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SRSNE Site Group

Remedial Design Project Operations Plan Attachment D

Health and Safety Plan

Solvents Recovery Service of New England, Inc.
(SRSNE) Superfund Site
Southington, Connecticut

November 2010

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Operations Plan Attachment D

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New England, Inc. (SRSNE)
Superfund Site
Southington, Connecticut

Prepared for:

SRSNE Site Group

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Date:

November 2010

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Health and Safety Plan Acknowledgement

I have read the Site-Specific Health and Safety Plan, or its contents have been presented to me, and I understand the contents and I agree to abide by its requirements.

Name (Print)	Signature	Representing	Date

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Appendices

1. Introduction

1.1 Objective

This *Health and Safety Plan* (HASP) has been prepared to provide general health and safety information and establish the minimum health- and safety-related procedures and requirements associated with implementing Remedial Design (RD) activities at the Solvents Recovery Service of New England, Inc. (SRSNE) Site (the Site), located in Southington, Connecticut. It is intended to establish the minimum health- and safety-related information for personnel engaged in RD-related activities at the Site, including representatives of the SRSNE Site Group, United States Environmental Protection Agency (USEPA), Connecticut Department of Environmental Protection (CTDEP), and their respective contractors and subcontractors. At the discretion of each firm/organization engaged in site activities, the information presented herein may be supplemented by addenda or contractor-specific health and safety plans addressing the task(s) to be performed by their respective personnel.

RD activities expected to potentially occur at the site and addressed by this HASP include the following:

- Mobilization
- Clearing and Grubbing
- Field Survey
- Monitoring Well Installation
- Monitoring Well Abandonment
- Groundwater Sampling/NAPL Recovery
- Soil Sampling
- Excavation
- Waste Handling and Loading
- Cleanup
- Soil Gas Sampling
- Indoor Air Sampling
- Decontamination
- Demobilization

The general safety procedures and protective equipment presented in this general HASP have been established based on an analysis of potential physical, chemical, and biological hazards associated with these types of tasks. The hazard control methodologies presented are intended to minimize the potential of accident or injury.

1.2 Site and Facility Description

The Site is located at 90 Lazy Lane in Southington, Connecticut (Figure D-1) and encompasses approximately 14 acres of land. The SRSNE site comprises portions of several properties/areas, including the former SRSNE Operations Area, the former Boston & Maine (B&M) railroad right-of-way, the former Cianci property, and the Town Well Field property. Each property is depicted on Figure D-2 and briefly discussed below:

- **Former SRSNE Operations Area -** The former SRSNE Operations Area comprises approximately 2.5 paved acres on a 3.7-acre lot South of Lazy Lane in the Quinnipiac River basin approximately 600 feet west of the Quinnipiac River channel. This is the area where SRSNE historically performed solvent recovery and related operations. The remains of the foundations of several former buildings are located in the Operations Area of the Site.

- **Railroad Right-of-Way -** The railroad right-of-way is an approximately 50-foot wide right-of-way running north-south that separates the former Operations Area (to the west) from the former Cianci property (to the east).

- **Former Cianci Property -** The former Cianci Property is a 10-acre parcel located immediately east of the Operations Area and railroad right-of-way. The Quinnipiac River borders the eastern edge of the former Cianci Property. Lazy Lane is to the north, and the Town of Southington Well Field (Town Well Field) borders the property to the south. There is a treatment system building located on the former Cianci Property, located in the northeastern portion of the Site.

- **Town Well Field Property -** The Town Well Field Property consists of approximately 28.2 acres of undeveloped land south of the former Cianci Property and southeast of the Operations Area. The well field is bounded to the east by the Quinnipiac River and to the south by the Quinnipiac River and Curtiss Street. The railroad right-of-way and the Delahunty property border the western perimeter of the well field. The Connecticut Light & Power (CL&P) easement runs northwest-southeast through the northern portion of the well field.

1.3 Policy Statement

Work activities at this site will be carried out in a manner that protects the safety and health of employees, the general public and the environment.

The basic provisions of this plan are mandatory for all personnel and contractors assigned to the project. Agencies/firms may prepare their own site-specific HASPs (or addenda to this HASP) that present the specific means and methods that will be employed to meet the basic requirements of this HASP. All visitors to work areas at the Site must abide by the requirements of this plan.

1.4 References

This HASP complies with applicable Occupational Safety and Health Administration (OSHA) regulations, and USEPA regulations. This plan follows the guidelines established in the following:

- *Standard Operating Safety Guides*, USEPA (Publication 9285.1-03, June 1992).

- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, National Institute for Occupational Safety and Health (NIOSH), OSHA, United States Coast Guard (USCG), USEPA (86116, October 1985).

- *Title 29 of the Code of Federal Regulations* (CFR), Part 1910.

- *Title 29 of the* CFR, Part 1926.

- *Pocket Guide to Chemical Hazards*, Department of Health and Human Services (DHHS), Center for Disease Control (CDC), NIOSH (2005).

- *Threshold Limit Values*, American Conference of Governmental Industrial Hygienists (ACGIH) (2008).

- *Guide to Occupational Exposure Values*, ACGIH (2008).

- *Quick Selection Guide to Chemical Protective Clothing*, Forsberg, K. and S.Z. Mansdorf, 5th Ed. (2005).

1.5 Definitions

The following definitions (listed alphabetically) are applicable to this HASP:

- *Contamination Reduction Zone (CRZ)* - Area between the exclusion zone and support zone that provides a transition between contaminated and clean areas. Decontamination stations are located in this zone.

- *Exclusion Zone (EZ)* - Any portions of the site where hazardous substances are, or are reasonably suspected to be, present and pose an exposure hazard to on-site personnel.

- *Incident* - All losses, including first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions.

- *Near Miss* - An incident in which no injury; illness; motor vehicle accident; equipment, property, or other damage occurred, but that could have occurred under slightly different circumstances.

- *On-site Personnel* - All contractors and subcontractor field personnel involved with the project.

- *Project* - All on-site work performed under the scope of work.

- *Site* - The area described in Section 1.2, Site and Facility Description, where the work is to be performed.

- *Subcontractor* - Includes personnel hired by a direct contractor to perform site work.

- *Support Zone (SZ)* - All areas of the site, except the EZ and CRZ. The SZ surrounds the CRZ and EZ. Support equipment and break areas are located in this zone.

- *Visitor* - All other personnel, except the on-site personnel.

- *Work Area* - The portion of the site where work activities are actively being performed. This area may change daily as work progresses and includes the SZ, CRZ, and EZ. If the work area is located in an area on the site that is not contaminated, or suspected of being contaminated, the entire work area may be a SZ.

