIN CONTACT:
IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. HOLD EYELIDS OPEN DURING THIS FLUSHING WITH WATER. CALL A PHYSICIAN. IMMEDIATELY FLUSH SKIN WITH PLENTY OF WATER WHILE REMOVING CONTAMINATED CLOTHING AND BOOTS. CALL A PHYSICIAN. IF SKIN FEELS SLIPPERY, CAUSTIC MAY STILL BE PRESENT IN SUFFICIENT QUANTITIES TO CAUSE RASH OR BURN. CONTINUE WASHING UNTIL SLICK SKIN FEELING IS GONE. THOROUGHLY CLEAN CONTAMINATED CLOTHING AND BOOTS BEFORE REUSE OR DISCARD.

INGESTION:
IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER OR ACIDIC BEVERAGE (TOMATO OR ORANGE JUICE, CARBONATED SOFT DRINKS). DO NOT INDUCE VOMITING. TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF VOMITING OCCURS, ADMINISTER ADDITIONAL WATER. IF UNCONSCIOUS OR IN CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO INDUCE VOMITING OR GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN (INCLUDING ANTIDOTES):
TREAT SYMPTOMATICALLY.

SECTION 6 - REACTIVITY DATA

STABILITY:
STABLE
CONDITIONS TO AVOID:
MATERIALS LISTED BELOW.

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.
CONDITIONS TO AVOID: NONE

INCOMPATIBILITY (MATERIALS TO AVOID):
ORGANIC MATERIALS AND CONCENTRATED ACIDS, MAGNESIUM, ALUMINUM, ZINC (GALVANIZED), TIN, CHROMIUM, BRASS, BRONZE AND VARIOUS FOOD SUGAR.

AZARDOUS DECOMPOSITION PRODUCTS:
REACTION WITH VARIOUS FOOD SUGARS MAY FORM CARBON MONOXIDE.

SECTION 7 - SPILL OR LEAK PROCEDURES

TEPS TO BE TAKEN IF MATERIAL IS SPILLED OR RELEASED:
DIKE AREA TO CONTAIN SPILL. ONLY TRAINED PERSONNEL EQUIPPED WITH NIOSH/MSHA-APPROVED, FULL FACEPIECE COMBINATION DUST/MIST AND ACID GAS RESPIRATORS SHOULD BE PERMITTED IN THIS AREA. RECLAIM SPILLED MATERIAL IF POSSIBLE. OR, DILUTE MATERIAL WITH A LARGE QUANTITY OF WATER, THEN NEUTRALIZE WITH DILUTE ACID. PROPERLY NEUTRALIZED LIQUID RESIDUES (PH 6-9) MAY BE DISPOSED OF IN WASTE WATER TREATMENT FACILITIES WHICH ALLOW THE DISCHARGE OF NEUTRAL SALT SOLUTIONS. NEUTRALIZED MATERIAL CAN BE RECOVERED BY VACUUM TRUCK FOR DISPOSAL (SEE BELOW). AFTER ALL VISIBLE TRACES HAVE BEEN REMOVED, FLUSH WITH LARGE AMOUNTS OF WATER.

ASTE DISPOSAL METHOD:
THE MANUFACTURER RECOMMENDS DISPOSAL OF NEUTRALIZED MATERIAL IN AN APPROVED AZARDOUS WASTE MANAGEMENT FACILITY. CARE MUST BE TAKEN WHEN USING OR ISPOSING OF CHEMICAL MATERIALS AND/OR THEIR CONTAINERS TO PREVENT NVIRONMENTAL CON-TAMINATION. IT IS YOUR DUTY TO DISPOSE OF THE CHEMICAL ATERIALS AND/OR THEIR CONTAINERS IN ACCORDANCE WITH THE CLEAN AIR ACT, THE LEAN WATER ACT, THE RESOURCE CONSERVATION AND RECOVERY ACT, AS WELL AS ANY THER RELEVANT FEDERAL, STATE, OR LOCAL LAWS/REGULATIONS REGARDING DISPOSAL.

SECTION 8 - SPECIAL PROTECTION INFORMATION

ESPIRATORY PROTECTION:
USE NIOSH/MSHA-APPROVED DUST/MIST FILTER RESPIRATOR FOR ROUTINE WORK PURPOSES WHEN EXPOSURE TO MISTS EXCEED THE PERMISSIBLE EXPOSURE LIMITS. THE RESPIRATOR USE LIMITATIONS MADE BY NIOSH/MSHA OR THE MANUFACTURER MUST BE OBSERVED. RESPIRATORY PROTECTION PROGRAMS MUST MEET THE REQUIREMENTS OF 29 CFR 1910.134.

ENTILATION(TYPE):
LOCAL EXHAUST SUFFICIENT TO MINIMIZE EMPLOYEE EXPOSURE TO MISTBELOW PERMISSIBLE EXPOSURE LIMITS.

E PROTECTION:
CLOSE FITTING CHEMICAL SAFETY GOGGLES
WITH FACE SHIELD

GLOVES:
NITRILE, NEOPRENE OR PVC

OTHER PROTECTIVE EQUIPMENT:
RUBBER BOOTS WITH SAFETY TOES, RUBBER APRONS, PVC CLOTHING, PLASTIC HARD HAT 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:
- WHEN HANDLING, WEAR SAFETY GOGGLES AND FACE SHIELD, RUBBER GLOVES, RUBBER BOOTS, RUBBER APRON, COTTON OR POLYESTER LONG-SLEEVED SHIRT AND PLASTIC HARD HAT.
- WEAR NIOSH/MSHA-APPROVED RESPIRATOR FOR PROTECTION WHERE MISTS MAY BE GENERATED.
- NEVER TOUCH EYES OR FACE WITH HANDS OR GLOVES THAT MAY BE CONTAMINATED WITH CAUSTIC SODA.
- NEVER ENTER A CAUSTIC SODA STORAGE TANK OR CONTAINER (TANK TRUCK OR TANK CAR)-EVEN IF IT APPEARS TO BE EMPTY.
- AVOID CONTACT WITH ORGANIC MATERIALS AND CONCENTRATED ACIDS-MAY CAUSE VIOLENT REACTION; CAUSTIC SODA REACTS WITH MAGNESIUM, ALUMINUM, ZINC (GALVANIZED), TIN, CHROMIUM, BRASS AND BRONZE, GENERATING HYDROGEN WHICH IS EXPLOSIVE. ALSO, CAUSTIC SODA MAY REACT WITH VARIOUS SUGARS TO GENERATE CARBON MONOXIDE.
- WHEN DILUTING, ADD 30% LIQUID CAUSTIC SODA SLOWLY TO SURFACE OF COLD WATER TO AVOID VIOLENT ERUPTION.
- LIQUID CAUSTIC SODA IS SHIPPED HOT (100-180 F). AVOID SKIN CONTACT--CAN CAUSE THERMAL BURNS.
- HAZARDOUS CARBON MONOXIDE GAS CAN FORM UPON CONTACT WITH FOOD AND BEVERAGE PRODUCT IN ENCLOSED VESSELS AND CAN CAUSE DEATH. FOLLOW APPROPRIATE TANK ENTRY PROCEDURES (SEE ANSI Z177.1-1977).

OTHER PRECAUTIONS:
- DO NOT GET IN EYES, ON SKIN, ON CLOTHING. CAN CAUSE SEVERE INJURY OR BLINDNESS.
- DO NOT BREATHE MIST.
- DO NOT SWALLOW.
- WASH THOROUGHLY AFTER HANDLING.
- DO NOT EAT, DRINK, OR SMOKE IN WORK AREA.

COMMENTS:
TSCA - SODIUM HYDROXIDE IS ON THE TSCA INVENTORY UNDER CAS #1310-73-2.

PRODUCT: LIQUID CAUSTIC SODA, 30%

ORDER NO: 150173
PROD NO : 237980

SARA TITLE III - A) 311/312 CATEGORIES - ACUTE AND REACTIVITY, B) NOT LISTED IN SECTION 313, 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 EXCEDD THE RQ MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER, 800-424-8802.

---------- FOR ADDITIONAL INFORMATION ----------

CONTACT: MSDS COORDINATOR VAN WATERS & ROGERS INC.
DURING BUSINESS HOURS, PACIFIC TIME (206)889-3400

10/26/95 15:59 PRODUCT: 237980 CUST NO: 357307 ORDER NO: 150173

---------- NOTICE ----------

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PROCESS TECHNOLOGIES, INC.

ATTN: SAFETY DIRECTOR
PROCESS TECHNOLOGY INC
PO BOX 476
BOISE ID 83701-0476

DATE: 04/10/95
CUST#: 942742
PO#: 4/7/95

MATERIAL SAFETY DATA SHEET

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

PRODUCT #: 22232-1 NAME: SODIUM CARBONATE, GRANULAR, 99.5+%, A.C.S. REAGENT

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #:497-19-8
MF: CNA2O3

SYNONYMS
CARBONIC ACID, DISODIUM SALT * CRYSTOL CARBONATE * DISODIUM CARBONATE * SODA ASH * SOLVAY SODA * TRONA *

SECTION 3. - - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - - -

EEL PRECAUTIONARY STATEMENTS
IRRITANT
CAUSES SEVERE IRRITATION.
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
DO NOT BREATHE DUST.

SECTION 4. - - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA
NONCOMBUSTIBLE.

CONTINUED ON NEXT PAGE

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CUST#: 942742
PO#: 4/7/95

PRODUCT #: 222321 NAME: SODIUM CARBONATE, GRANULAR, 99.5+%, A.C.S. REAGENT
MF: CNA2O3

USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
WEAR DISPOSABLE COVERALLS AND DISCARD THEM AFTER USE.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

..ION 7. - - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -

REFER TO SECTION 8.

ADDITIONAL INFORMATION
REACTS VIGOROUSLY WITH FLUORINE.

SECTION 8. - - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
SEVERE IRRITANT.
KEEP TIGHTLY CLOSED.

CONTINUED ON NEXT PAGE

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MATERIAL SAFETY DATA SHEET

CUST#: 942742
PO#: 4/7/95

PRODUCT #: 222321 NAME: SODIUM CARBONATE, GRANULAR, 99.5+%, A.C.S. REAGENT
MF: CNA2O3

HYGROSCOPIC
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - - -

APPEARANCE AND ODOR
WHITE GRANULAR POWDER
MELTING POINT: 851 C
SPECIFIC GRAVITY: 2.532

SECTION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - - -

INCOMPATIBILITIES
STRONG ACIDS
ALUMINUM
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
CARBON MONOXIDE, CARBON DIOXIDE

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
CAUSES SEVERE IRRITATION.
HIGH CONCENTRATIONS ARE EXTREMELY DESTRUCTIVE TO TISSUES OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
RTECS NO: VZ4050000
SODIUM CARBONATE (2:1)
IRRITATION DATA

SKN-RBT 500 MG/24H MLD	28ZPAK -,7,72
EYE-RBT 100 MG/24H MOD	28ZPAK -,8,72
EYE-RBT 100 MG/30S RINSE MLD	TXCYAC 23,281,82
EYE-RBT 50 MG SEV	GTPZAB 20(11),55,76

TOXICITY DATA

CONTINUED ON NEXT PAGE

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PO#: 4/7/95

PRODUCT #: 222321 NAME: SODIUM CARBONATE, GRANULAR, 99.5+%, A.C.S. REAGENT
MF: CNA2O3

ORL-RAT LD50:4090 MG/KG	28ZPAK -,8,72
IHL-RAT LC50:2300 MG/M3/2H	ENVRAL 31,138,83
ORL-MUS LD50:6600 MG/KG	GTPZAB 20(11),55,76
IHL-MUS LC50:1200 MG/M3/2H	ENVRAL 31,138,83
IPR-MUS LD50:117 MG/KG	COREAF 257,791,63
SCU-MUS LD50:2210 MG/KG	RPTOAN 33,266,70
IHL-GPG LC50:800 MG/M3/2H	ENVRAL 31,138,83

TARGET ORGAN DATA
EFFECTS ON FERTILITY (PRE-IMPLANTATION MORTALITY)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -
DATA NOT YET AVAILABLE.

ION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - - -

FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -

REVIEWS, STANDARDS, AND REGULATIONS
EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION
FEREAC 54,7740,89
NOHS 1974: HZD 68850; NIS 389; TNF 148455; NOS 193; TNE 1143671
NOES 1983: HZD 68850; NIS 373; TNF 89358; NOS 215; TNE 1764461; TFE 602485

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CUST#: 942742
PO#: 4/7/95

PRODUCT #: 222321 NAME: SODIUM CARBONATE, GRANULAR, 99.5+%, A.C.S. REAGENT
MF: CNA2O3

EPA GENETOX PROGRAM 1988, INCONCLUSIVE: E COLI POLA WITHOUT S9
EPA TSCA CHEMICAL INVENTORY, JUNE 1993
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JULY 1994

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

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M A T E R I A L S A F E T Y D A T A S H E E T

CTION 1. - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

CATALOG #: 22351-4
NAME: SODIUM CHLORIDE, 99+%, A.C.S. REAGENT

CTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #: 7647-14-5
MF: CLNA
EC NO: 231-598-3

SYNONYMS
COMMON SALT * DENDRITIS * EXTRA FINE 200 SALT * EXTRA FINE 325 SALT * HALITE * H.G. BLENDING * NATRIUMCHLORID (GERMAN) * PUREX * ROCK SALT * SALINE * SALT * SEA SALT * STERLING * TABLE SALT * TOP FLAKE * USP SODIUM CHLORIDE * WHITE CRYSTAL *

CTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

PRECAUTIONARY STATEMENTS
IRRITANT
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING.
HYGROSCOPIC
KEEP TIGHTLY CLOSED.

CTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.

CTION 5. - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - -

EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.

SPECIAL FIREFIGHTING PROCEDURES
FOR FIRES INVOLVING THIS MATERIAL, DO NOT ENTER ANY ENCLOSED OR CONFINED FIRE SPACE WITHOUT PROPER PROTECTIVE EQUIPMENT. THIS MAY

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CATALOG #: 22351-4
NAME: SODIUM CHLORIDE, 99+%, A.C.S. REAGENT

INCLUDE SELF-CONTAINED BREATHING APPARATUS TO PROTECT AGAINST THE HAZARDOUS EFFECTS OF THE NORMAL PRODUCTS OF COMBUSTION OR OXYGEN DEFICIENCY.

CTION 6. - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

CTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - -

REFER TO SECTION 8.

ADDITIONAL INFORMATION
REACTS VIOLENTLY WITH BROMINE TRIFLUORIDE AND LITHIUM.

CTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

CHEMICAL SAFETY GOGGLES.
USE PROTECTIVE CLOTHING, GLOVES AND MASK.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
WASH THOROUGHLY AFTER HANDLING.
IRRITANT.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

:CTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -

APPEARANCE AND ODOR
WHITE CRYSTALLINE POWDER

PHYSICAL PROPERTIES
MELTING POINT: 801 C
VAPOR PRESSURE: 1MM 865 C
SPECIFIC GRAVITY: 2.165

:CTION 10. - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
STRONG ACIDS
PROTECT FROM MOISTURE.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

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PO#: VF0505

CATALOG #: 22351-4
NAME: SODIUM CHLORIDE, 99+%, A.C.S. REAGENT

NATURE OF DECOMPOSITION PRODUCTS NOT KNOWN.

CTION 11. - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

CUTE EFFECTS
MAY BE HARMFUL BY INHALATION, INGESTION, OR SKIN ABSORPTION.
CAUSES EYE IRRITATION.
CAUSES SKIN IRRITATION.
MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.

TECS #: VZ4725000
SODIUM CHLORIDE

RRITATION DATA

SKN-RBT 50 MG/24H MLD	BIOFX* 20-3/71
SKN-RBT 500 MG/24H MLD	28ZPAK -,7,72
EYE-RBT 100 MG MLD	BIOFX* 20-3/71
EYE-RBT 100 MG/24H MOD	28ZPAK -,7,72
[illegible]-RBT 10 MG MOD	TXAPA9 55,501,80

[illegible]ITY DATA

ORL-RAT LD50:3 GM/KG	TXAPA9 20,57,71
IHL-RAT LC50:>42 GM/M3/1H	BIOFX* 20-3/71
ORL-MUS LD50:4 GM/KG	FRPPAO 27,19,72
IPR-MUS LD50:6614 MG/KG	COREAF 256,1043,63
SCU-MUS LD50:3 GM/KG	ARZNAD 7,445,57
IVN-MUS LD50:645 MG/KG	ARZNAD 7,445,57
ICV-MUS LD50:131 MG/KG	TYKNAQ 27,131,80
SKN-RBT LD50:>10 GM/KG	BIOFX* 20-3/71

TARGET ORGAN DATA
BEHAVIORAL (SOMNOLENCE)
BEHAVIORAL (CONVULSIONS OR EFFECT ON SEIZURE THRESHOLD)
BEHAVIORAL (MUSCLE CONTRACTION OR SPASTICITY)
CARDIAC (OTHER CHANGES)
ENDOCRINE (ESTROGENIC)
MATERNAL EFFECTS (OVARIES, FALLOPIAN TUBES)
MATERNAL EFFECTS (OTHER EFFECTS ON FEMALE)
EFFECTS ON FERTILITY (PRE-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (ABORTION)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
EFFECTS ON EMBRYO OR FETUS (FETAL DEATH)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

CTION 12. - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - -

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CUST#: 942742
PO#: VF0505

CATALOG #: 22351-4
NAME: SODIUM CHLORIDE, 99+%, A.C.S. REAGENT

DATA NOT YET AVAILABLE.

ECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

CONTACT A LICENSED PROFESSIONAL WASTE DISPOSAL SERVICE TO DISPOSE OF THIS MATERIAL.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

ECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

ECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - -

EUROPEAN INFORMATION
IRRITANT
R 36/37/38
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
S 26
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
S 36
WEAR SUITABLE PROTECTIVE CLOTHING.

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK
EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION
FEREAC 54,7740,89
NOHS 1974: HZD 68880; NIS 265; TNF 63391; NOS 163; TNE 630453
NOES 1983: HZD E0256; NIS 1; TNF 403; NOS 5; TNE 4029; TFE 2015
NOES 1983: HZD 68880; NIS 336; TNF 69628; NOS 211; TNE 1743954; TFE 817249
EPA GENETOX PROGRAM 1988, NEGATIVE: IN VITRO CYTOGENETICS-NONHUMAN; SPERM MORPHOLOGY-MOUSE
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: MAMMALIAN MICRONUCLEUS
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES
EPA TSCA SECTION 8(E) RISK NOTIFICATION, 8EHQ-0892-9201
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, OCTOBER 1995

ECTION 16. - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - -

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Material Safety Data Sheet

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Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

Emergency Telephone Number: 314-982-5000

SODIUM HYDROXIDE

PRODUCT IDENTIFICATION:

Synonyms: Caustic soda; lye; sodium hydroxide solid; sodium hydrate

Formula CAS No.: 1310-73-2

Molecular Weight: 40.00

Chemical Formula: NaOH

Hazardous Ingredients: Sodium hydroxide

PRECAUTIONARY MEASURES

DANGER! MAY BE FATAL IF SWALLOWED. CAUSES SEVERE BURNS.

Do not get in eyes, on skin, or on clothing.
Avoid breathing dust.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

If swallowed, do NOT induce vomiting. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: White, deliqueacent pellets.

Odor: Odorless.

Solubility: 111 g/100 g of water.

Boiling Point: 1390°C (2534°F)

Melting Point: 318°C (604°F)

Specific Gravity (water=1): 2.13

Vapor Density (Air=1): No information found.

Vapor Pressure (mm Hg): Negligible.

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not considered to be a fire hazard. Hot or molten material can react violently with water.
Can react with certain metals, such as aluminium, to generate flammable hydrogen gas.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Adding water to caustic solution generates large amounts of heat.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Very hygroscopic. Can slowly pick up moisture from air and react with carbon dioxide from air to form sodium carbonate.

Hazardous Decomposition Products:
Sodium oxide.

Hazardous Polymerization:
This substance does not polymerize.

Incompatibilities:
Contact with water, acids, flammable liquids, and organic halogen compounds, especially trichloroethylene, may cause fire or explosion. Contact with nitromethane and other similar nitro compounds causes formation of shock-sensitive salts. Contact with metals such as aluminum, tin, and zinc causes formation of flammable hydrogen gas.

SECTION 4 Leak/Spill Disposal Information

This is a test line. 1000°C. Clean-up personnel require protective clothing and respiratory protection from dust. Sweep, scoop or pick up spilled material. Avoid dusting. Collected waste may be transferred to a closed, preferably metal, container and sent to a RCRA-approved waste disposal facility. Do not flush to the sewer. Caution! Floor and other surfaces may be slippery. Do not contact with water. Neutralize traces with dilute acid.

Ensure compliance with local, state and federal regulations.

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Severe pneumonitis may occur.

Ingestion:
Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result.

Skin Contact:
Corrosive! Contact of skin can cause irritation or severe burns and scarring with greater exposures.

Eye Contact:
Corrosive! May cause irritation of eyes, and with greater exposures, severe burns with possibly blindness resulting.

Chronic Exposure:
Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1986)

No LD50/LC50 information found relating to normal routes of occupational exposure. Irritation data: Skin, rabbit: 50 mg/24H Severe Eye, rabbit: 50 mg/24H Severe

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
2 mg/m^3 Ceiling
-ACGIH Threshold Limit Value (TLV):
2 mg/m^3 Ceiling

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded, a dust/mist respirator with chemical goggles may be worn, in general, up to ten times the TLV. Consult respirator supplier for limitations. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container. Protect from physical damage. Store in a cool,dry, ventilated area away from sources of heat, moisture and incompatibilities. Always add the caustic to water while stirring; never the reverse.

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Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS must include a copy of this addendum

(Chem.Key: MOXID)

Product or Components of Product:

SODIUM HYDROXIDE (1310-73-2)

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X				

SARA EHS Sect. 302 RQ (lbs.)	SARA EHS Sect. 302 TPQ (lbs.)	SARA Section 313 Chemicals Name List	SARA Section 313 Chemicals Chemical Category	CERCLA Sec.103 RQ (lbs.)	RCRA Sec. 261.33
No	No	Yes	No	1000	No

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.
SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.
SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec. 103: Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4
RCRA: Re[illegible]rce Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

Effective [illegible]e: 04-06-89 Supersedes 11-03-85

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BOISE ID

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PO#:

MATERIAL SAFETY DATA SHEET

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -

CATALOG #: 42504-4
NAME: SODIUM HYPOCHLORITE, SOLUTION, AVAILABLE CHLORINE 10-13%

SECTION 2. - - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -

CAS #: 7681-52-9
MF: CLNAO
EC NO: 231-668-3

SYNONYMS
ANTIFORMIN * B-K LIQUID * CARREL-DAKIN SOLUTION * CHLOROS * CHLOROX * CLOROX * DAKINS SOLUTION * DEOSAN * HYPOCHLORITE SOLUTIONS WITH >5% BUT <16% AVAILABLE CHLORINE (DOT) * HYPOCHLORITE SOLUTIONS WITH 16% OR MORE AVAILABLE CHLORINE (DOT) * HYCLORITE * HYPOCHLORITE SOLUTION CONTAINING >7% AVALIABLE CHLORINE BY WT. (UN1791) * JAVEX * KLOROCIN * MILTON * NEO-CLEANER * NEOSEPTAL CL * PAROZONE * PURIN B * SODIUM CHLORIDE OXIDE * SODIUM HYPOCHLORITE * SODIUM OXYCHLORIDE * SURCHLOR * UN1791 (DOT) *

SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -

LABEL PRECAUTIONARY STATEMENTS
OXIDIZING
CORROSIVE
CONTACT WITH COMBUSTIBLE MATERIAL MAY CAUSE FIRE.
CAUSES BURNS.
HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.
CONTACT WITH ACIDS LIBERATES TOXIC GAS.
POSSIBLE RISK OF IRREVERSIBLE EFFECTS.
POSSIBLE MUTAGEN.
KEEP AWAY FROM COMBUSTIBLE MATERIAL.
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
DO NOT BREATHE VAPOR.
REFRIGERATE.

SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED

CONTINUED ON NEXT PAGE

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CATALOG #: 42504-4
NAME: SODIUM HYPOCHLORITE, SOLUTION, AVAILABLE CHLORINE 10-13%

CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA
DRY CHEMICAL POWDER.

SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
OXIDIZER.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
MAY ACCELERATE COMBUSTION.
CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - -

REFER TO SECTION 8.

ADDITIONAL INFORMATION
REACTS VIOLENTLY WITH AMMONIUM SALTS, AZIRIDINE, METHANOL, PHENYLACETONITRILE SOMETIMES RESULTING IN EXPLOSIONS. REACTS WITH PRIMARY ALIPHATIC OR AROMATIC AMINES TO FORM EXPLOSIVELY UNSTABLE N-CHLOROAMINES. REACTION WITH FORMIC ACID BECOMES EXPLOSIVE AT 55 C.

SECTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT

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CUST#: 942742

MATERIAL SAFETY DATA SHEET

CATALOG #: 42504-4
NAME: SODIUM HYPOCHLORITE, SOLUTION, AVAILABLE CHLORINE 10-13%

GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
POSSIBLE MUTAGEN.
AVOID CONTACT WITH ACID.
KEEP TIGHTLY CLOSED.
DO NOT STORE NEAR, NOR ALLOW CONTACT WITH, CLOTHING AND OTHER COMBUSTIBLE MATERIAL.

SECTION 9. - - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - - -

PHYSICAL PROPERTIES
BOILING POINT: 111 C
FLASHPOINT NONE
SPECIFIC GRAVITY: 1.206

TION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - - -

INCOMPATIBILITIES
STRONG ACIDS
ORGANIC MATERIALS
FINELY POWDERED METALS
FORMS EXPLOSIVE MIXTURES WITH:
AMINES
AMMONIA
METHANOL

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
HYDROGEN CHLORIDE GAS
CHLORINE
SODIUM/SODIUM OXIDES

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND

CONTINUED ON NEXT PAGE

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CUST#: 942742

M A T E R I A L S A F E T Y D A T A S H E E T PAGE

CATALOG #: 42504-4
NAME: SODIUM HYPOCHLORITE, SOLUTION, AVAILABLE CHLORINE 10-13%

VOMITING.

CHRONIC EFFECTS
LABORATORY EXPERIMENTS HAVE SHOWN MUTAGENIC EFFECTS.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

RTECS #: NH3486300
HYPOCHLOROUS ACID, SODIUM SALT

IRRITATION DATA
EYE-RBT 10 MG MOD
TXAPA9 55,501,80

TOXICITY DATA
ORL-MUS LD50:5800 MG/KG
SKEZAP 27,553,86

TARGET ORGAN DATA
BEHAVIORAL (SOMNOLENCE)
VASCULAR (BP LOWERING NOT CHARACTERIZED IN AUTONOMIC SECTION)
LUNGS, THORAX OR RESPIRATION (OTHER CHANGES)
GASTROINTESTINAL (NAUSEA OR VOMITING)
SKIN AND APPENDAGES (CORROSIVE)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

CONTACT A LICENSED PROFESSIONAL WASTE DISPOSAL SERVICE TO DISPOSE OF THIS MATERIAL.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -

EUROPEAN INFORMATION
EC INDEX NO: 017-011-01-9
OXIDIZING
CORROSIVE
R 31

CONTINUED ON NEXT PAGE

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CUST#: 942742

MATERIAL SAFETY DATA SHEET PAGE

CATALOG #: 42504-4
NAME: SODIUM HYPOCHLORITE, SOLUTION, AVAILABLE CHLORINE 10-13%

CONTACT WITH ACIDS LIBERATES TOXIC GAS.
R 34
CAUSES BURNS.
S 28
AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH PLENTY OF WATER.
S 45
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).

REVIEWS, STANDARDS, AND REGULATIONS

DEL=MAK
IARC CANCER REVIEW:ANIMAL INADEQUATE EVIDENCE IMEMDT 52,159,91
IARC CANCER REVIEW:HUMAN NO AVAILABLE DATA IMEMDT 52,159,91
IARC CANCER REVIEW:GROUP 3 IMEMDT 52,159,91
EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION FEREAC 54,7740,89
NOHS 1974: HZD 69090; NIS 202; TNF 70228; NOS 111; TNE 556864
NOES 1983: HZD 69090; NIS 168; TNF 23747; NOS 132; TNE 562423; TFE 265913
EPA GENETOX PROGRAM 1988, POSITIVE: E COLI POLA WITHOUT S9
EPA GENETOX PROGRAM 1988, POSITIVE/DOSE RESPONSE: IN VITRO CYTOGENETICS-NONHUMAN
EPA GENETOX PROGRAM 1988, POSITIVE/DOSE RESPONSE: IN VITRO CYTOGENETICS-HUMAN LYMPHOCYTE
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: HISTIDINE REVERSION-AMES TEST
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, APRIL 1996

SECTION 16. - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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NorLAB
A DIVISION OF NORCO, INC.