1.6 Acronyms

The following acronyms (listed alphabetically) are applicable to this HASP:

- *ACGIH* - American Conference of Governmental Industrial Hygienists
- *ANSI* - American National Standards Institute
- *ASTM* - ASTM International
- *B&M* - Boston & Maine
- *bgs* - below ground surface
- CBYD - Call Before You Dig
- *CDC* - Center for Disease Control
- *CFR* - Code of Federal Regulations
- *CL&P* - Connecticut Light & Power
- *COC* - constituent(s) of concern
- *CPR* - cardiopulmonary resuscitation
- *CRZ* - Contamination Reduction Zone
- *CTDEP* - Connecticut Department of Environmental Protection
- *dBA* - decibels
- *DEET* - diethyltoluamide
- *DHHS* - Department of Health and Human Services
- *EMS* - Emergency Medical Services
- *EZ* - Exclusion Zone
- *FM* - Factory Mutual Engineering Corporation
- *GFCI* - ground fault circuit interrupter
- *HASP* - Health and Safety Plan
- *HAZWOPER* - Hazardous Waste Operations and Emergency Response Standard
- *HCTS* - Hydraulic Containment and Treatment System
- *HEPA* - high-efficiency particulate air

- *HSO* - Health and Safety Officer
- *HSS* - Health and Safety Supervisor
- *II* - Incident Investigation
- *IQAT* - Independent Quality Assurance Team
- *kV* - kilovolt
- *LEL* - lower explosive limit
- *LOTO* - lockout/tagout
- *MSDS* - Material Safety Data Sheet
- *NAPL* - non-aqueous phase liquid
- *NEC* - National Electrical Code
- *NESC* - National Electrical Safety Code
- *NIOSH* - National Institute for Occupational Safety and Health
- *NRR* - Noise Reduction Rating
- *OSHA* - Occupational Safety and Health Administration
- *OSRR* - Office of Site Remediation and Restoration
- *PAHs* - polycyclic aromatic hydrocarbons
- *PCBs* - polychlorinated biphenyls
- *PEL* - permissible exposure limit
- *PID* - photoionization detector
- *PM* - Project Manager
- *PPE* - personal protective equipment
- *ppm* - part per million
- *PVC* - polyvinyl chloride
- *QAPP* - Quality Assurance Project Plan
- *RD* - Remedial Design
- *RMSF* - Rocky Mountain Spotted Fever
- *RSA* - risk self-assessment
- *SOP* - Standard Operating Procedure
- *SRSNE* - Solvents Recovery Service of New England, Inc.
- *SS* - Site Supervisor
- *SZ* - Support Zone
- *TLV* - Threshold Limit Value
- TOV - total organic vapors
- *TSA* - task safety analysis
- *UL* - Underwriters Laboratories

- *USCG* - United States Coast Guard
- *USEPA* - United States Environmental Protection Agency
- *VI* - vapor intrusion
- *VOC* - volatile organic compound

2. Roles and Responsibilities

2.1 All Personnel

All personnel must adhere to the procedures outlined in this HASP during the performance of their work. Each person is responsible for completing tasks safely, and reporting any unsafe acts or conditions to his/her supervisor. No person may work in a manner that conflicts with these procedures.

All personnel will receive site-specific safety orientation and training in accordance with applicable regulations and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. In addition, all personnel will attend an initial hazard briefing prior to beginning work at the site.

The roles of site personnel are outlined in the following sections. Key project personnel and contacts are summarized below in Table 1.

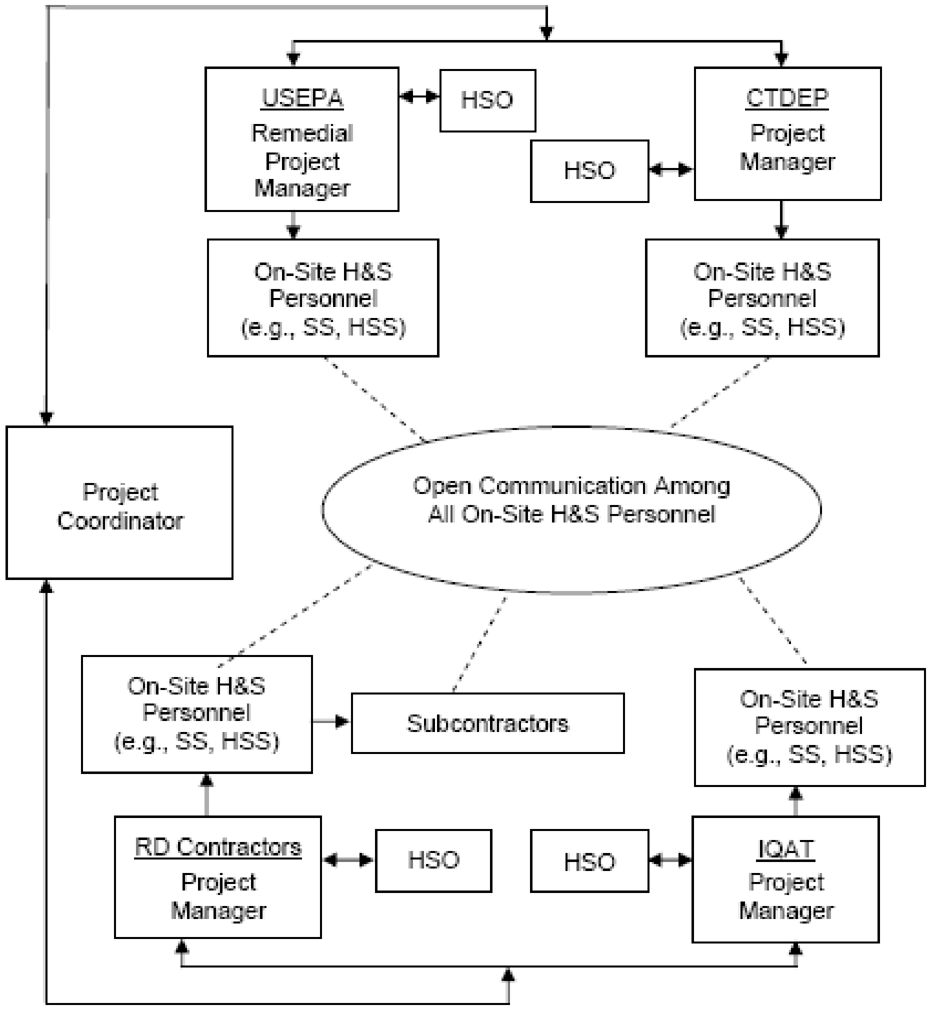
Table 1 – Key Personnel

Firm/Agency	Role	Name	Position/Title	Address/Telephone No.
USEPA	Federal Regulatory Agency	Karen Lumino	Remedial Project Manager	EPA Region 1 Office of Site Remediation and Restoration (OSRR) CT Superfund Section 5 Post Office Square, Suite 100 Mail Code OSRR07-4 Boston, MA 02109 617.918.1348
CTDEP	State Regulatory Agency	Ryan Santos	Project Manager	CTDEP Bureau of Water Management 79 Elm Street Hartford, CT 06106 860.424.3865