Emergency Contact: Chemtrec (800) 424-9300
or Norco (208) 336-1643

[redacted]21 W. Amity
[redacted]D 83705
20[redacted]6-1643

Carbon Dioxide in Nitrogen 0.0001% to 30%

MATERIAL SAFETY DATA SHEET

Identification

Product Name: **CARBON DIOXIDE IN NITROGEN 0.0001% TO 30%** Revision Date 9/12/95
CAS Number: N/A
Chemical Family: Gas Mixture
Chemical Formula: CO2 in N2
MSDS Identification Code/Number: 2040

Composition/Information on Ingredients

Ingredient Name	Exposure Limits	Concentration Percent by Weight
CARBON DIOXIDE CAS Number: 124-38-9	ACGIH TLV-TWA: 5,000 ppm ACGIH TLV-STEL: 30,000 ppm IDLH: 50,000 ppm OSHA PEL-TWA: 5,000 ppm (transition) OSHA PEL-TWA: 10,000 ppm (final) OSHA PEL-STEL: 30,000 ppm (final)	.0001 to 30.0
NITROGEN CAS Number: 7727-37-9	Simple Asphyxiant	70.0 to 99.9999

Hazard Identification

No data given

First Aid Measures

Inhalation

Prompt medical attention is mandatory in all cases of overexposure. Rescue personnel should be equipped with self-contained breathing apparatus.

Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given mouth-to-mouth resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

Fire Fighting Measures

Flammable Properties

Flash Point: N/A
Lower Explosive Limit (%): N/A
Upper Explosive Limit (%): N/A

Fire and Explosion Hazards

Electrical Classification: Nonhazardous.

Extinguishing Media

Non-flammable, inert gas

Accidental Release Measures

Evacuate all personnel from affected areas. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with an inert gas prior to attempting repairs. If a leak is in container or container valve, contact CHEMTREC or your closest Norco location for emergency assistance.

Handling & Storage

Handling and Storage Precautions

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous backflow into the cylinder.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of noncombustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Use a "first in, first out" inventory system to prevent full cylinders being stored for excessive periods of time.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

Exposure Controls/Personal Protection

Engineering Controls

Use local exhaust to prevent accumulation of high concentrations so as to reduce the oxygen level in the air to less than 19.5 molar percent.

Eye/Face Protection

Safety goggles or glasses.

Skin Protection

Protective gloves of any material.

Respiratory Protection

Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.

Other/General Protection

Safety shoes.

Physical & Chemical Properties

Appearance: A colorless gas.
Odor: Odorless.

Basic Physical Properties

Solubility (H20): Slightly soluble

Stability & Reactivity

Stability: Stable
Hazardous Decomposition Products: Carbon dioxide forms Carbonic Acid in the presence of water or moisture.
Hazardous Polymerization: Will not occur

Toxicological Information

Acute Inhalation Effects

Low concentrations of carbon dioxide (3 to 5 molar percent) cause increased respiration and headache. 8 to 15 molar percent concentrations cause headache, nausea and vomiting which may lead to unconsciousness if not moved to open air or given oxygen. Higher concentrations cause rapid circulatory insufficiency leading to coma and death. Maintain oxygen levels above 19.5% at sea level.

Miscellaneous Toxicological Information

Carbon Dioxide is the most powerful cerebral vasodilator known. Inhaling large concentrations causes rapid circulatory insufficiency leading to coma and death. Chronic, harmful effects are not known from repeated in halation of low (3 to 5 molar percent) concentrations.

Carcinogenicity - NTP: No IARC: No OSHA: No

Ecological Information

No data given

Disposal Considerations

Do not attempt to dispose of waste or unused quantities. Return in the shipping container *properly labeled, with any valve outlet plugs or caps secure and valve protection cap in place* to Norco for proper disposal.

Transport Information

Proper Shipping Name: Compressed Gas, n.o.s., (Nitrogen, Carbon Dioxide)
Hazardous Class: 2.2
DOT Identification Number: UN1956
DOT Shipping Label: Nonflammable gas

Regulatory Information

SARA Title III Notifications and Information

SARA Title III - Hazard Classes: Acute Health Hazard
Sudden Release of Pressure Hazard

Other Information

Hazard Rating	Health:	1 Slight
	Fire:	0 Negligible
	Reactivity:	0 Negligible

MSDS Identification Code/Number: 2040

Reference Documentation

Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipments of a compressed gas cylinder, which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR).

Disclaimer of Expressed & Implied Warranties

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained therein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

MSDS'S Enclosed: Carbon Monoxide, Isobutylene, Air, Nitrogen

December, 1

NorLAB
A DIVISION OF NORCO, INC.

MATERIAL SAFETY DATA SHEET

An explanation of the terms used herein may be found in OSHA 29 CFR 1910. 1200, available from OSHA regional or area offices. (Essentially similar to U.S. Department of Labor Form OSHA-20 and generally accepted in Canada for information purposes) Do Not Duplicate This Form. Request Original.

Product: Carbon Monoxide

I. PRODUCT IDENTIFICATION

RODUCT: Carbon Monoxide
HEMICAL NAME: Carbon Monoxide
ORMULA: CO
YNONYMS: Carbonic Oxide, Carbon Oxide
HEMICAL FAMILY: Not applicable.
OLECULAR WEIGHT: 28.01
RADE NAME: Carbon Monoxide

II. HAZARDOUS INGREDIENTS

or mixtures of this product request the respective component Material Safety Data Sheets. See ection IX

ATERIAL (CAS NO.): Carbon Monoxide (630-08-0)
T (%): 100
990-1991 ACGIH TLV-TWA (OSHA-PEL): 50 ppm (35 ppm)

his product is subject to the Pennsylvania Worker and Community Right-To-Know Act (34 P.S. ections 7301-7320).

III. PHYSICAL DATA

OILING POINT, 760 mm. Hg: –191.5°C (–312.7°F)
PECIFIC GRAVITY (H_2O = 1): Gas
APOR DENSITY (air = 1): 0.968
ERCENT VOLATILES BY VOLUME: 100
REEZING POINT: –207°C (–340.6°F)
APOR PRESSURE AT 20°C.: Gas
OLUBILITY IN WATER, % BY WT.: Negligible
VAPOR ATION RATE: (Butyl Acetate =1) Not applicable.
PE E AND ODER: Colorless gas at normal temperature and pressure; odorless.

IV. HEALTH HAZARD DATA

HRESHOLD LIMIT VALUE: 50 ppm — ACGIH (1988-89).

FFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:

Swallowing A highly unlikely route of exposure.

Skin Absorption No evidence of adverse effects from available information.

Inhalation Depending on the concentration and duration of exposure, may cause headache, drowsiness, dizziness, excitation, rapid breathing, pallor, cyanosis, excess salivation, nausea, vomiting, hallucinations, confusion, angina, convulsions and unconsciousness. With well established poisoning, the mucosal surface will be bright red (cherry red) in color. Lack of oxygen can cause death.

Skin Contact No evidence of adverse effects from available information.

Eye Contact No evidence of adverse effects from available information.

FFECTS OF REPEATED (CHRONIC) OVEREXPOSURE:

Repeated hypoxia from CO exposure will cause gradually increasing central nervous system (CNS) damage, with loss of sensation in the fingers, poor memory, and mental deterioration. Chronic exposure may facilitate the development of atherosclerosis.

THER EFFECTS OF OVEREXPOSURE:

Other effects include embryotoxicity, impaired cardiovascular function, pulmonary edema, pneumonia, gross neuropsychiatric damage, memory impairment, permanent CNS damage and cerebral edema with irreversible brain damage. Late, fatal demyelinization is a rare, but possible, complication.

EDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:

Due to hypoxia from carboxyhemoglobin formation, may aggravate established coronary and cerebral circulatory insufficiency.

IGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD VALUATION:

Carbon monoxide produces embryotetal toxicity in laboratory animals, but only at doses which cause maternal toxicity. There is no information available with respect to possible effects in humans.

MERGENCY AND FIRST AID PROCEDURES:

Swallowing This product is a gas at normal temperature and pressure.

Skin Contact Wash with soap and water.

Inhalation Remove to fresh air. Give artificial respiration if not breathing. Give oxygen if breathing is difficult. Call a physician.

Eye Contact Flush with water.

OTES TO PHYSICIAN: There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient. Angina and depression of the ST segment of the electrocardiogram indicate myocardial hypoxia. Exposure to high concentrations can result in cerebral edema. With severe doses, the use of hyperbaric oxygen may be beneficial. Individuals repeatedly overexposed may present positive Romberg's sign.

V. FIRE AND EXPLOSION HAZARD DATA

LASH POINT (test method): Flammable Gas

AUTOIGNITION TEMPERATURE: 609°C (1128°F)
FLAMMABLE LIMITS IN AIR, % by volume
LOWER: 12.5% UPPER: 74%
EXTINGUISHING MEDIA: CO_2, dry chemical, water spray or fog.
SPECIAL FIRE FIGHTING PROCEDURES:

Evacuate all personnel from danger area. Immediately cool containers with water spray from maximum distance. Take care not to extinguish flames. Remove ignition sources if without risk. If flames are accidentally extinguished, re-ignition may occur.

Use self-contained breathing apparatus. Stop flow of gas if without risk while continuing cooling water spray. Remove containers from area of fire if without risk. Allow fire to burn out.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

Flammable toxic gas. Cannot be detected by odor. Forms explosive mixtures with air and oxidizing agents. Container rupture due to heat of fire. Do not extinguish flames due to possibility of explosive re-ignition. Flammable vapor spread from spill.

Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with appropriate device. No part of container should be subjected to a temperature higher than 52°C (approximately 125°F). Containers are provided with a pressure relief device designed to vent contents when they are exposed to elevated temperatures.

VI. REACTIVITY DATA

STABILITY: Stable
CONDITIONS TO AVOID: Temperatures in excess of 400°C. See Section IX.
INCOMPATIBILITY (materials to avoid): Oxidizing agents, oxygen, flammables, metal oxide metals in presence of moisture, and/or sulfur compounds.
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide will decompose to form carbon dioxide and carbon above 400°C.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: None currently known.

VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

DANGER: May form explosive mixtures with air (see Section V). Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Remove all sources of ignition if without risk. Reduce gas cloud with fine water spray. Shut off leak if without risk. Ventilate area of leak or move leaking container to well-ventilated area. Flammable toxic gas may spread from spill. Before entering area, especially confined areas, check atmosphere with appropriate device.

WASTE DISPOSAL METHOD:

Prevent waste from contaminating surrounding environment. Keep personnel away. Discard any product residue in disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state and local regulations.

VIII. SPECIAL PROTECTION INFORMATION.

RESPIRATORY PROTECTION (specify type):

Select in accordance with OSHA 29 CFR 1910.134 and ANSI Z88.2. For concentrations up to 10 times the applicable exposure limit any NIOSH/MSHA approved supplied air respirator is recommended. Up to 50 times a NIOSH/MSHA approved respirator with a full face piece or self-contained breathing apparatus is recommended. For high concentrations use a self-contained breathing apparatus operated in the pressure-demand mode.

VENTILATION:

LOCAL EXHAUST: Explosion proof system is acceptable.
MECHANICAL (general): Inadequate.
SPECIAL: Use only in a closed system.
OTHER: See SPECIAL.

PROTECTIVE GLOVES: Preferred for cylinder handling.
EYE PROTECTION: Select in accordance with OSHA 29 CFR 1910.133.
OTHER PROTECTIVE EQUIPMENT: Select in accordance with OSHA 29 CFR. 1910.132 & 1910.133.

IX. SPECIAL PRECAUTIONS

DANGER:

Flammable, toxic gas under pressure. Gas cannot be detected by odor. Harmful if inhaled. Use piping and equipment adequately designed to withstand pressures to be encountered. May form explosive mixtures with air. Ground all equipment. Only use spark-proof tools and explosion-proof equipment. Keep away from heat, spark and open flame. Store and use with adequate ventilation at all times. Use only in a closed system. Close valve when not in use and when empty. Keep away from oxidizing agents.

MIXTURES:

When two or more gases, or liquefied gases are mixed, their hazardous properties may combine to create additional unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist, or other trained person when you make your safety evaluation of the end product. Remember gases and liquids have properties which can cause serious injury or death.

Be sure to read and understand all labels and other instructions supplied with all containers of this product.

STORAGE:

Remove all sources of ignition. Electric installation should be explosion-proof construction. Protect container against sunlight, and store in well-ventilated safe areas.

3.1

75-44-5

Scott Specialty Gases

MATERIAL SAFETY DATA SHEET

PLUMSTEADVILLE, PA 215-766-8861 (Corporate Offices and Production Facility)
BREDA, THE NETHERLANDS 076-71 18 28 (European Headquarters and Production Facility)

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TROY, MI 313-589-2950
SOUTH PLAINFIELD, NJ 908-754-7700
SAN BERNARDINO, CA 909-887-2571
WAKEFIELD, MA 617-245-8707
DURHAM, NC 919-220-0803
HOUSTON, TX 713-644-4820

SECTION I: MATERIAL IDENTIFICATION

CHEMICAL NAME: Phosgene

CHEMICAL FORMULA: $COCl_2$

CHEMICAL FAMILY: Carbonyl gas

DATE PREPARED: 4/1/92

SUPPLIER: Scott Specialty Gases, Inc.

ADDRESS: 6141 Easton Road, Plumsteadville, PA 18949

In Case of Emergency, Contact your Regional Plant Manager

OTHER DESIGNATIONS: Carbon oxychloride, carbonyl chloride, Chloroformyl chloride. CAS# 75-44-5

SECTION II: HAZARDOUS INGREDIENTS

			EXPOSURE LIMITS (PPM)		
			ACGIH	OSHA	
COMPONENT	CAS #	CONCENTRATION	TLV	PEL	OTHER
Phosgene	75-44-5	99+%	C.1	0.1	None

SECTION III: PHYSICAL DATA

BOILING POINT (°F): 46.8

SPECIFIC GRAVITY (H_2O = 1) @ 20°C: 1.4

VAPOR PRESSURE @ 69°F: 1.55 atm

PERCENT, VOLATILE BY VOLUME (%): N/A

VAPOR DENSITY (AIR = 1): 3.4

EVAPORATION RATE (____ = 1): N/A

SOLUBILITY IN WATER 20°C: Negligible

APPEARANCE AND ODOR: Colorless gas with sweet characteristic odor or musty hay @ 0.5 to 1 ppm. A pungent irritating odor @ 2 ppm. **Rapid olfactory fatigue occurs.**

SECTION IV: FIRE AND EXPLOSION HAZARD DATA

FLASH POINT AND METHOD	FLAMMABLE LIMITS	LEL	UEL
N/A	Nonflammable		

EXTINGUISHING MEDIA: Use what is appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus and full protective clothing. Use water spray to keep fire exposed cylinders cool.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Fire fighters should use self-contained breathing apparatus.

Disclaimer: The information in this Material Safety Data Sheet is offered without charge for use by technically qualified personnel at their discretion and risk. Scott Specialty Gases, Inc. has made this sheet available with data which we believe is reliable, but the accuracy and completeness of the data is not guaranteed and no warranty is either expressed or implied. Since Scott Specialty Gases, Inc. has no control over the use of the product described herein, we assume no liability for loss or damage incurred from the proper or improper use of such product. This form is essentially similar to U.S. Department of Labor form OSHA-174.