Firm/Agency	Role	Name	Position/Title	Address/Telephone No.
de maximis, inc.	Supervising Contractor, Project Coordinator, Independent Quality Assurance Team (IQAT)	Bruce Thompson	Project Coordinator	200 Day Hill Road Suite 200 Windsor, CT 06095 860.298.0541
		John Hunt	Project Manager	
		Brandon Pizzoferrato	IQAT Manager	
ARCADIS	Remedial Design (RD) Contractor	Jeffrey S. Holden	Project Manager	160 Chapel Road, Suite 201 Manchester, CT 06042 860.533.9906
		Chuck Webster	Health and Safety Officer	6723 Towpath Road P.O. Box 66 Syracuse, NY 13214-0066 315-671-9297
		Dave Cornell	Site Supervisor, Health and Safety Supervisor	6723 Towpath Road P.O. Box 66 Syracuse, NY 13214-0066 315.671.9379
TerraTherm, Inc.	In-Situ Thermal Remediation (ISTR) Contractor	John LaChance	Project Manager	10 Stevens Road Fitchburg, MA 01420 978.343.0300 jlachance@terratherm.com
Weston Solutions, Inc.	RD Support Contractor and Hydraulic Containment and Treatment System (HCTS) Operator	Erin Kinney	Senior Project Manager	148 Eastern Boulevard Glastonbury, CT 06033 860.368-3200
		Bryce Fletcher	Project Engineer	43 Constitution Avenue Suite 2 West Bedford, NH 03110 603.656.5414
		Ralph Fletcher	Groundwater Treatment Facility Operator	453 North Main Street PMB No. 189 Southington, CT 06489-2521 860.621.5263

2.2 Site Personnel

The following sections discuss the roles and responsibilities of site personnel. Communication between the various parties is depicted in the following chart:



2.2.1 Contractor Health and Safety Officer (HSO)

Each contractor must designate an HSO to assume overall responsibility for the technical health and safety aspects of the project, including review and approval of the contractor’s site-specific HASP. Inquiries regarding health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSO or his designee must approve changes or addenda to this HASP. The HSO does not necessarily have to remain on site during work activities. Each contractor’s HSO will be point of contact for health and safety issues that arise for their respective employees. All HSOs will be responsible for notifying the Project Coordinator (see Table 1) in the event a health and safety issue or emergency arises.

2.2.2 Contractor Project Manager (PM)

Each contractor must designate a PM to be responsible for verifying that project activities are completed in accordance with the requirements of this HASP. The PM is responsible for confirming that the Contractor Health and Safety Supervisor (HSS) has the equipment, materials, and qualified personnel to fully implement the safety requirements of this HASP, and/or that contractors and subcontractors assigned to this project meet the requirements established in this HASP. It is also the responsibility of the PM to:

- Consult with the HSO regarding on-site health and safety issues.
- Verify that subcontractors meet health and safety requirements prior to commencing work.
- Verify that all incidents are thoroughly investigated.
- Approve, in writing, addenda or modifications to this HASP.
- Suspend work or modify work practices, as necessary, for personal safety, protection of property, and regulatory compliance.

2.2.3 Contractor Health and Safety Supervisor (HSS)

Each contractor must designate an HSS to be responsible for field health and safety issues, including the execution of this HASP. Questions in the field regarding health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSS will advise the PM on health and safety issues and will establish and coordinate the project air monitoring program if one is deemed necessary (see Section 6.1, Air Monitoring). Each contractor’s HSS is the primary site contact for that organization on health and safety matters. It is the responsibility of the HSS to:

- Provide on-site technical assistance, if necessary.
- Participate in all incident investigations (IIs) and confirm that they are reported to the HSO, PM and project coordinator within 24 hours.
- Coordinate site and personal air monitoring, as required, including equipment maintenance and calibration.
- Conduct site safety orientation training and safety meetings.
- Verify that site personnel have received the required physical examinations and medical certifications.
- Review site activities with respect to compliance with this HASP.
- Maintain required health and safety documents and records.
- Assist the SS in instructing field personnel on project hazards and protective procedures.

2.2.4 Contractor’s Site Supervisor (SS)

Each contractor must designate an SS to be responsible for implementing this HASP, including communicating requirements to on-site personnel. The SS will be responsible for informing the PM of changes in the Work Plan, procedures, or site conditions so that those changes may be addressed in this HASP. Other responsibilities are to:

- Consult with the HSS on site health and safety issues.
- Stop work, as necessary, for personal safety, protection of property, and regulatory compliance.
- Obtain a site map and determine and post emergency telephone numbers and routes to medical facilities.

- Notify local public emergency representatives (as appropriate) of the nature of the site operations, and post their telephone numbers (e.g., local fire department personnel who would respond for a confined space rescue).

- Observe on-site project personnel for signs of ill health effects.

- Investigate and report any incidents to the HSS.

- Verify that all on-site personnel have had applicable training.

- Verify that on-site personnel are informed of the physical, chemical, and biological hazards associated with the site activities, and the procedures and protective equipment necessary to control those hazards.

- Issue/obtain any required work permits (e.g., hot work, confined space).

2.2.5 Stop Work Authority

Every employee and subcontractor on site is empowered, expected, and responsible for stopping the work of another co-worker if the working conditions or behaviors are considered unsafe. No repercussions will result from this action. Site or project conditions that are possible reasons to stop work and to consider modifications to the HASP include:

- Site temperatures outside the range predicted in this HASP (possibly resulting in greater risk of heat or cold stress).

- Personal protective equipment (PPE) breakthrough or unexpected degradation.

- Unusual odors that cannot be identified.

- Unexplained, elevated readings on an organic vapor monitor.

- Unexpected changes in soil coloration or texture that might indicate undisclosed contamination.

This list is not comprehensive and should be used only as guidance.

2.3 All On-Site Personnel

All on-site personnel must read and acknowledge their understanding of this HASP before commencing work, and abide by the requirements of the plan. All on-site personnel shall sign the HASP Acknowledgement Form following their review of this HASP.

All personnel will receive training in accordance with applicable regulations and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. In addition, all on-site personnel will attend an initial hazard briefing prior to beginning work at the Site, as well as the daily safety meetings.

On-site personnel will immediately report the following to the SS or HSS:

- Personal injuries and illnesses no matter how minor.
- Unexpected or uncontrolled release of chemical substances.
- Symptoms of chemical exposure.
- Unsafe or hazardous situations.
- Unsafe or malfunctioning equipment.
- Changes in site conditions that may affect the health and safety of project personnel.
- Damage to equipment or property.
- Situations or activities for which they are not properly trained.
- Near misses.

2.4 Visitors

All visitors to work areas must check in with the SS and receive site-specific safety orientation training. Visitors will be cautioned to avoid skin contact with surfaces, soils, groundwater, or other materials that may impacted or be suspected to be impacted by constituents of concern (COC).

Visitors requesting to observe work at the site must don appropriate PPE prior to entry to the work area and must have the appropriate training and medical clearances to do so. If respiratory protective devices are necessary, visitors who wish to enter the work area must have been respirator-trained and fit-tested for a respirator within the past 12 months.

3. Project Hazards and Control Measures

3.1 Scope of Work

The scope of work is expected to include the following tasks:

- Mobilization
- Clearing and Grubbing
- Field Survey
- Monitoring Well Installation
- Monitoring Well Abandonment
- Groundwater Sampling/NAPL Recovery
- Soil Sampling
- Excavation
- Waste Handling and Loading
- Cleanup
- Soil Gas Sampling
- Indoor Air Sampling
- Decontamination
- Demobilization

The hazards, COCs, and control techniques specific to each task are presented in the following sections.

The contractor's HSS and SS must routinely monitor operations in the course of work activity to provide compliance with the requirements of this plan. Many or most of the field tasks will be conducted individually; however, there may times that individuals are working on various tasks simultaneously. In all cases, operations will be conducted under the direction of the contractor's HSS and/or SS in compliance with the requirements of this plan.

3.2 Field Activities, Hazards, and Control Procedures

The following task safety analyses (TSAs) identify potential health, safety, and environmental hazards associated with each type of field activity. Because of the complex and changing nature of field projects, supervisors must continually inspect the site to identify hazards that may affect on-site personnel, the community, or the environment. Contractor SSs must be aware of these changing conditions and discuss them with the appropriate PM whenever these changes impact employee health, safety, the environment, or performance of the project. The contractor SSs will keep on-site personnel informed of the changing conditions, the HSO and PM will write and/or approve addenda or revisions to this HASP, as necessary. A TSA will be prepared by the contractor employees who will perform the task in basic three column format (see Appendix D-1) for each safety critical task to be performed. TSAs should be reviewed and updated daily or as conditions change.

3.2.1 Mobilization

All appropriate permits will be obtained by the PM or designee prior to starting this task.

Site mobilization and area reconnaissance will include establishing staging and decontamination locations, determining the location of utilities and other installations, and establishing work areas. Mobilization may also include setting up equipment and establishing a temporary site office. A break area may be set up outside regulated work areas. Mobilization may involve clearing areas for the SZ and CRZ.

During this initial phase, the contractor’s PM will walk the site to confirm the existence of anticipated hazards and to identify safety and health issues that may have arisen since the writing of this plan. These activities will be coordinated with Supervising Contractor personnel. The hazards of this phase of activity are associated with heavy equipment operation, manual materials handling, installation of temporary on-site facilities, and manual site preparation.

Manual materials handling and manual site preparation may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. Installation of temporary field office and support facilities may expose personnel to electrical hazards, underground and overhead utilities, and physical injury due to the manual lifting and moving of materials. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

Environmental hazards include plants such as poison ivy and poison oak; aggressive fauna such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens such as rabies, Lyme disease, and blood-borne pathogens.

Control procedures for these hazards are discussed in Section 4, General Safety Practices. In addition, the following precautions will be followed:

- (ASTM International [ASTM] 2412 and F2413) approved safety footwear with a rugged sole will be used.

- Everyone who enters an unlighted area will have a flashlight or other portable light source available.

- Entrants will continually monitor their location and be aware of the closest exit route.

- Entrants will avoid contact with any biological waste material and will utilize universal precautions (PPE, personal hygiene, training) in the event that handling or sampling is necessary.

- A system to communicate with the on-site security (if necessary) will be available (radio or cellular phone).

3.2.2 Clearing and Grubbing

The proposed excavation areas will be marked in the field prior to any other fieldwork in order to identify any hazards that may be present.

Physical Hazards - The physical hazards involved with construction and removal relate to work done with heavy equipment, hand tools, and the environment itself. There exists a potential for incidents involving personnel struck by or struck against powered equipment, timber, or materials, which could result in fractures, cuts, punctures, or abrasions. Walking and working surfaces during construction activities may involve slip, trip, and fall hazards. Working at elevations may also create a fall hazard.

Working Surfaces - Uneven terrain and slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls. All personnel should frequently inspect the area in which they are working and keep the area as clear as possible.

Powered Equipment Operations - Site workers are exposed to serious hazards during construction and excavation when using powered equipment. Workers may be struck by blades or by material thrown by powered equipment.

Materials Handling - The most common type of accident that occurs in material-handling operations is the “caught between” situation when a load is being handled, and a finger or toe gets caught between two objects. Extreme care must be taken when loading and unloading material. Proper lifting technique must be employed, and mechanical means must be used to lift objects whenever possible.

Health Hazards - Due to the type of work involved in excavation and clearing, the primary health hazards involve potential exposure to site contaminants, repetitive motion disorders, lifting, and other ergonomic stressors. Noise may also present a hazard. Operation of heavy equipment and power-actuated and pneumatic hand tools frequently results in high noise levels.

Control - Prior to the start of excavation and removal activities, the operation will be reviewed with all employees. Hazards will be identified, and protective measures will be explained, including the appropriate level of PPE. Equipment will be inspected and in proper working condition prior to use. Inspections will be conducted at the beginning of each shift and documented on Equipment Inspection Forms (provided by each contractor for their respective equipment; an example form is included in Appendix D-2). Employees will receive training to address the equipment and its operation and care. Personnel should be scheduled in a manner to reduce the likelihood of performing repetitive tasks for prolonged periods. Technical assistance should be provided for large lifting tasks. Hearing protection is required for use when personnel are exposed to noise levels exceeding 85 dBA or a level that commonly results in difficult conversation. Air monitoring (as described in Section 6) will be implemented to evaluate the airborne exposure levels and adequacy of specified PPE.