SECTION V - REACTIVITY DATA

STABILITY: Stable under normal storage conditions.

INCOMPATIBILITY (MATERIALS TO AVOID): Water, ammonia, alcohols, phenols, amines, powdered aluminum.

HAZARDOUS DECOMPOSITION PRODUCTS: At temperatures above 300°C, phosgene decomposes into Cl_2 and CO.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION IV - HEALTH HAZARD DATA

ROUTES OF ENTRY: Inhalation

EFFECTS OF OVEREXPOSURE: (ACUTE): Do not rely on odor for a warning of unsafe conditions (rapid olfactory fatigue occurs). Gas irritates the eyes, skin, throat, and lungs. Other symptoms include: weakness, vomiting and cyanosis. The onset of lung symptoms can be decayed by as much as 24 hours. (CHRONIC): Respiratory functions may be impaired. (MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE): Respiratory problems.

CARCINOGENICITY - NTP? NO IARC MONOGRAPHS? NO OSHA REGULATED? NO

EMERGENCY AND FIRST AID: If odor is detected, immediate corrective action or withdrawal must be taken. Remove victim from contaminated area minimizing their physical exertions. Restore and/or support breathing as required. Administer oxygen. Keep victim warm and at rest. Contact physician promptly. Observe all those exposed for 24-36 hours.

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN: Evacuate and ventilate area. Establish emergency plan where phosgene is used. Shut off flow. Prevent liquid from entering sewers. Remove leaking cylinder to exhaust hood or safe outdoors area if this can be done safely.

WASTE DISPOSAL METHOD: Pass controlled discharges of phosgene through a 10% sodium hydroxide solution. Return cylinders to supplier for proper disposal with any valve outlet plugs or caps secured and valve protection cap in place.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE): Worker exposure must be maintained below the TLV for nonroutine or emergency use. Use a self-contained breathing apparatus in case of emergency or non-routine use.

VENTILATION: Provide adequate general and local exhaust ventilation.

OTHER PROTECTIVE EQUIPMENT: Wear safety goggles, rubber gloves, and safety shoes. A safety shower and eyewash station should be readily available.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in well ventilated areas only. Keep valve protection cap on cylinders when not in use and secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

OTHER PRECAUTIONS: Empty containers contain residual product and remain hazardous. Protect containers from physical damage. Do not deface cylinders or labels. Move cylinder with adequate hand truck. Cylinder should be refilled by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).

SECTION 1 CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

M SON GAS PRODUCTS
30 SEAVIEW DRIVE
SECAUCUS, NEW JERSEY 07096
(201) 867-4100

EMERGENCY CONTACT:
CHEMTREC 1-800-424-9300

CAS NUMBER: 7782-50-5
RTECS NUMBER: FO2100000

SUBSTANCE: CHLORINE

TRADE NAMES/SYNONYMS:
CHLORINE MOLECULAR; CHLORINE MOL.; DIATOMIC CHLORINE; DICHLORINE; MOLECULAR CHLORINE; STCC 4904120; UN 1017; CL2; MAT04600

CHEMICAL FAMILY:
HALOGEN

INORGANIC GAS

CREATION DATE: 01/24/89 REVISION DATE: 07/14/93

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT : CHLORINE
CAS NUMBER: 7782-50-5
PERCENTAGE: 100.0

CONTAMINANTS: NONE

SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

EMERGENCY OVERVIEW:
HARMFUL IF INHALED. CAUSES RESPIRATORY TRACT, SKIN AND EYE BURNS. CONTAINER MAY RUPTURE IN HEAT OF FIRE. MAY IGNITE COMBUSTIBLES.
DO NOT BREATHE GAS. DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING. KEEP AWAY FROM HEAT AND FLAME. STORE AWAY FROM COMBUSTIBLE MATERIALS. DO NOT PUNCTURE CONTAINER. KEEP CONTAINER TIGHTLY CLOSED. WASH THOROUGHLY AFTER HANDLING. USE ONLY WITH ADEQUATE VENTILATION.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: MAY CAUSE BURNS. ADDITIONAL EFFECTS MAY INCLUDE RUNNY NOSE, SNEEZING, COUGHING, PALENESS, HOARSENESS, DROOLING, BLOODY SPIT, DIFFICULTY BREATHING, HEADACHE, WEAKNESS, DIZZINESS, ANXIETY, RESTLESSNESS, BLUISH SKIN COLOR, SUFFOCATION, LUNG DAMAGE AND HEART FAILURE. MAY ALSO CAUSE DEATH.
LONG TERM EFFECTS: MAY CAUSE EFFECTS AS IN SHORT TERM EXPOSURE. ADDITIONAL EFFECTS MAY INCLUDE ACNE, TOOTH DECAY AND LUNG EFFECTS.
SKIN CONTACT:

SHORT TERM EXPOSURE: MAY CAUSE BURNS. ADDITIONAL EFFECTS MAY INCLUDE BLISTERS AND FROSTBITE.
LONG TERM EFFECTS: SAME EFFECTS AS SHORT TERM EXPOSURE.

EYE CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE BURNS. ADDITIONAL EFFECTS MAY INCLUDE TEARING AND EYE DAMAGE.
LONG TERM EFFECTS: SAME EFFECTS AS SHORT TERM EXPOSURE.

INGESTION:
SHORT TERM EXPOSURE: MAY CAUSE SORES, BURNS, STOMACH PAIN, IRREGULAR HEARTBEAT, WEAKNESS AND SHOCK.
LONG TERM EFFECTS: NO INFORMATION IS AVAILABLE.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION:
FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
FIRST AID- DO NOT USE GASTRIC LAVAGE OR EMESIS. DILUTE THE ACID IMMEDIATELY BY DRINKING LARGE QUANTITIES OF WATER OR MILK. IF VOMITING PERSISTS, ADMINISTER FLUIDS REPEATEDLY. INGESTED ACID MUST BE DILUTED APPROXIMATELY 100 FOLD TO RENDER IT HARMLESS TO TISSUES. MAINTAIN AIRWAY AND TREAT SHOCK (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION.

NOTE TO PHYSICIAN
ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

SECTION 5 FIRE FIGHTING MEASURES

I AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN OR OTHER GASES WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER. CONTACT WITH EASILY OXIDIZABLE, ORGANIC, OR OTHER COMBUSTIBLE MATERIALS MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

EXTINGUISHING MEDIA:
WATER ONLY, NO DRY CHEMICAL, CARBON DIOXIDE OR HALON
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, USE WATER SPRAY OR FOG
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. FOR MASSIVE FIRE IN CARGO AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; IF THIS IS IMPOSSIBLE, WITHDRAW FROM AREA AND LET FIRE BURN. FOR SMALL FIRES, CONTAIN AND LET BURN; IF FIRE MUST BE FOUGHT, WATER SPRAY OR FOG IS RECOMMENDED (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 20).

EXTINGUISH USING AGENTS SUITABLE FOR TYPE OF FIRE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING POISONOUS VAPORS, KEEP UPWIND. EVACUTE TO A RADIUS OF 2500 FEET IF MATERIAL IS LEAKING.

DOUS COMBUSTION PRODUCTS:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC AND CORROSIVE FUMES OF CHLORINE.

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
STOP LEAK IF YOU CAN DO IT WITHOUT RISK. KEEP COMBUSTIBLES AWAY FROM SPILLED MATERIAL. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE AREA AND DENY ENTRY UNTIL GAS HAS DISPERSED. VENTILATE CLOSED SPACES BEFORE ENTERING.

REPORTABLE QUANTITY (RQ): 10 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

SOIL SPILL:
DIG A PIT, POND, LAGOON OR HOLDING AREA TO CONTAIN LIQUID OR SOLID MATERIAL. DIKE SURFACE FLOW USING SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB BULK LIQUID WITH FLY ASH OR CEMENT POWDER. ADD CAUSTIC SODA.

AIR SPILL:
APPLY WATER SPRAY TO KNOCK DOWN AND REDUCE VAPORS. KNOCK-DOWN WATER IS CORROSIVE AND TOXIC AND SHOULD BE DIKED FOR CONTAINMENT AND LATER DISPOSAL.

WATER SPILL:
NEUTRALIZE WITH CAUSTIC SODA.

IF DISSOLVED, AT A CONCENTRATION OF 10 PPM OR GREATER, APPLY ACTIVATED CARBON AT TEN TIMES THE AMOUNT THAT HAS BEEN SPILLED.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

SECTION 7 HANDLING AND STORAGE

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING THIS SUBSTANCE.

PROTECT AGAINST PHYSICAL DAMAGE. SEPARATE FROM COMBUSTIBLE, ORGANIC OR EASILY OXIDIZABLE MATERIALS AND ESPECIALLY ISOLATE FROM ACETYLENE, AMMONIA, HYDROGEN, HYDROCARBONS, ETHER, TURPENTINE, AND FINELY DIVIDED METALS. STORE OUTDOORS OR IN A WELL-VENTILATED, DETACHED OR SEGREGATED AREAS OF NONCOMBUSTIBLE CONSTRUCTION (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

CONSULT NFPA PUBLICATION 43C, STORAGE OF GASEOUS OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

THRESHOLD QUANTITY (TQ): 1500 POUNDS
THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) PROCESS SAFETY MANAGEMENT (PSM) STANDARD REQUIRES THAT FACILITIES UTILIZING A PROCESS WHICH INVOLVES A CHEMICAL AT OR ABOVE ITS SPECIFIED THRESHOLD QUANTITY COMPLY WITH THE PROVISIONS OF 29 CFR 1910.119, PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:
CHLORINE:
0.5 PPM (1.5 MG/M3) OSHA TWA; 1 PPM (3 MG/M3) OSHA STEL
0.5 PPM (1.5 MG/M3) ACGIH TWA; 1 PPM (3 MG/M3) ACGIH STEL
0.5 PPM (1.5 MG/M3) NIOSH RECOMMENDED TWA;
1 PPM (3 MG/M3) NIOSH RECOMMENDED STEL
0.5 PPM (1.5 MG/M3) DFG MAK TWA;
1 PPM (3 MG/M3) DFG MAK 5 MINUTE PEAK, MOMENTARY VALUE, 8 TIMES/SHIFT

MEASUREMENT METHOD: BUBBLER; ION-SPECIFIC ELECTRODE; (OSHA # ID101).

100 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
10 POUNDS SARA SECTION 304 REPORTABLE QUANTITY
POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
0 POUNDS OSHA PROCESS SAFETY MANAGEMENT THRESHOLD QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING.

OSHA REVOKED THE FINAL RULE LIMITS OF JANUARY 19, 1989 IN RESPONSE TO THE 11TH CIRCUIT COURT OF APPEALS DECISION (AFL-CIO V. OSHA) EFFECTIVE JUNE 30, 1993. SEE 29 CFR 1910.1000 (58 FR 35338)

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

CHLORINE:

5 PPM- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH CARTRIDGE(S) PROVIDING PROTECTION AGAINST CHLORINE.
ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

12.5 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.
ANY POWERED, AIR-PURIFYING RESPIRATOR WITH CARTRIDGE(S) PROVIDING PROTECTION AGAINST CHLORINE.

25 PPM- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY AIR-PURIFYING, FULL-FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE, FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION
ANY POWERED, AIR-PURIFYING RESPIRATOR WITH A TIGHT-FITTING FACEPIECE AND CARTRIDGE(S) PROVIDING PROTECTION AGAINST CHLORINE.

ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND CARTRIDGE(S) PROV CARTRIDGE(S) PROVIDING PROTECTION AGAIS

30 PPM- ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING, FULL-FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE, FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAIST CHLORINE.
ANY APPROPRIATE ESCAPE-TYPE, SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: PALE GREENISH-YELLOW GAS WITH A CHARACTERISTIC, SUFFOCATING ODOR.
MOLECULAR WEIGHT: 70.906
MOLECULAR FORMULA: CL2
BOILING POINT: -31 F (-35 C)
MELTING POINT: -150 F (-101 C)
VAPOR PRESSURE: 5168 MMHG @ 21 C
VAPOR DENSITY: 2.49
SPECIFIC GRAVITY: 3.214 G/L @ 0 C
WATER SOLUBILITY: 1.46% @ O C
ODOR THRESHOLD: 0.01 PPM
SOLVENT SOLUBILITY: SOLUBLE IN ALKALIES.

VISCOSITY: 0.01327 CPS @ 20 C.

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

CONDITIONS TO AVOID:
AVOID CONTACT WITH COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC); CONTACT MAY RESULT IN IGNITION OR EXPLOSION. MATERIAL MAY BE POISONOUS; AVOID INHALATION OF VAPORS OR CONTACT WITH SKIN. DO NOT ALLOW MATERIAL TO CONTAMINATE WATER SOURCES.

INCOMPATIBILITIES:
CHLORINE:
ACETYLENE: EXPLOSIVE REACTION.
ALCOHOLS: FORMATION OF EXPLOSIVE ALKYL HYPOCHLORITES.
ALKYL ISOTHIOUREA SALTS: FORMATION OF EXPLOSIVE NITROGEN TRICHLORIDE.
AMMONIA: EXPLODES WHEN HEATED.
ANTIMONY: IGNITION REACTION.
ARSENIC: SPONTANEOUS IGNITION.