3.2.3 Monitoring Well Installation

Groundwater monitoring wells will be installed using a standard drill rig and a Geoprobe® will be used to collect soil borings. Hazards and controls associated with the use of both pieces of equipment are similar and are outlined below.

In addition to the hazards discussed below, inhalation exposure to silica sand and concrete dust during the monitoring well construction process are possible. Workers must be aware of such hazards and employ safe work practices (e.g., standing upwind) when handling said materials.

3.2.3.1 Drilling Hazards

The primary physical hazards for this activity are associated with the use of the drilling rig. Rig accidents can occur as a result of improperly placing the rig on uneven or unstable terrain, or failing to adequately secure the rig prior to the start of operations. Underground and overhead utility lines can create hazardous conditions if contacted by drilling equipment. Tools such and equipment such as elevators, cat lines, and wire rope have the potential for striking, pinning, or cutting personnel.

Wire Rope – Worn or frayed wire rope presents a laceration hazard if loose wires protrude from the main bundle.

Cat Lines – Cat lines are used on drilling rigs to hoist material. Accidents that occur during cat line operations may injure the employee doing the rigging as well as injure the operator. Minimal hoisting control causes sudden and erratic load movements, which may result in hand and foot injuries.

Working Surfaces – Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls.

Materials Handling – The most common type of accident that occurs in material handling operations is the "caught between" situation when a load is being handled and a finger or toe gets caught between two objects. Rolling stock can shift and/or fall from a pipe rack or truck bed.

3.2.3.2 Drilling Safety Procedures

Drill Crews – All drillers must possess required state or local licenses to perform such work. All members of the drill crew shall receive site specific training prior to beginning work.

The driller is responsible for the safe operation of the drill rig as well as the crew's adherence to the requirements of this HASP. The driller must ensure that all safety equipment is in proper condition and is properly used. The members of the crew must follow all instructions of the driller, wear all personal protective equipment, and be aware of all hazards and control procedures. The drill crew must participate in the daily safety meeting and be aware of emergency procedures.

Rig Inspection – Each day, prior to the start of work, the drill rig and associated equipment must be inspected by the driller and/or drill crew. Inspections must be documented. The following items must be inspected:

- Vehicle condition
- Proper storage of equipment
- Condition of all wire rope
- Condition of all drill rods and internal threads
- Fire extinguisher
- First aid kit

Drill Rig Set Up – The drill rig must be properly blocked and leveled prior to raising the derrick. The wheels which remain on the ground must be chocked. The leveling jacks shall not be raised until the derrick is lowered. The rig shall be moved only after the derrick has been lowered.

All well sites will be inspected by the driller prior to the location of the rig to verify a stable surface exists. This is especially important in areas where soft, unstable terrain is common.

The drill rig must be properly blocked and leveled prior to raising the derrick. Blocking provides a more stable drilling structure by evenly distributing the weight of the rig. Proper blocking ensures that differential settling of the rig does not occur.

When the ground surface is soft or otherwise unstable, wooden blocks, at least 24" by 24" and 4" to 8" thick shall be placed between the jack swivels and the ground. The emergency brake shall be engaged, and the wheels that are on the ground shall be chocked.

Site Drilling Rules – Before drilling activities commence, the existence and location of underground pipe, electrical equipment and gas lines and other utilities must be determined. Connecticut’s Call Before You Dig (CBYD) must be contacted at least 3 business days, but no more than 2 weeks, prior to subsurface activities. The SS will meet with all underground utility representatives on site prior to marking out the underground utilities. During this meeting, the SS will provide the underground utility representatives with a site figure showing the locations where drilling activities will be completed. The SS will conduct a site walkover with the underground utility representatives to visually identify each location where intrusive activities are to be completed during site operations. The Underground/Overhead Utility Checklist (see Appendix D-3) will be used to document that nearby utilities have been marked on the ground and that excavation and/or drilling areas have been cleared. The completed Underground/Overhead Utility Checklist will be in the possession of the SS prior to commencing any intrusive investigation.

Combustible gas readings of the general work area will be made regularly in areas where, and/or during operations when, the presence of flammable vapors or gases is suspected, such as during intrusive activities (see Section 6). Operations must be suspended and corrective action taken if the airborne flammable concentration reaches 10% of the lower explosive limit (LEL) in the immediate area (a one-foot radius) of the point of drilling, or near any other ignition sources.

Under no circumstances will personnel be permitted to ride the traveling block or elevators, nor will the catline be used as a personnel carrier.

Overhead Electrical Clearances – If drilling is conducted in the vicinity of overhead power lines, the power to the lines must be shut off or the equipment must be positioned and blocked such that no part, including cables can come within the minimum clearances as follows:

Table 2 – Minimum Overhead Electrical Clearances (All Equipment)

Nominal System Voltage	Minimum Required Clearance
0 – 50 kilovolts (kV)	10 feet
51 – 100kV	12 feet
101 – 200kV	15 feet
201 – 300kV	20 feet
301 – 500kV	25 feet
501 – 750kV	35 feet
751 – 1,000kV	45 feet

When the drill rig is in transit, with the boom lowered and no load, the equipment clearance must be at least 4 feet for voltages less than 50kV, 10 feet for voltages of 50 kV to 345 kV, and 16 feet for voltages above 345 kV.

Hoisting Operations – Drillers should never engage the rotary clutch without watching the rotary table, and ensuring it is clear of personnel and equipment.

- Unless the drawworks is equipped with an automatic feed control, the brake should not be left unattended without first being tied down.

- Drill pipe, auger strings or casing should be picked up slowly. Drill pipe should not be hoisted until the driller is sure that the pipe is latched in the elevator, or the derrickman has signaled that he may safely hoist the pipe.

- During instances of unusual loading of the derrick or mast, such as when making an unusually hard pull, only the driller should be on the rig floor; no one else should be on the rig or derrick.

- The brakes on the drawworks of the drill rig should be tested by the driller each day. The brakes should be thoroughly inspected by a competent individual each week.

- A hoisting line with a load imposed should not be permitted to be in direct contact with any derrick member or stationary equipment, unless it has been specifically designed for line contact.

- Workers should never stand near the borehole whenever any wire line device is being run.

- Hoisting control stations should be kept clean and controls labeled as to their functions.

Catline Operations – Only experienced workers will be allowed to operate the cathead controls. The kill switch must be clearly labeled and operational prior to operation of the catline. The cathead area must be kept free of obstructions and entanglements. The following are some additional guidelines:

- The operator should not use more wraps than necessary to pick up the load. More than one layer of wrapping is not permitted.

- Personnel should not stand near, step over, or go under a cable or catline which is under tension.

- Employees rigging loads on catlines shall:

    - Keep out from under the load.

    - Keep fingers and feet where they will not be crushed.

    - Be sure to signal clearly when the load is being picked.

    - Use standard visual signals only and not depend on shouting to coworkers.

    - Make sure the load is properly rigged, since a sudden jerk in the catline will shift or drop the load.

Wire Rope – When two wires are broken or rust or corrosion is found adjacent to a socket or end fitting, the wire rope shall be removed from service or resocketed. Special attention shall be given to the inspection of end fittings on boom support, pendants, and guy ropes. The following are some additional guidelines. Rigging selection use and inspection must conform to the requirements OSHA 1926 Subpart H.:

- Wire rope removed from service due to defects shall be cut up or plainly marked as being unfit for further use as rigging.

- Wire rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope; the clip nuts shall be re-tightened immediately after initial load carrying use and at frequent intervals thereafter.

- When a wedge socket fastening is used, the dead or short end of the wire rope shall have a clip attached to it or looped back and secured to itself by a clip; the clip shall not be attached directly to the live end.

- Protruding ends of strands in splices on slings and bridles shall be covered or blunted.

- Except for eye splices in the ends of wires and for endless wire rope slings, wire rope used in hoisting, lowering, or pulling loads, shall consist of one continuous piece without knot or splice.

- An eye splice made in any wire rope shall have not less than five full tucks.

- Wire rope shall not be secured by knots. Wire rope clips shall not be used to splice rope.

- Eyes in wire rope bridles, slings, or bull wires shall not be formed by wire clips or knots.

Pipe/Auger Handling – Pipe and auger sections shall be transported by cart or carried by two persons. Individuals should not carry auger or pipe sections without assistance. The following are some additional guidelines:

- Workers should not be permitted on top of the load during loading, unloading, or transferring of pipe or rolling stock.

- Employees should be instructed never to try to stop rolling pipe or casing; they should be instructed to stand clear of rolling pipe.

- Slip handles should be used to lift and move slips. Employees are not permitted to kick slips into position.

- When pipe is being hoisted, personnel should not stand where the bottom end of the pipe could whip and strike them.

- Pipe and augers stored in racks, catwalks or on flatbed trucks should be secured to prevent rolling.

3.2.3.3 Well Development Hazards and Controls

Field operations will include the development of wells after installation to improve the well's hydraulic connection with the aquifer.

Hazards – The physical hazards of monitoring well development are primarily associated with manipulating and operating the pump and its associated equipment. Other physical hazards of this phase of activity are associated with site conditions and manual materials handling. Equipment operation may present noise, vibration and electrical hazards, and the potential for employee contact with hot surfaces. Manual materials handling may cause blisters, sore muscles, and joint and/or skeletal injuries. The work area may present slip, trip, and fall hazards from scattered debris and wet or irregular walking surfaces. Wet weather may cause wet, muddy, and/or slick walking surfaces. Exposure to soil and water containing COCs is also possible.

Environmental hazards include plants, such as poison ivy and poison oak; aggressive fauna, such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood-borne pathogens.

Control – To control dermal exposure during well development activities, a minimum of Modified Level D protection will be worn. If necessary, based on field observations and site conditions, air monitoring may be conducted during groundwater sampling and monitoring activities to assess the potential for exposure to airborne COCs. If the results of air monitoring indicate the presence of organic vapors in a concentration causing concern, personnel will upgrade to Level C protection. Section 6.1 (Air Monitoring), describes air monitoring requirements and action levels. Each level of PPE is described in Section 5 (Personal Protective Equipment). Control procedures for environmental and general hazards are discussed in Section 4 (General Safety

Practices). Protection from electrical shock hazards shall be in accordance with the provisions of OSHA 1926 subpart K.

3.2.4 Monitoring Well Abandonment

This activity includes tremie grouting the bedrock portions of select existing bedrock monitoring wells with neat cement grout; overdrilling the well with a hollow-stem auger; and tremie grouting the borehole to ground surface. The abandonment of select overburden monitoring wells will involve tremie grouting the boreholes to ground surface. The primary hazards with this activity include exposure to the grout and the constituents of concern in the groundwater, as well as the hazards associated with drilling (see Sections 3.2.3.1 and 3.2.3.2).

Pumps used in pumping the cement grout into the monitoring well will be properly grounded if electric; all pipes, tubing, or hoses will be intact to minimize the possibility of an explosive release of grout.

Hazards – The physical hazards of these operations are primarily associated with drilling and the manipulation and operation of the pump and its associated equipment. Other physical hazards of this phase of activity are associated with Site conditions and manual materials handling. Equipment operation may present noise hazards, vibration hazards, and potential for employee contact with hot surfaces. Manual slurry handling may cause blisters, sore muscles, and joint and/or skeletal injuries. The work area may present slip, trip, and fall hazards from scattered debris and wet or irregular walking surfaces. Wet weather may cause wet, muddy, and/or slick walking surfaces.

Control – For monitoring well abandonment, Modified Level D protection will be used unless, based on air monitoring and Site conditions, the SS determines that a higher level of protection is necessary. Air sampling may be conducted to assess the potential exposure to COC. If the results of air monitoring indicate COC at a concentration causing concern, based on Section 6 (Air Monitoring), personnel will upgrade to Level C protection. Refer to Section 6 (Air Monitoring) for a description of requirements and action levels. A description of each level of PPE protection is included in Section 5 (Personal Protective Equipment). In addition, inhalation exposure to silica sand and concrete dust during the monitoring well abandonment process are possible. Workers must be aware of such hazards and employ safe work practices (e.g., standing upwind) when handling said materials.

3.2.5 Groundwater Sampling/NAPL Recovery

Groundwater sampling will involve uncapping, purging (pumping water out of the well), sampling, and monitoring, new or existing monitoring wells. Recovery of non-aqueous phase liquid (NAPL) will also be done using similar procedures. A mechanical pump may be used to purge the wells and can be hand-, gas-, or electric-operated. Water samples taken from the wells are then placed in containers and shipped to an analytical laboratory for analysis. The physical hazards of these operations are primarily associated with the sample collection methods and procedures used.

NAPL monitoring and removal (if necessary) will involve uncapping, purging (pumping or bailing NAPL out of the well), and monitoring new and existing monitoring wells. A mechanical pump may be utilized to remove NAPL and can be electric or hand-operated. Any NAPL recovered from the monitoring wells will be disposed of in 55-gallon drums. Hazards associated with this activity are primarily associated with contact with NAPL.