N-ARYLSULFINAMIDES: POSSIBLE VIOLENT REACTION.
BENZENE: EXPLOSIVE REACTION CATALYZED BY LIGHT.
BORON: IGNITES ON CONTACT.
BROMINE PENTAFLUORIDE: EXPLOSIVE REACTION.
CALCIUM CHLORITE: FORMS EXPLOSIVE CHLORINE DIOXIDE.
CALCIUM NITRIDE: INCANDESCENT REACTION.
CARBON (ACTIVATED): IGNITES ON CONTACT.
CARBON DISULFIDE: EXPLOSIVE REACTION IN THE PRESENCE OF IRON CATALYST.
CESIUM NITRIDE: ATTACKED BY CHLORINE.
3-CHLOROPROPYNE: POSSIBLE EXPLOSION.
CHROMYL CHLORIDE + CARBON: POSSIBLE EXPLOSION.
COMBUSTIBLE MATERIALS: CONTACT WITH THE LIQUID IS LIKELY TO RESULT IN AN EXPLOSION. CONTACT WITH THE GAS MAY RESULT IN IGNITION OR AN EXPLOSION.
DIBORANE: EXPLODES ON CONTACT AT AMBIENT TEMPERATURES.
DICHLOROMETHYLARSINE: POSSIBLE EXPLOSION.
DIETHYL ETHER: EXPLODES.
DIETHYLZINC: IGNITION.
DIMETHYLFORMAMIDE: EXPLOSION HAZARD.
DIMETHYL PHOSPHORAMIDATE: MAY FORM EXPLOSIVE NITROGEN TRICHLORIDE.
DIOXYGEN DIFLUORIDE: IGNITION OR EXPLOSIVE REACTION.
DISILYL OXIDE: EXPLOSIVE REACTION.
4,4'-DITHIODIMORPHOLINE: MAY FORM EXPLOSIVE COMPOUND.
ETHYLENE: EXPLOSIVE REACTION IN THE PRESENCE OF LIGHT OR CATALYSTS.
ETHYLENE IMINE: FORMATION OF EXPLOSIVE 1-CHLOROETHYLENE IMINE.
ETHYLPHOSPHINE: EXPLOSION ON CONTACT.
FLAMMABLE COMPOUNDS: CONTACT WITH THE LIQUID IS LIKELY TO RESULT IN AN EXPLOSION. CONTACT WITH THE GAS MAY RESULT IN IGNITION OR AN EXPLOSION.
FLUORINE: IGNITION FOLLOWED BY EXPLOSION ON SPARKING.
HEXACHLORODISILANE: IGNITION ABOVE 300 C WITH POSSIBLE EXPLOSION.
HYDRAZINE: IGNITION REACTION.
HYDROCARBONS: CONTACT WITH THE LIQUID IS LIKELY TO RESULT IN AN EXPLOSION. CONTACT WITH THE GAS MAY RESULT IN IGNITION OR AN EXPLOSION. ADDITION OF LEWIS ACID TO CHLORINE-HYDROCARBON MIXTURES WILL RESULT IN THE RELEASE OF LARGE VOLUMES OF HYDROGEN CHLORIDE.
HYDROGEN: EXPLOSIVE MIXTURES.
HYDROGEN PEROXIDE + POTASSIUM HYDROXIDE: LUMINESCENT REACTION.
HYDROXYLAMINE: SPONTANEOUS IGNITION.
IODINE: VIOLENT REACTION.
IRON CARBIDE: INCANDESCENT REACTION.
LITHIUM SILICIDE: INCANDESCENT REACTION WHEN HEATED.
METALS AND ALLOYS: IGNITION ON CONTACT; SOME METALS MAY BE CORRODED IN THE PRESENCE OF MOISTURE.
METAL ACETYLIDES: IGNITION REACTION.
METAL HYDRIDES: IGNITION.
METAL OXIDES: VIGOROUS REACTION AND POSSIBLE IGNITION.
METAL PHOSPHIDES: IGNITION.
NITROGEN COMPOUNDS: MAY FORM EXPLOSIVE NITROGEN TRICHLORIDE.
NITROGEN TRIIODIDE: EXPLOSIVE REACTION ON CONTACT.
NON-METAL HYDRIDES: IGNITE ON CONTACT.
OXYGEN: EXPLOSION ON HEATING.
OXYGEN DIFLUORIDE: EXPLODES ON WARMING.
PHENYLMAGNESIUM BROMIDE: POSSIBLE EXPLOSION.
PHOSPHOROUS: EXPLOSIVE REACTION ON CONTACT WITH THE LIQUID; IGNITION ON CONTACT WITH THE GAS.
PHOSPHOROUS COMPOUNDS: IGNITION.
PHOSPHOROUS ISOCYANATE: VIGOROUS REACTION.
POLYCHLOROBIPHENYL: EXOTHERMIC REACTION.
(POLY)OXOMONOSILANE: IGNITION.

POTASSIUM HALIDES: IGNITION.
SILICON: IGNITES ON CONTACT WITH GASEOUS CHLORINE AT AMBIENT TEMPERATURES.
SILOXANES: POSSIBLE EXPLOSION ON HEATING.
SODIUM HYDROXIDE: VIOLENT REACTION.
STANNOUS FLUORIDE: REACTION OCCURS WITH FLAMING.
STIBINE: EXPLOSIVE REACTION IF HEATED.
SULFAMIC ACID: MAY FORM EXPLOSIVE NITROGEN TRICHLORIDE.
SULFIDES: IGNITION.
TELLURIUM: INCANDESCENT REACTION.
TETRAMETHYLDIARSINE: SPONTANEOUS IGNITION.
TETRAMETHYLSILANE: POSSIBLE EXPLOSION IN PRESENCE OF A CATALYST.
TETRASELENIUM TETRANITRIDE: EXPLOSION ON CONTACT.
TRIALKYLBORANES: IGNITION REACTION.
TRIMETHYL THIONOPHOSPHATE: POSSIBLE EXPLOSION.
VANADIUM (POWDER): EXPLOSION ON CONTACT WITH THE LIQUID.

HAZARDOUS DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC AND CORROSIVE FUMES OF CHLORINE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

SECTION 11 TOXICOLOGY INFORMATION

CHLORINE:
TOXICITY DATA: 2530 MG/M3/30 MINUTES INHALATION-HUMAN LCLO; 500 PPM/5 MINUTES INHALATION-HUMAN LCLO; 293 PPM/1 HOUR INHALATION-RAT LC50; 137 PPM/1 HOUR INHALATION-MOUSE LC50; 660 PPM/4 HOURS INHALATION-RABBIT LCLO; 330 PPM/7 HOURS INHALATION-GUINEA PIG LCLO; 800 PPM/30 MINUTES INHALATION-DOG LCLO; 660 PPM/4 HOURS INHALATION-CAT LCLO; 500 PPM/5 MINUTES INHALATION-MAMMAL LCLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYE.
ACUTE TOXICITY LEVEL: TOXIC BY INHALATION.
TARGET EFFECTS: POISONING MAY AFFECT THE LUNGS.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH PRE-EXISTING HEART DISEASE OR TUBERCULOSIS.

HEALTH EFFECTS
INHALATION:
CHLORINE:
CORROSIVE/TOXIC.
30 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- MUCOUS MEMBRANE IRRITATION MAY OCCUR AT 0.2 TO 16 PPM AND COUGH AT 30 PPM. INHALATION OF 500 PPM FOR 5 MINUTES HAS BEEN LETHAL IN HUMANS AND 1000 PPM MAY BE FATAL AFTER A FEW DEEP BREATHS. OCCUPATIONAL EXPOSURES HAVE RESULTED IN BURNING OF THE NOSE AND MOUTH WITH RHINORRHEA, RESPIRATORY DISTRESS WITH COUGHING, CHOKING, WHEEZING, RALES, RETCHING, HEMOPTYSIS, SUBSTERNAL PAIN, DYSPNEA, AND CYANOSIS. TRACHEOBRONCHITIS, PROGRESSING TO IMMEDIATE OR POSSIBLY DELAYED PULMONARY EDEMA AND OCCASIONAL PNEUMONITIS HAVE ALSO BEEN REPORTED. COUGH GENERALLY INCREASES IN FREQUENCY AND SEVERITY AFTER TWO TO THREE DAYS AND BECAME PRODUCTIVE OF THICK MUCOPURULENT SPUTUM, WHICH DISAPPEARS BY THE END OF 14 DAYS. LUNG DAMAGE IS USUALLY NOT PERMANENT; RESPIRATORY DISTRESS USUALLY SUBSIDES WITHIN 72 HOURS. AT HIGH CONCENTRATIONS, CHLORINE MAY ACT AS AN

ASPHYXIANT BY CAUSING CRAMPS OF THE LARYNX MUSCLES AND SWELLING OF THE THE MUCOUS MEMBRANES. OTHER SYMPTOMS MAY INCLUDE SALIVATION, ANXIETY, SNEEZING, PALLOR OR REDNESS OF THE FACE, WEAKNESS, HOARSENESS, HEADACHE, DIZZINESS, AND GENERAL EXCITEMENT AND RESTLESSNESS. MASSIVE INHALATION MAY ALSO CAUSE DEATH BY CARDIAC ARREST.

CHRONIC EXPOSURE- PERSONS REPEATEDLY EXPOSED TO LOW CONCENTRATIONS MAY DEVELOP CHLORACNE, OLFACTORY DEFICIENCY AND TOLERANCE BUILD-UP. PROLONGED AND REPEATED EXPOSURE TO 0.8-1.0 PPM MAY CAUSE PERMANENT, ALTHOUGH MODERATE REDUCTION IN PULMONARY FUNCTION. CHRONIC EXPOSURE AT 5 PPM MAY RESULT IN INFLAMMATION OF THE MUCOUS MEMBRANES OF THE NOSE, DISEASE OF THE BRONCHI, AND INCREASED SUSCEPTIBILITY TO RESPIRATORY INFECTION INCLUDING TUBERCULOSIS. DENTAL EROSION MAY OCCUR. ANIMALS SURVIVING SUBLETHAL EXPOSURES FOR 15 TO 193 DAYS AFTER GASSING SHOWED MARKED EMPHYSEMA.

SKIN CONTACT:
CHLORINE:
CORROSIVE.

ACUTE EXPOSURE- HIGH VAPOR CONCENTRATIONS MAY IRRITATE THE SKIN AND CAUSE BURNING AND PRICKING SENSATIONS, INFLAMMATION, AND VESICLE FORMATION. CONTACT WITH LIQUID MAY CAUSE BURNS, BLISTERING, TISSUE DESTRUCTION, AND FROSTBITE.

CHRONIC EXPOSURE- EFFECTS DEP CHRONIC EXPOSURE- EFFECTS DEPEND ON THE CONCENT EXPOSURE. REPEATED OR PROLONGED CONTACT MAY RESULT IN DERMATITIS OR EFFECTS SIMILAR TO ACUTE EXPOSURE.

EYE CONTACT:
CHLORINE:
CORROSIVE.

ACUTE EXPOSURE- EXPOSURE TO CONCENTRATIONS OF CHLORINE GAS AS LOW AS 3-6 PPM MAY CAUSE REDNESS, PAIN, BLURRED VISION, AND LACRIMATION. DIRECT CONTACT WITH LIQUID MAY CAUSE BURNS. CHLORINE DISSOLVED IN WATER, AND PLACED INTO THE ANTERIOR CHAMBERS OF RABBIT EYES CAUSED SEVERE INFLAMMATION, CORNEAL OPACITY, IRIS ATROPHY, AND INJURY TO THE LENS.

CHRONIC EXPOSURE- EFFECTS DEPEND ON THE CONCENTRATION AND DURATION OF EXPOSURE. REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS OR EFFECTS AS IN ACUTE EXPOSURE.

INGESTION:
CHLORINE:

ACUTE EXPOSURE- INGESTION OF A GAS IS VERY UNLIKELY. INGESTION OF THE LIQUID MAY CAUSE BURNS OF THE LIPS, MOUTH AND MUCOUS MEMBRANES OF THE GASTROINTESTINAL TRACT, POSSIBLE ULCERATION OR PERFORATION, ABDOMINAL PAIN, TACHYCARDIA, PROSTRATION AND CIRCULATORY COLLAPSE.

CHRONIC EXPOSURE- NO DATA AVAILABLE.

SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): NO DATA AVAILABLE

ACUTE AQUATIC TOXICITY: NO DATA AVAILABLE

DEGRADABILITY: NO DATA AVAILABLE

LOG BIOCONCENTRATION FACTOR (BCF): NO DATA AVAILABLE

LOG OCTANOL/WATER PARTITION COEFFICIENT: NO DATA AVAILABLE

SECTION 13 DISPOSAL INFORMATION

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN DISPOSING OF THIS SUBSTANCE.

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D001.
100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

SECTION 14 TRANSPORTATION INFORMATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49-CFR 172.101:
NONFLAMMABLE GAS NONFLAMMABLE GAS

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49-CFR 172.101 AND SUBPART E:
NONFLAMMABLE GAS AND POISON

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49-CFR 173.304;
49-CFR 173.314 AND 49-CFR 173.315
EXCEPTIONS: NONE

FINAL RULE ON HAZARDOUS MATERIALS REGULATIONS (HMR, 49 CFR PARTS 171-180), DOCKET NUMBERS HM-181, HM-181A, HM-181B, HM-181C, HM-181D AND HM-204. EFFECTIVE DATE OCTOBER 1, 1991. HOWEVER, COMPLIANCE WITH THE REGULATIONS IS AUTHORIZED ON AND AFTER JANUARY 1, 1991. (55 FR 52402, 12/21/90)

EXCEPT FOR EXPLOSIVES, INHALATION HAZARDS, AND INFECTIOUS SUBSTANCES, THE EFFECTIVE DATE FOR HAZARD COMMUNICATION REQUIREMENTS IS EXTENDED TO OCTOBER 1, 1993. (56 FR 47158, 09/18/91)

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
CHLORINE-UN 1017

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
2.3 - POISONOUS GAS

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
POISON GAS

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: NONE
NON-BULK PACKAGING: 49 CFR 173.304
BULK PACKAGING: 49 CFR 173.314 AND 49 CFR 173.315

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: FORBIDDEN
CARGO AIRCRAFT ONLY: FORBIDDEN

SECTION 15 REGULATORY INFORMATION

TS STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	10	POUNDS RQ
SARA SECTION 302 (40CFR355.30):	Y	100	POUNDS TPQ
SARA SECTION 304 (40CFR355.40):	Y	10	POUNDS RQ
SARA SECTION 313 (40CFR372.65):	Y		
OSHA PROCESS SAFETY (29CFR1910.119):	Y	1500	POUNDS TQ
CALIFORNIA PROPOSITION 65:	N		

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	Y

SECTION 16 OTHER

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-ADDITIONAL INFORMATION-

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PRODUCT DATA SHEET

PRODUCT: Germicidal Ultraviolet Lamps including ozone producing types

SECTION 1 MANUFACTURER

Manufacturer's Name and Address: Atlantic Ultraviolet Corporation
375 Marcus Boulevard
Hauppauge, NY 11788
Telephone (516) 273-0500
Fax (516) 273-0771

SECTION 2 HAZARDOUS INGREDIENTS

	OSHA PEL	ACGIH TLV	PERCENTAGE
Inert ingredients (glass,tungsten,molybdenum,copper)			approx. 99.95% by wt
Mercury	.05 mg/m3	.05 mg.m3	approx. .05% by wt.

SECTION 3 PHYSICAL CHEMICAL CHARACTERISTICS

Not applicable. This item is an ultraviolet lamp. Up to 6 foot long and up to 1.5 inches in diameter.

SECTION 4 FIRE AND EXPLOSION DATA

Fire and explosion data not applicable. Under extreme heat, glass envelope might melt or crack; plastic base may burn.

SECTION 5 REACTIVITY DATA

Stability: Lamp is stable
Incompatibility: Glass will react with Hydrofluoric Acid
Polymerization: Not applicable

SECTION 6 HEALTH HAZARD DATA

Ultraviolet Rays

This product (germicidal lamps) is intended for applications only where humans will not be intentionally exposed to the ultraviolet rays. Avoid exposure of persons to direct or reflected germicidal ultraviolet rays. If it is desired to operate germicidal lamps in such a way that persons will or may be exposed to the germicidal ultraviolet rays, adequate eye, face and skin protection must be worn by all exposed persons. Overexposure to direct or reflected rays will cause painful eye irritation and reddening of the skin (TLV = 6.0 mJ/cm2 at 254 nm).