Hazards – Inhalation and absorption of COCs are the primary routes of entry associated with groundwater sampling, due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. A potential also exists for splashing of groundwater onto the employee. During this project, several different groundwater sampling methodologies may be used based on equipment accessibility and the types of materials to be sampled. These sampling methods may include hand, electrical or mechanical bailing. The primary hazards associated with these specific sampling procedures are not potentially serious; however, other operations in the area or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with groundwater sampling procedures are generally limited to strains or sprains from hand bailing, and potential eye hazards. Exposure to water containing COCs is also possible.

The flora and fauna of the site may present hazards of poison ivy, poison oak, ticks, fleas, mosquitoes, wasps, spiders, and snakes. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil. Freezing-weather hazards include frozen, slick and irregular walking surfaces.

Control – To control dermal exposure during groundwater sampling activities, a minimum of modified Level D protection will be worn. If necessary, based on field observations and site conditions, air monitoring may be conducted during groundwater sampling to assess the potential for exposure to airborne COCs. If the results of air monitoring indicate the presence of organic vapors in a concentration causing concern, personnel will upgrade to Level C protection. Section 6.1 (Air Monitoring) describes air monitoring requirements and action levels. Each level of personal protection is described in Section 5 (Personal Protective Equipment). Control procedures for environmental and general hazards are discussed in Section 4 (General Safety Practices).

3.2.6 Soil Sampling

This task involves collecting soil samples (subsurface) for subsequent analysis and evaluation of potential impact by COCs. The physical hazards of these operations are primarily associated with the sample collection methods and procedures used. In addition, personnel may be exposed to hazards associated with heavy equipment.

Hazards – Inhalation and absorption of COCs are the primary routes of entry associated with soil sampling due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. During this project, samples will be collected primarily via direct push drilling. Hand augering to depths of up to 5 feet below ground surface (bgs) will also occur. The primary hazards associated with this sampling procedure are not potentially serious; however, other operations in the area, or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with soil sampling procedures are generally limited to strains or sprains, and potential eye hazards. Exposure to soil containing COCs is also possible. Employees may be exposed to sharp edges and blades during the cutting of plastic tubing surrounding core samples. In addition to the safety hazards specific to sampling operations, hazards associated with the operation of vehicles (especially large vehicles with limited operator visibility), is a concern. Of particular concern will be the backing up of trucks, excavation equipment, and other support vehicles.

The flora and fauna of the site may present hazards of poison ivy, poison oak, ticks, ants, fleas, mosquitoes, wasps, spiders, and snakes. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

Control – To control dermal exposure during soil sampling activities, a minimum of Modified Level D protection will be worn. Avoid laying tools and equipment on the ground to avoid contact with native poisonous or irritating flora and fauna. If necessary, based on field observations and site conditions, air monitoring may be conducted during soil sampling activities to assess the potential for exposure to airborne COCs. If the results of air monitoring indicate the presence of organic vapors in a concentration causing concern, personnel will upgrade to Level C protection. Each level of personal protection is described in Section 5 (Personal Protective Equipment). Control procedures for environmental and general hazards are discussed in Section 4 (General Safety Practices).

3.2.7 Excavation – Hazards and Control Procedures

The physical hazards involved in the excavation of soils are related to the excavation itself and the operation of heavy equipment. The presence of overhead utilities such as power lines requires careful positioning of the excavating equipment in order to maintain a safe distance between the lines and the closest part of the equipment. The presence of underground utilities such as gas lines, power lines, water lines, and sewer pipes must be determined prior to beginning the excavation.

Excavations pose significant hazards to employees if they are not carefully controlled. There exists a chance for the excavation to collapse if it is not dug properly, sloped, benched, or shored as required by 29 CFR 1926 Subpart P. Protective systems, as required by 29 CFR 1926 Subpart P, must be utilized if the potential for hazardous cave-ins exists. The excavation also is a fall hazard, and employees must pay careful attention to what they are doing or they risk a fall into the excavation. Fall protection, as required by 29 CFR 1926 Subpart M, will be required. Excavations may also constitute confined spaces in which hazardous atmospheres may develop based on their size and configuration. Special provision as detailed in OSHA 1910.146 & 1926.21 are applicable. Each excavation shall be monitored by a competent person and must be evaluated prior to considering allowing personnel to enter for any reason.

Personnel should not enter excavations unless they are required to do so and no remote options are available. All activities shall be done remotely, without entering the excavation, to the extent feasible.

Noise also may present a hazard. Heavy equipment operation frequently results in noise levels exceeding 85 dBA, requiring the use of hearing protection.

At the end of each work day, open test-pit excavations will be backfilled or covered and guarded, and equipment will be moved to a location away from high-voltage electrical equipment and away from routes necessary to access high-voltage electrical equipment.

Airborne concentrations of COC in the site soil and the dust from the excavation procedure pose the potential for inhalation exposure. PPE for this phase is described in Section 5 (Personal Protective Equipment). Airborne particulate generation will be controlled during site excavations. Dry, dusty soil will be wetted with a water spray from a potable water source to control the generation of dust. Soil will not be wetted to a degree that will cause runoff or erosion.

Before excavation activities commence, the existence and location of underground pipe, electrical equipment, and gas lines shall be determined. At a minimum excavators must comply with the Regulations of the Connecticut State Agencies as detailed in the CBYD Excavator’s Manual. This will be done, if possible, by contacting the appropriate client representative and having him/her mark the location of the lines. If the client’s knowledge of the area is incomplete, an appropriate device, such as a magnetometer, will be used to locate the line. An Underground/Overhead Utility Checklist, (an example is presented in Appendix D-3), shall be used to document that nearby utilities have been marked on the ground and that the excavation areas have been cleared. The completed checklist will be in the possession of the SS prior to commencement of any intrusive investigation.

All excavation activities shall be conducted in accordance with 29 CFR 1926 Subpart P. If excavation operations are located near underground installations, the exact location of the installations must be determined by safe and acceptable means. While the excavation is open, underground installations must be protected, supported, or removed, as necessary, to safeguard employees.

A license will be required to operate any equipment that meets or exceeds **ALL** of the following criteria:

1. Motorized Equipment
2. Used in construction, demolition or excavation work
3. At a construction site of a project that
    a. Is other than residential structures of less than four stories and
    b. Estimated cost of which is more than $1,250,000
4. With manufacturer’s rated lifting capacity exceeding 5 tons
5. Manufacturer’s rated maximum reach in excess of 32 feet

3.2.7.1 Inspections by a Competent Person

Daily inspections of excavations, the adjacent areas, and protective systems must be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection must be conducted by the competent person prior to the start of work and as needed throughout the shift (an example Periodic Excavation Inspection Form is presented in Appendix D-4).