Ozone

Some germicidal lamps (ozone producing types), in addition to producing ultraviolet rays, will also produce substantial quantities of ozone when operated in air. Care should be exercised in design and installation of equipment so that ozone concentration will not exceed .05 parts per million in areas occupied by people. Provide adequate ventilation in all areas where equipment utilizing ozone producing lamps are employed.

Breakage of the lamp may result in some exposure to elemental mercury vapor. No adverse affects are expected from occasional exposure to broken lamps, but as a matter of good practice, prolonged or frequent exposure should be avoided through the use of adequate ventilation during disposal of large quantities of lamps.

.....

SECTION 7 PRECAUTIONS FOR SAFE HANDLING AND USE

See Section 6

Normal precautions should be taken for collection of broken glass.

WASTE DISPOSAL METHOD: Dispose in accordance with applicable Federal, State and local regulations.

.....

SECTION 8 CONTROL MEASURES

Appropriate eye, skin and face protection should be worn by all persons exposed to germicidal ultraviolet rays.

Adequate ventilation will tend to prevent excessive accumulation of ozone.

Respiratory Protection: Appropriate dust mask should be used if large volumes of lamps are being broken for disposal.

Ventilation: Avoid inhalation of any airborne dust.
Provide local exhaust when disposing large quantities of lamps.

Hand and Eye Protection: Appropriate hand and eye protection should be worn when disposing of lamps or handling broken glass.

051 MATERIAL SAFETY DATA SHEET MAT11150 Page 001 of 010

SECTION 1 CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

ESON GAS PRODUCTS
EAVIEW DRIVE
SECAUCUS, NEW JERSEY 07096
(201) 867-4100

EMERGENCY CONTACT:
CHEMTREC 1-800-424-9300

CAS NUMBER: 7647-01-0
RTECS NUMBER: MW9610000

SUBSTANCE: HYDROGEN CHLORIDE, ANHYDROUS

TRADE NAMES/SYNONYMS:
HYDROCHLORIC ACID, ANHYDROUS; HYDROGEN CHLORIDE; SPIRITS OF SALT; MURIATIC ACID; HYDROCHLORIC ACID; HYDROCHLORIC ACID GAS; ANHYDROUS HYDROCHLORIC ACID; HYDROGEN CHLORIDE (HCL); STCC 4904270; UN 1050; CLH; MAT11150

CHEMICAL FAMILY:
Inorganic acid

CREATION DATE: 01/24/89 REVISION DATE: 08/25/94

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT : HYDROGEN CHLORIDE, ANHYDROUS
CAS NUMBER: 7647-01-0
PERCENTAGE: 100

OTHER CONTAMINANTS: NONE

SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

EMERGENCY OVERVIEW:
Colorless gas or fuming liquid with a suffocating odor.
Causes skin burns. Causes severe burns to mucous membranes. Causes respiratory tract and eye irritation, possibly severe.
Container may rupture in heat of fire. May react with water.
Do not breathe gas. Do not get in eyes, on skin, or on clothing. Keep away from heat and flame. Do not allow water to get in container. Do not puncture container. Keep container tightly closed. Wash thoroughly after handling.
Use only with adequate ventilation. Handle with caution.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause irritation, possibly severe. Additional effects may include sores, coughing, headache and lung damage. May also cause reproductive effects.
LONG TERM EFFECTS: May cause effects as in short term exposure. Additional effects may include digestive disorders.
SKIN CONTACT:

SHORT TERM EFFECTS: May cause irritation, possibly severe. Additional effects may include sores, frostbite, reaction of skin to light, sweating, irregular heartbeat and shock.
LONG TERM EFFECTS: Same effects as short term exposure.

EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation, possibly severe. Additional effects may include frostbite and blindness.
LONG TERM EFFECTS: Same effects as short term exposure.

INGESTION:
SHORT TERM EFFECTS: May cause burns. Additional effects may include thirst, chills, fever, drooling, nausea, vomiting, diarrhea, kidney damage and shock.
LONG TERM EFFECTS: Same effects as short term exposure.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Maintain airway, blood pressure and respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). If burns occur, proceed with the following: Cover affected area securely with sterile, dry, loose-fitting dressing. Treat symptomatically and supportively. Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Continue irrigating with normal saline until the pH has returned to normal (30-60 minutes). Cover with sterile bandages. Get medical attention immediately.

INGESTION:
FIRST AID- Do not use gastric lavage or emesis. Give large amounts of water or milk. Repeat if vomiting occurs. Ingested corrosive should be diluted approximately 100 times to render it harmless to tissues. (Dreisbach & Robertson; Handbook of Poisoning; 12th Ed.). Do not give anything by mouth to a person who is unconscious or otherwise unable to swallow. If vomiting occurs, keep head lower than hips to help prevent aspiration. Maintain airway and respiration. Treat symptomatically and supportively. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Negligible fire hazard when exposed to heat or flame.

Container may explode in heat of fire.

EXTINGUISHING MEDIA:
Dry chemical or carbon dioxide
(1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam
(1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:
Do not get water inside container. Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. Isolate area until gas has dispersed (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 15).

Use agent suitable for type of fire. Cool containers with flooding quantities of water, apply from as far a distance as possible. Avoid breathing corrosive vapors, keep upwind.

FLASH POINT: no data available
LOWER FLAMMABLE LIMIT: no data available
UPPER FLAMMABLE LIMIT: no data available
AUTOIGNITION: no data available

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic and corrosive fumes of chlorine.

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Stop leak if you can do it without risk. Use water spray to reduce vapors; do not put water directly on leak or spill area. Do not get water inside container. Isolate area until gas has dispersed. For small spills, flush area with flooding amounts of water. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Isolate the leak or spill area immediately for at least 150 feet in all directions.

Reportable Quantity (RQ): 1 pound
The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SOIL SPILL:
Dig holding area such as lagoon, pond or pit for containment.

Dike flow of spilled material using soil or sandbags or foamed barriers such as polyurethane or concrete.

Use cement powder or fly ash to absorb liquid mass.

Neutralize spill with slaked lime, sodium bicarbonate or crushed limestone.

AIR SPILL:
Knock down vapors with water spray. Keep upwind.

Water used to knock down vapors may become corrosive or toxic and should be contained properly for later disposal.

WATER SPILL:
Neutralize with agricultural lime, slaked lime, crushed limestone, or sodium bicarbonate.

ù SECTION 7 HANDLING AND STORAGE ù

Observe all federal, state and local regulations when storing this substance.

Store in accordance with 29 CFR 1910.101.

Protect against physical damage. Store in cool, well-ventilated place, separated from all oxidizing materials (NFPA 49, Hazardous Chemicals Data, 1975).

Store away from incompatible substances.

Threshold Planning Quantity (TPQ):
The Superfund Amendments and Reauthorization Act (SARA) Section 302 requires that each facility where any extremely hazardous substance is present in a quantity equal to or greater than the TPQ established for that substance notify the state emergency response commission for the state in which it is located. Section 303 of SARA requires these facilities to participate in local emergency response planning (40 CFR 355.30).

Threshold quantity (TQ): 5000 pounds
The Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard requires that facilities utilizing a process which involves a chemical at or above its specified threshold quantity comply with the provisions of 29 CFR 1910.119, Process Safety Management of highly hazardous chemicals.

ù SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION ù

EXPOSURE LIMITS:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
5 ppm (7.6 mg/m3) OSHA ceiling
5 ppm (7.6 mg/m3) ACGIH ceiling
5 ppm (7.6 mg/m3) NIOSH recommended ceiling
5 ppm (7.6 mg/m3) DFG MAK TWA;
10 ppm (15.2 mg/m3) DFG MAK 5 minute peak, momentary value, 8 times/shift

Measurement method: Silica gel tube; sodium bicarbonate/sodium carbonate; n chromatography; (NIOSH Vol. III # 7903, Inorganic Acids).

500 pounds SARA Section 302 Threshold Planning Quantity (gas)
5000 pound SARA Section 304 Reportable Quantity (gas)
5000 pounds CERCLA Section 103 Reportable Quantity (liquid)
5000 pounds OSHA Process Safety Management Threshold Quantity (gas)
Subject to SARA Section 313 Annual Toxic Chemical Release Reporting

VENTILATION:
Provide local exhaust or process enclosure ventilation to meet published exposure limits.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

Emergency wash facilities:
Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent any possibility of skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to emical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):

50 ppm- Any supplied-air respirator.
Any self-contained breathing apparatus.
Any chemical cartridge respirator with cartridge(s) providing protection against hydrochloric acid.

100 ppm- Any supplied-air respirator operated in a continuous flow mode.
Any supplied-air respirator with a full facepiece.
Any self-contained breathing apparatus with a full facepiece.
Any air-purfiying, full-facepiece respirator (gas mask) with a chin-style, front-, or back- mounted canister providing protection against hydrochloric acid.
Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against hydrochloric acid.
Any powered, air-purfiying respirator with cartridge(s) providing protection against hydrochloric acid.

Escape- Any air-purifying, full facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister.
Any appropriate escape-type self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

ù SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES ù

DESCRIPTION: Colorless gas or fuming liquid with a suffocating odor.
MOLECULAR WEIGHT: 36.46
MOLECULAR FORMULA: H-CL
BOILING POINT: -121 F (-85 C)
FREEZING POINT: -175 F (-115 C)
VAPOR PRESSURE: 3040 mmHg @ 17.8 C
VAPOR DENSITY: 1.268
SPECIFIC GRAVITY: 1.187 @ -85 C
WATER SOLUBILITY: 82.3% @ 0 C
PH: acidic in solution
ODOR THRESHOLD: 1-5 ppm
EVAPORATION RATE: not applicable
SOLVENT SOLUBILITY: Soluble in alcohol, ether, benzene, methanol.

ù SECTION 10 STABILITY AND REACTIVITY ù

REACTIVITY:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
May react exothermically with water.

CONDITIONS TO AVOID:
Material is extremely poisonous; avoid inhalation of vapors or contact with skin. Contents may be under pressure; containers may rupture violently and travel a considerable distance.

INCOMPATIBILITIES:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
ACETIC ANHYDRIDE: Violent reaction.
ALCOHOLIC HYDROGEN CYANIDE: Explosive reaction.
ALUMINUM: Explosion.
ALUMINUM-TITANIUM ALLOYS: Ignites or incandesces when heated.
2-AMINOETHANOL: Violent reaction.
AMMONIUM HYDROXIDE: Violent reaction.
BASES: Violent reaction.
BRASS: Corrodes.
BRONZE: Corrodes.
CALCIUM CARBIDE: Reacts with incandescence.
CALCIUM HYPOCHLORITE: Ignition.
CESIUM ACETYLIDE: Ignites on contact.
CHLORINE + DINITROANILINES: Vigorous reaction with release of flammable

hydrogen gas fumes.
CHLOROSULFONIC ACID: Violent reaction.
1,1-DIFLUOROETHYLENE: Extremely exothermic decomposition reaction.
DRIERITE 100: Decomposes.
ETHYLENE DIAMINE: Violent reaction.
ETHYLENE IMINE: Violent reaction.
FLUORINE: Ignites on contact.
HEXALITHIUM DISILICIDE: Incandesces.
IRON: Corrodes with evolution of flammable hydrogen gas.
MAGNESIUM BORIDE: Produces a spontaneously flammable gas.
MERCURIC SULFATE: Violent reaction at 125 C.
METAL ACETYLIDES: Violent reaction.
METALS: Severe corrosion with evolution of flammable hydrogen gas.
OLEUM: Violent reaction.
OXIDIZERS (STRONG): Violent reaction.
OXYGEN + PLATINUM: Ignites on contact.
PERCHLORIC ACID: Violent reaction.
PLASTICS, RUBBER, COATINGS: Attacks.
POTASSIUM PERMANGANATE: Explosion hazard.
BETA-PROPIOLACTONE: Violent reaction.
PROPYLENE OXIDE: Violent reaction.
RUBIDIUM ACETYLIDE: Ignites on contact.
SILICA (GEL): Incompatible.
SODIUM: Vigorous or explosive reaction.
SULFURIC ACID: Explosive reaction with release of toxic hydrogen chloride gas.
TETRASELENIUM TETRANITRIDE: Explodes on contact.
VINYL ACETATE: Violent reaction.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic and corrosive fumes of chlorine.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11 TOXICOLOGY INFORMATION

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
IRRITATION DATA:
ANHYDROUS: 100 mg rinsed eye-rabbit mild.
HYDROCHLORIC ACID: 5 mg/30 seconds rinsed eye-rabbit mild.
TOXICITY DATA:
HYDROGEN CHLORIDE (ANHYDROUS GAS): 4701 ppm/30 minutes inhalation-rat LC50; 2644 ppm/30 minutes inhalation-mouse LC50.
MONOHYDRATE: No data available.
DIHYDRATE: No data available.
TRIHYDRATE: No data available.
HEXAHYDRATE: No data available.
HYDROGEN CHLORIDE (AEROSOL): 5666 ppm/30 minutes inhalation-rat LC50; 2142 ppm/30 minutes inhalation-mouse LC50.
HYDROCHLORIC ACID: 1300 ppm/30 minutes inhalation-human LCLo; 3000 ppm/5 minutes inhalation-human LCLo; 3124 ppm/1 hour inhalation-rat LC50; 1108 ppm/1 hour inhalation-mouse LC50; 4413 ppm/30 minutes inhalation-rabbit LCLo; 4413 ppm/30 minutes inhalation-guinea pig LCLo; 900 mg/kg oral-rabbit LD50; 1449 mg/kg intraperitoneal-mouse LD50;

81 mg/kg unreported-man LDLo; mutagenic data (RTECS); reproductive effects data (RTECS).
CARCINOGEN STATUS: Human Inadequate Evidence, Animal Inadequate Evidence (IARC Group-3).
LOCAL EFFECTS: Corrosive- inhalation, skin, eye and ingestion.
ACUTE TOXICITY LEVEL: Moderately toxic by inhalation and ingestion.
TARGET EFFECTS: No data available.

HEALTH EFFECTS
INHALATION:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE. 100 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- Inhalation of gas or fumes at levels of 5-35 ppm may cause irritation and burning of the throat, coughing and choking; 50-100 ppm may be barely tolerable for 1 hour. High levels may cause inflammation and occasionally ulceration of the nose, throat or larynx, bronchitis, pneumonia, palpitations and headache. Higher concentrations may cause necrosis of the tracheal and bronchial epithelium, nasoseptal perforation, atelectasis, emphysema, damage to pulmonary blood vessels and lesions of the liver and other organs. Death may be due to laryngeal spasm, bronchopneumonia or pulmonary edema. 1300-2000 ppm may be dangerous, even on brief exposures. Reproductive effects have been reported in animals.
CHRONIC EXPOSURE- Repeated or prolonged exposure may cause erosion and discoloration of exposed teeth, chronic bronchitis and gastritis.

SKIN CONTACT:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE.
ACUTE EXPOSURE- Contact may cause severe irritation, inflammation, ulceration, necrosis and chemical burns. Shock symptoms may develop including rapid pulse, sweating and collapse. Photosensitization reactions may occur in persons previously exposed. Contact with a compressed gas may cause frostbite.
CHRONIC EXPOSURE- Repeated or prolonged contact with vapors or dilute solutions may cause dermatitis. Photosensitization may occur.

EYE CONTACT:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE.
ACUTE EXPOSURE- Contact may cause severe irritation, conjunctivitis, corneal necrosis and burns with impairment or permanent loss of vision. A drop of hydrochloric acid splashed in the eye and immediately washed out has produced a white coagulation of the corneal and conjunctival epithelium. Animals exposed to vapor concentrations of 1350 ppm for one and a half hours showed clouding of the cornea and 300 ppm for 6 hours showed slight erosion of the corneal epithelium. Contact with a compressed gas may cause frostbite.
CHRONIC EXPOSURE- Animals exposed to vapor at 100 ppm for 6 hours daily for 50 days showed only slight unrest and irritation of the eyes, but no ocular injury. Effects are dependent upon concentration and duration of exposure. Conjunctivitis or effects similar to those for acute exposure may occur.

INGESTION:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
CORROSIVE.
ACUTE EXPOSURE- Ingestion of the acid may cause burns of the mouth,

throat, esophagus and stomach with consequent pain, uneasiness, nausea, salivation, vomiting, diarrhea, chills, shock and intense thirst. Nephritis, fever and perforation of the intestinal tract, and circulatory collapse may occur. Death may be due to esophageal or gastric necrosis.
CHRONIC EXPOSURE- No data available.

SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

SECTION 13 DISPOSAL INFORMATION

Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA Hazardous Waste Number D002.
100 pound CERCLA Section 103 Reportable Quantity.

SECTION 14 TRANSPORTATION INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Hydrogen chloride, refrigerated liquid-UN 2186

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
2.3 - Poisonous gas

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Poison gas, corrosive

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: None
NON-BULK PACKAGING: None
BULK PACKAGING: 49 CFR 173.314 and 49 CFR 173.315

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: Forbidden
CARGO AIRCRAFT ONLY: Forbidden

SECTION 15 REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	5000	pounds RQ
SARA SECTION 302 (40CFR355.30):	Y	500	pounds TPQ
SARA SECTION 304 (40CFR355.40):	Y	5000	pounds RQ
SARA SECTION 313 (40CFR372.65):	Y		
OSHA PROCESS SAFETY (29CFR1910.119):	Y	5000	pounds TQ
CALIFORNIA PROPOSITION 65:	N		

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	N
REACTIVITY HAZARD:	Y
SUDDEN RELEASE HAZARD:	Y

ù SECTION 16 OTHER ù

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MALLINCKRODT

Material Safety Data Sheet

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Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

Emergency Telephone Number: 314-982-5000

HYDROCHLORIC ACID, 37%

PRODUCT IDENTIFICATION:

Synonyms: Muriatic acid

Formula CAS No.: 7647-01-0

Molecular Weight: 36.46 (HCl)

Chemical Formula: HCl

Hazardous Ingredients: Hydrogen chloride

PRECAUTIONARY MEASURES

DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE.

Do not get in eyes, on skin, or on clothing.
Avoid breathing mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING!
Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: Clear, colorless fuming liquid.

Odor: Pungent odor of hydrogen chloride.

Solubility: Infinite in water with slight evolution of heat.

Boiling Point: 53°C (127°F); Azeotrope (20.2%) boils at 109°C (228°F)

Melting Point: -74°C (-101°F)

Specific Gravity: 1.18

Vapor Density (Air=1): No information found.

Vapor Pressure (mm Hg): 190 @ 25°C (77°F)

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Can react with metals to release flammable hydrogen gas.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
If involved in a fire, use water spray.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.

SECTION 4 Leak/Spill Disposal Information

Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic or corrosive fluids or vapors. Isolate or enclose the area of the leak or spill.
Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). Sewer neutralized material with excess water. Larger spills and lot sizes: Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite). Provide forced ventilation to dissipate fumes. Dispose in a RCRA-approved waste facility or sewer the neutralized slurry with excess water if local ordinances allow.

Reportable Quantity (RQ)(CWA/CERCLA) : 5000 lbs.

Ensure compliance with local, state and federal regulations.

3.56

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflamation of the nose, throat, and upper respiratory tract. Inhalation of higher concentrations may cause lung damage.

Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea.

Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.

Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Splashes may cause severe burns and permanent eye damage.

Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

B. FIRST AID

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1986)

Oral rat LD50: 900 mg/kg (Hydrochloric acid concentrated) Mutation references cited.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
5 ppm Ceiling
-ACGIH Threshold Limit Value (TLV):
5 ppm Ceiling

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Protect from moisture.

HYDCH

MALLINCKRODT

Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

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Emergency Telephone Number: 314-982-5000

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS must include a copy of this addendum

(Chem.Key: HYDCH)

Product or Components of Product:

HYDROCHLORIC ACID, 37% (7647-01-0)

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X			X

SARA EHS Sect. 302 RQ (lbs.)	SARA EHS Sect. 302 TPQ (lbs.)	SARA Section 313 Chemicals Name List	SARA Section 313 Chemicals Chemical Category	CERCLA Sec.103 RQ (lbs.)	RCRA Sec. 261.33
1	500gas	Yes	No	5000 (HCl acid)	No

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.
SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.
SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec. 103: Comprehensive Enviromental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4
RCRA: Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

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ASEPSIS, INC. MATERIAL SAFETY DATA SHEET

Product Name:	OMNI SPA ANTIFOAM	Date Prepared:	09/06/94
Product Number:	AOMN32424	Supersedes:	09/06/94

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Identifier:	AOMN32424
Product Use:	Antifoam
Product Description:	OMNI SPA ANTIFOAM
Chemical Family:	Organosilicone Emulsion
Technical Name:	Polydimethylsiloxane Emulsion

Manufacturer/Supplier:	Emergency Telephone Numbers:
ASEPSIS, INC. P.O. BOX 537 AVONDALE ESTATES, GEORGIA 30002 800-959-SWIM (7946)	CHEMTREC (800)424-9300 Health (303)623-5716 Prepared: REGULATORY AFFAIRS

SECTION 2 - HAZARDOUS COMPONENTS

COMPONENT	WT%	CAS Number
No Hazardous Materials are Contained in this Product		

SECTION 3 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: CAUTION: Harmful if swallowed. Avoid breathing vapors. Avoid contact with eyes, skin, or clothing. Wear goggles or safety glasses and rubber gloves when handling this product. Remove and wash contaminated clothing.

EFFECTS OF OVEREXPOSURE - EYE CONTACT: CAUTION: Causes eye irritation. Avoid contact with eyes.

EFFECTS OF OVEREXPOSURE - SKIN CONTACT: CAUTION: Causes skin irritation. Avoid contact with skin.

EFFECTS OF OVEREXPOSURE - INHALATION: Irritating to nose and throat. Avoid breathing vapors.

EFFECTS OF OVEREXPOSURE - INGESTION: Harmful if swallowed.

EFFECTS OF OVEREXPOSURE - CHRONIC HAZARDS: There are no known chronic hazards.

PRIMARY ROUTE(S) OF ENTRY: Skin Contact, Inhalation, Ingestion, Eye Contact

ASEPSIS, INC.

MATERIAL SAFETY DATA SHEET

Product Name:	OMNI SPA ANTIFOAM	Date Prepared:	09/06/94
Product Number:	AOMN32424	Supersedes:	09/06/94

SECTION 4 - FIRST AID MEASURES

FIRST AID - EYE CONTACT: If contact with eyes occurs: Immediately flush with cold water for at least 15 minutes. Then get immediate medical attention.
FIRST AID - SKIN CONTACT: If contact with skin: Brush off excess chemical and flush skin with cold water for at least 15 minutes. If irritation persists, get medical attention. If contact with skin: Wash off excess chemical with soap and water and flush skin with cold water for at least 15 minutes. If irritation persists, get medical attention.
FIRST AID - INHALATION: If inhaled: Remove to fresh air. If breathing is difficult, have trained person administer oxygen. If not breathing, give artificial respiration. Call a physician immediately.
FIRST AID - INGESTION: If swallowed: Drink large amounts of water. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Call a physician or poison control center immediately.

SECTION 5 - FIRE FIGHTING MEASURES

Flashpoint and Method:	None	
Flammable Limits:	LEL: N.A.	UEL: N.A.
Autoignition Temperature:		

EXTINGUISHING MEDIA: CO_2, Dry Chemical, Water Fog

UNUSUAL FIRE AND EXPLOSION HAZARDS: There are no unusual fire and explosion hazards known.
SPECIAL FIREFIGHTING PROCEDURES: Firefighters should wear full protective clothing and self contained breathing apparatus (SCBA). Throughly decontaminate fire fighting equipment including all fire fighting wearing apparel after the incident.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASE OR SPILLED: Utilizing appropriate clothing and safety equipment, contain spilled material. Cover the liquid with a inert absorbent. Using clean, dedicated equipment, sweep and scoop all spilled material, contaminated soil, and other contaminated material and place into clean dry plastic containers for disposal. Dispose of according to local, state and federal regulations.

ASEPSIS, INC. MATERIAL SAFETY DATA SHEET

Product Name:	OMNI SPA ANTIFOAM	Date Prepared:	09/06/94
Product Number:	AOMN32424	Supersedes:	09/06/94

SECTION 7 - HANDLING AND STORAGE

HANDLING: Mix only with water. Do not mix with other chemicals. Use clean dry utensils. Do not add this product to any dispensing device containing remnants of any other product. Such use may cause a violent reaction leading to fire or explosion. Contamination with other chemicals may start a chemical reaction generating heat, hazardous gases, fire and explosion. In case of contamination or decomposition, do not reseal container. If possible, isolate container in open air or well ventilated area. Flood area with large volumes of water, if necessary.
STORAGE: Keep this product in original closed container when not in use. Store in a cool, dry, well ventilated area away form heat or open flame. Do not add any other product to container. Never return unused product to container; dispose of product in accordance with local, state, or federal regulations.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: General room ventilation plus local exhaust should be used to maintain exposure below TLV.
RESPIRATORY PROTECTION: A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.
SKIN PROTECTION: Wear rubber gloves when handling this product. Avoid contact with skin.
EYE PROTECTION: Wear goggles or safety glasses with side shields when handling this product.
OTHER PROTECTIVE EQUIPMENT: Facilities storing or utilizing this material should be equipped with an eyewash and a safety shower.
HYGIENIC PRACTICES: Remove and wash contaminated clothing before reuse.

ASEPSIS, INC.

MATERIAL SAFETY DATA SHEET

Product Name:	OMNI SPA ANTIFOAM	Date Prepared:	09/06/94
Product Number:	AOMN32424	Supersedes:	09/06/94

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Vapor Pressure:	Est. <20 mm Hg
Specific Gravity:	1.0
Solubility:	Dispersible
pH:	7.0 -
Melting Point:	Not Applicable.
Boiling Point:	212 F
Viscosity:	Not Available
Vapor Density (Air = 1):	Is heavier than air
Evaporation Rate (n-Butyl Acetate = 1):	Is slower than Butyl Acetate
Odor:	Silicone
Appearance:	Milky White
Physical State:	Liquid
Partition Coefficient (n-octanol/water):	Not Available.

SECTION 10 - STABILITY AND REACTIVITY

HAZARDOUS POLYMERIZATION: Will not occur under normal conditions.
STABILITY: This product is stable under normal conditions.
CONDITIONS TO AVOID: High Temperature. Poor Ventilation. Contamination.
INCOMPATIBILITY: Avoid contact with easily oxidizable material. Ammonia, urea, or similar nitrogen containing compounds. Inorganic reducing compounds. Other swimming pool/spa chemicals in their concentrated forms.
HAZARDOUS DECOMPOSITION PRODUCTS: Vapors/fumes of organic/inorganic materials plus oxides of carbon may be emitted.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION: This product is not a mutagen or teratogen. This product is not listed as a carcinogen by EPA, NTP, or IARC. Toxicological information indicates this product may be irritating to skin and eyes.

SECTION 12 - ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION: This product may be toxic to fish and aquatic organisms. Keep product from entering waterways and watersheds.

MSDS Number 00001578 is continued on the following page

ASEPSIS, INC. MATERIAL SAFETY DATA SHEET

Product Name:	OMNI SPA ANTIFOAM	Date Prepared:	09/06/94
Product Number:	AOMNI32424	Supersedes:	09/06/94

SECTION 13 - DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Do not put product, spilled product, or filled or partially filled containers into the trash or waste compactor. Contact with incompatible materials could cause a reaction or fire. Do not reuse container. Rinse throughly before discarding in trash. Disposal of unused, uncontaminated product is regulated according to local, state and federal regulations.

SECTION 14 - TRANSPORTATION INFORMATION

DOT:

Proper Shipping Name: Not Regulated.
Hazard Class:
Identification Number:
Packing Group:
RQ:

SECTION 15 - REGULATORY INFORMATION

FEDERAL:

OSHA (Occupational Safety and Health Act):
Product is not hazardous by definition of the Hazard Communication Standard.

TSCA (Toxic Substance Control Act):
This product or its components are listed on the TSCA Inventory.
This product contains the following chemical substances subject to the reporting requirements of TSCA 12(B) if exported from the United States:
This product or its components are not subject to export notification.

FIFRA (Federal Insecticide, Fungicide, Rodenticide Act):
This product is not a registered pesticide.

CERCLA (Comprehensive Response, Compensation and Liability Act):
This product or its components are not listed.

SARA (Superfund Amendments and Reauthorization Act):

SARA 313: This product or its components are not listed.

ASEPSIS, INC. MATERIAL SAFETY DATA SHEET

Product Name:	OMNI SPA ANTIFOAM	Date Prepared:	09/06/94
Product Number:	AOMN32424	Supersedes:	09/06/94

SECTION 16 - OTHER INFORMATION

NFPA: Health: 0 Flammability: 0 Reactivity: 0
HMIS: Health: 0 Flammability: 0 Reactivity: 0 Personal Protection: B

REVISION SUMMARY:

IMPORTANT: This information is given without a warranty or guarantee. No suggestions for use are intended or shall be construed as arecommendation to infringe any existing patents or violate any Federal, State or local laws. Safe handling and use is the responsibility of the customer. Read the label before using this product. This information is true and accurate to the best of our knowledge.

MATERIAL SAFETY DATA SHEET

M' 'ESON GAS PRODUCTS
3 EAVIEW DRIVE
SECAUCUS, NEW JERSEY 07096
(201) 867-4100

EMERGENCY CONTACT:
CHEMTREC 1-800-424-9300

SUBSTANCE IDENTIFICATION

CAS-NUMBER 7727-37-9

SUBSTANCE: NITROGEN, COMPRESSED GAS

TRADE NAMES/SYNONYMS:
DIATOMIC NITROGEN; DINITROGEN; NITROGEN; NITROGEN-14; NITROGEN GAS; STCC 4904565; UN 1066; N2; MAT16625

CHEMICAL FAMILY:
INORGANIC GAS

MOLECULAR FORMULA: N2

MOLECULAR WEIGHT: 28.0134

CERCLA RATINGS (SCALE 0-3): HEALTH=U FIRE=0 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=U FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: NITROGEN, COMPRESSED GAS PERCENT: 100.0
CAS# 7727-37-9

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NO OCCUPATIONAL EXPOSURE LIMITS ESTABLISHED BY OSHA, ACGIH, OR NIOSH.

PHYSICAL DATA

DESCRIPTION: ODORLESS, TASTELESS, COLORLESS, INERT GAS.

BOILING POINT: -321 F (-196 C) MELTING POINT: -346 F (-210 C)

SPECIFIC GRAVITY: 1.2506 G/L VOLATILITY: 100%

VAPOR PRESSURE: 760 MMHG @ -196 C SOLUBILITY IN WATER: 1.6% @ 20 C

VAPOR DENSITY: 0.967

SOLVENT SOLUBILITY: SOLUBLE IN LIQUID AMMONIA; SLIGHTLY SOLUBLE IN ALCOHOL.

VISCOSITY: 0.01787 CPS @ 27 C

FIRE AND EXPLOSION DATA

FI AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

CYLINDER MAY EXPLODE IN HEAT OF FIRE.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE OR HALON
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. STAY AWAY FROM STORAGE TANK ENDS. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM THE SIDE UNTIL WELL AFTER THE FIRE IS OUT. WITHDRAW IMMEDIATELY IF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANKS DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 12).

EXTINGUISH USING AGENT SUITABLE FOR TYPE OF SURROUNDING FIRE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER FROM AS FAR A DISTANCE AS POSSIBLE.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:
NONFLAMMABLE GAS

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND SUBPART E:
NONFLAMMABLE GAS

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.304 AND 49 CFR 173.314
EXCEPTIONS: 49 CFR 173.306

TOXICITY

NITROGEN:
CARCINOGEN STATUS: NONE.
ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.
TARGET EFFECTS: SIMPLE ASPHYXIANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NITROGEN:
SEE INFORMATION ON SIMPLE ASPHYXIANTS. NITROGEN INHALED UNDER INCREASED ATMOSPHERIC PRESSURE, (>1.5 ATMOSPHERES), MAY DISSOLVE IN THE FAT-CONTAINING BRAIN CELLS, AND ACT AS AN ANESTHETIC, CAUSING NARCOSIS. PERSONS WHO HAVE BEEN EXPOSED TO INCREASED PRESSURE FOR A TIME AND WHO ARE

SUDDENLY RELEASED FROM THE PRESSURE MAY DEVELOP DECOMPRESSION SICKNESS. REPEATED EXPOSURE, WITHOUT COMPLETE DECOMPRESSION, MAY RESULT IN DECOMPRESSION SICKNESS.

SIMPLE ASPHYXIANTS:
ACUTE EXPOSURE- THE SYMPTOMS OF ASPHYXIA DEPEND ON THE RAPIDITY WITH WHICH THE OXYGEN DEFICIENCY DEVELOPS AND HOW LONG IT CONTINUES. IN SUDDEN ACUTE ASPHYXIA, UNCONSCIOUSNESS MAY BE IMMEDIATE. WITH SLOW DEVELOPMENT THERE MAY BE RAPID RESPIRATION AND PULSE, AIR HUNGER, DIZZINESS, REDUCED AWARENESS, TIGHTNESS IN THE HEAD, TINGLING SENSATIONS, INCOORDINATION, FAULTY JUDGEMENT, EMOTIONAL INSTABILITY, AND RAPID FATIGUE. AS THE ASPHYXIA PROGRESSES, NAUSEA, VOMITING, COLLAPSE, UNCONSCIOUSNESS, CONVULSIONS, DEEP COMA AND DEATH ARE POSSIBLE.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
NITROGEN:
ACUTE EXPOSURE- NO ADVERSE EFFECT HAVE BEEN REPORTED FROM THE GAS. DUE TO THE RAPID EVAPORATION, THE LIQUID MAY CAUSE FROSTBITE WITH REDNESS, TINGLING, AND PAIN OR NUMBNESS. IN MORE SEVERE CASES, THE SKIN MAY BECOME HARD AND WHITE AND DEVELOP BLISTERS.
CHRONIC EXPOSURE- NO ADVERSE EFFECTS HAVE BEEN REPORTED.

FIRST AID- IT IS UNLIKELY THAT EMERGENCY TREATMENT WILL BE REQUIRED. IF ADVERSE EFFECTS OCCUR, GET MEDICAL ATTENTION.
IN CASE OF FROSTBITE, WARM AFFECTED SKIN IN WARM WATER AT A TEMPERATURE OF 107 F. IF WARM WATER IS NOT AVAILABLE OR IMPRACTICAL TO USE, GENTLY WRAP AFFECTED PART IN BLANKETS. ENCOURAGE VICTIM TO EXERCISE AFFECTED PART WHILE IT IS BEING WARMED. ALLOW CIRCULATION TO RETURN NATURALLY (MATHESON GAS, 6TH ED.). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
NITROGEN:
ACUTE EXPOSURE- MAY CAUSE IRRITATION IF SPRAYED DIRECTLY INTO THE EYES. DUE TO RAPID EVAPORATION, THE LIQUID MAY CAUSE FROSTBITE WITH REDNESS, PAIN AND BLURRED VISION.
CHRONIC EXPOSURE- NO ADVERSE EFFECTS HAVE BEEN REPORTED.

FIRST AID- IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IF FROSTBITE IS PRESENT, WARM WATER MAY BE PREFERRED. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NITROGEN:
ACUTE EXPOSURE- INGESTION OF A GAS IS UNLIKELY. IF THE LIQUID IS SWALLOWED, FROSTBITE DAMAGE OF THE LIPS, MOUTH AND MUCOUS MEMBRANES MAY OCCUR.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- IT IS UNLIKELY THAT EMERGENCY TREATMENT WILL BE REQUIRED.
IF ADVERSE EFFECTS OCCUR, TREAT SYMPTOMATICALLY AND SUPPORTIVELY AND GET MEDICAL ATTENTION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
NITROGEN:
LITHIUM: MAY IGNITE IN THE GAS.
MAGNESIUM: VIOLENT REACTION WITH THE LIQUID ON IGNITION.
NEODYMIUM: VIGOROUS REACTION.
OZONE: MIXTURES OF THE GASES MAY BE EXPLOSIVE.
TITANIUM: WILL BURN IN NITROGEN ATMOSPHERE.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE IN ACCORDANCE WITH 29 CFR 1910.101.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

CONDITIONS TO AVOID

DO NOT PERMIT PHYSICAL DAMAGE OR OVERHEATING OF CONTAINERS. CONTENTS ARE UNDER PRESSURE; CONTAINERS MAY VIOLENTLY RUPTURE AND TRAVEL A CONSIDERABLE DISTANCE.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
STOP LEAK IF YOU CAN DO IT WITHOUT RISK. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION.

RESPIRATOR:
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON INFORMATION FOUND IN THE PHYSICAL DATA, TOXICITY AND HEALTH EFFECTS SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

ANY SUPPLIED-AIR RESPIRATOR OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ANY SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
FOR THE GAS FORM, PROTECTIVE CLOTHING NOT REQUIRED.
IF CONTACT WITH THE LIQUID FORM IS POSSIBLE, EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT SKIN FROM FREEZING.

GLOVES:
WEAR FULL PROTECTIVE, COLD INSULATING GLOVES.

EYE PROTECTION:
FOR THE GAS FORM EYE PROTECTION IS NOT REQUIRED BUT RECOMMENDED.
WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH THE LIQUID FORM, EMPLOYEE MUST WEAR SPLASH-PROOF SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THE LIQUID FORM OF THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED: MATHESON GAS PRODUCTS; NO DISTRIBUTION EXCEPT AS REQUIRED BY LAW.
CREATION DATE: 01/24/89 REVISION DATE: 09/28/90

-ADDITIONAL INFORMATION-

*MATHESON MAKES NO WARRANTIES, GUARANTEES OR REPRESENTATIONS OF ANY KIND OR NATURE WITH RESPECT TO THE PRODUCT OR THIS DATA, EITHER EXPRESSED OR IMPLIED,

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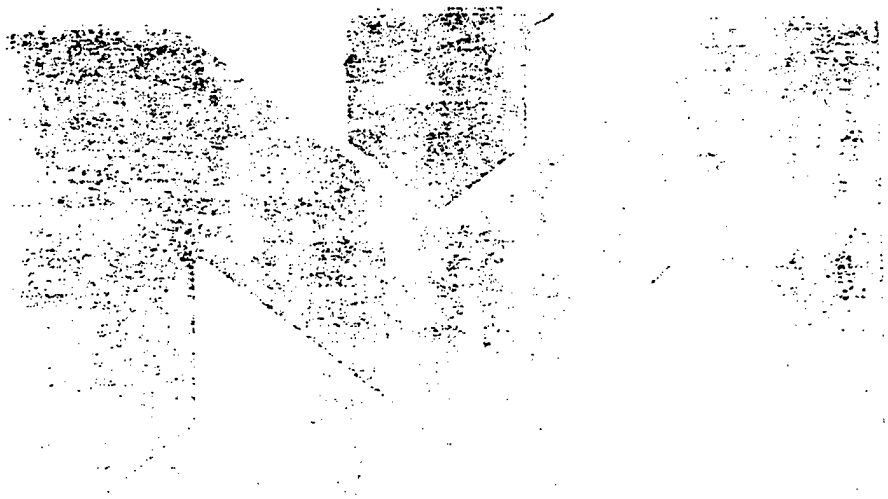

ISOPROPYL ALCOHOL

Material Safety Data Sheet

Mallinckrodt Chemical, Inc.
P.O. Box 800
Paris, Kentucky 40362

Emergency Telephone Number
314-539-1600

Effective Date: 02-17-95 Supersedes 04-06-89

PRODUCT IDENTIFICATION:

Synonyms: 2-propanol; sec-propyl alcohol; isopropanol

Formula CAS No.: 67-63-0 Molecular Weight: 60.10

Hazardous Ingredients: Isopropyl alcohol Chemical Formula: (CH3)2 CHOH

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE LIQUID. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

Keep away from heat, sparks and flame.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.

EMERGENCY FIRST AID

If swallowed, induce vomiting immediately as directed by medical personnel. ver give anything by mouth to an unconscious person. If inhaled, remove to esh 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. In all cases call a physician. SEE SECTION 5.

SECTION 1

Physical Data

Appearance: Clear, colorless liquid.

Odor: Rubbing alcohol.

Solubility: Infinite in water.

Boiling Point: 82 C (180 F).

Vapor Density (Air=1):2.1

Melting Point: -89 C (-128 F).

Vapor Pressure (mm Hg):33 @ 20 C (68 F)

Specific gravity: 0.79

Evaporation Rate:(n-BUAC = 1) 2.83

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

SECTION 2

Fire and Explosion Information

Fire: Flammable Liquid Flashpoint: 12 C (53 F). (closed cup). Autoignition temperature: 399 C (750 F). Flammable limits in air, % by volume: lel: 2.0; uel: 12.0.

Explosion: Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion.

Fire Extinguishing Media: Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures. Vapors can flow along surfaces to distant ignition source and flash back.

Reactivity Data — SECTION 3

Stability: Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.

Hazardous Decomposition Products: Toxic gases and vapors such as carbon monoxide may be released in a fire involving isopropyl alcohol.

Hazardous Polymerization: Will not occur.

Incompatibilities: Heat, flame, strong oxidizers, acetadehyde, acides, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, oleum and perchloric acid.

Leak/Spill Disposal Information — SECTION 4

Ventilate area of leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Contain and recover liquid when possible. Collect as hazardous waste and atomize in a suitable RCRA approved combustion chamber, or absorb with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!

Ensure compliance with local, state and federal regulations.

Health Hazard Information — SECTION 5

A. Exposure/Health Effects

Inhalation: Inhalation of vapors irritates the respiratory tract. Exposure to high concentrations has a narcotic effect, producing symptoms of dizziness, drowsiness, headache, staggering, unconsciousness and possibly death.

Ingestion: May cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls.

:in Contact: Has a defatting action of the skin that can cause irritation. May cause irritation with a stinging effect and burning sensation.

Eye Contact: Vapors may irritate the eyes. Splashes may cause severe irritation, possible corneal burns and eye

damage.

Chronic Exposure: Prolonged contact with skin may cause mild irritation, drying, cracking, or contact dermatitis may develop.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion: Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconcious person.

Skin Exposure: Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye Exposure: Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY (RTECS, 1994)

Oral rat LD50: 5045 mg/kg; skin rabbit LD50: 12.8 gm/kg; investigated as a tumorigen, mutagen, reproductive effector.

Occupational Control Measures SECTION 6

Airborne Exposure Limits: -OSHA Permissible Exposure Limit (PEL): 400 ppm (TWA), 500 ppm (STEL) -ACGIH Threshold Limit Value (TLV): 400 ppm (TWA), 500 ppm (STEL)

Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators (NIOSH Approved) If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to the maximum use concentration specified by the respirator supplier. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

Storage and Special Information SECTION 7

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment.

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ISALC

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be
Detached from the MSDS
Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS
must include a copy of this addendum

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X	X		

Product or Components of Product:	SARA EHS Sec. 302 RQ	SARA EHS Sec. 302 TPQ	SARA Sec. 313 Chemicals Name List	SARA Sec. 313 Chemicals Chemical Category	CERCLA Sec.103 RQ lbs	RCRA Sec. 261.33
ISOPROPYL ALCOHOL (67-63-0)	No	No	Yes	No	No	No

SARA Section 302 EHS RQ:
Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ:
Threshold Planning Quantity of Extremely Hazardous substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals:
Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103:
Comprehensive Environmental Response, Compensation and Liability Act (Superfund)
Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA:
Resource Conservation and Recovery Act. Commercial chemical product wastes designated as acute hazards or toxic under 40 CFR 261.33

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ISOPROPYL ALCOHOL