Inspections also must be made after every rainstorm or other hazard-increasing occurrence. These inspections are required only when employee exposure can be reasonably anticipated. Where the competent person finds evidence of a situation that could result in a possible cave-in, or indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees must be removed from the hazardous area until the necessary precautions have been taken to maintain their safety.

Walkways must be provided where employees or equipment are required or permitted to cross over excavations. Guardrails that comply with 1926.502(b) must be provided. Adequate barrier protection must be provided at all remotely located excavations. All wells, pits, shafts, and other similar excavations must be barricaded or covered. Upon completion of exploration and other similar operations, temporary wells, pits, shafts, and other similar excavation must be backfilled.

3.2.7.2 Soil Classification

29 CFR 1926 Subpart P, Appendix A describes methods of classifying soil and rock deposits based on site and environmental conditions and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils. This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in 1926.652(b)(2) as a method to protect employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with Appendix C to Subpart P of Part 1926, and when aluminum hydraulic shoring is designed in accordance with 29 CFR Subpart P Appendix D. This appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in 1926.652(c), and the use of the data are predicated on the use of the soil classification system set forth in Appendix A of 29 CFR 1926.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V). Short-term exposure means that an excavation is open for a period of time less than or equal to 24 hours. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from Table 3. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope that is at least one-half horizontal to one vertical (1/2H:1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope, and must assure that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P Appendix B.

Table 3 – 29 CFR 1926 Subpart P Appendix B - Maximum Allowable Slopes

Soil or Rock Type	Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[2]
Stable Rock	Vertical (90 degrees)
Type A[3]	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1½:1(34 degrees)

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. Sloping or benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.
3. A short-term maximum allowable slope of 1/2H:1V (63 degrees) is allowed in excavations in Type A soil that are 12 feet (3.67 meters 9 [m]) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be 3/4H:1V (53 degrees).

3.2.7.3 Overhead Electrical Clearances

If excavation activities are conducted in the vicinity of overhead power lines, the power to the lines must be de-energized, tested de-energized, marked up/guaranteed, and grounded, or the equipment must be positioned such that no part, including excavation boom, can come within the minimum clearances (as shown in Table 2 in Section 3.2.3.2).

If the above minimum clearances cannot be maintained, the following controls shall be instituted at the site to protect against live electrical conductors:

- Portable rubber protective equipment (blankets, hose, hoods, etc.) and/or barriers of approved material shall be placed to completely eliminate any possibility of contact with exposed live parts.

- When placing and removing protective equipment, and until and unless such complete protection is provided, workers shall wear the necessary personal protective equipment, including approved insulating gloves with arm gauntlets, hard hat, and body protection.

3.2.7.4 Excavation Entry Procedure

Persons entering an excavation must do so under controlled conditions and in accordance with the provisions detailed in1926 Subpart P. The excavation must be properly sloped, benched, or shored, and ladders or ramps must be available every 25 feet laterally in the excavation. Each entry shall have an attendant who observes the entrant(s) and is prepared to render assistance. The only excavations planned for RD are expected to be small and shallow; therefore, entry is not anticipated.

Duties of Workers Entering an Excavation

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants and pre entry atmospheric monitoring and Confined Space Entry permit requirements.

- Communicate with the attendant, as necessary, to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space.

- Alert the attendant whenever:

    - The entrant recognizes any warning sign or symptom of exposure to a dangerous situation.

    - The entrant detects a prohibited condition.

- Exit from the excavation as quickly as possible whenever:

  - An order to evacuate is given by the attendant or the supervisor.
  - The entrant recognizes any warning sign or symptom of exposure to a dangers situation.
  - The entrant detects a prohibited condition.

Duties of Attendants

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants.
- Continuously maintains a count of entrants in the excavation.
- Remains outside the excavation during entry operations until relieved by another attendant.
- Communicates with authorized entrants as necessary to monitor entrant status to alert entrants of the need to evacuate the excavation under any of the following conditions:
  - The attendant detects a prohibited condition.
  - The attendant detects the behavioral effects of hazard exposure in an entrant.
  - The attendant detects a situation outside the excavation that could endanger the entrants.
  - The attendant cannot effectively and safely perform his duties.
- Summon rescue and other emergency services if the attendant determines that entrants may need assistance to evacuate the excavation.

3.2.8 Waste Handling & Loading

Removal activities, including the loading of drums (see Section 3.2.9), will be coordinated with the appropriate parties according to the properties of the waste material. Waste handling and loading will be conducted in accordance with the methodology described in the standard operating procedure (SOP) provided in the *Remedial Design Quality Assurance Project Plan* (QAPP), which is provided as Attachment C to the *Remedial Design Project Operations Plan*.

Physical Hazards – The physical hazards involved with debris loading relate to work done with heavy equipment, limited clearance, and the environment itself. There exists a potential for incidents involving personnel struck by or struck against powered equipment, timber, or materials, which could result in fractures, cuts, punctures, or abrasions. Walking and working surfaces during construction activities may involve slip, trip, and fall hazards. Working at elevations may also create a fall hazard.

Working Surfaces – Uneven terrain and slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls. All personnel should frequently inspect the area in which they are working, and keep the area as clear as possible.

Powered Equipment Operations – Site workers are exposed to serious hazards during construction and excavation when using powered equipment. Workers may be struck by blades or by material thrown by powered equipment.

Materials Handling – The most common type of accident that occurs in material-handling operations is the “caught between” situation when a load is being handled, and a finger or toe gets caught between two objects. Extreme care must be taken when loading and unloading material. Proper lifting technique must be employed, and mechanical means must be used to lift objects whenever possible.

Health Hazards – Due to the type of work involved in concrete removal activities, the primary health hazards involve potential exposure to site contaminants, repetitive motion disorders, lifting, and other ergonomic stressors. Noise may also present a hazard. Operation of heavy equipment and power-actuated and pneumatic hand tools frequently results in high noise levels.

Control – Prior to the start of debris removal activities, the operation will be reviewed with all employees. Only trained, qualified personnel will be allowed to operate equipment. Hazards will be identified, and protective measures will be explained, including the appropriate level of PPE. Equipment will be inspected and in proper working condition prior to use. A clear line of sight and/or a means of communication will be maintained between personnel in the area and the equipment operator at all times. Inspections will be conducted at the beginning of each shift and documented on the attached Equipment Inspection Form. Employees will receive training to address the equipment and its operation and care. Personnel should be scheduled in a manner to reduce the likelihood of performing repetitive tasks for prolonged periods. Technical assistance should be provided for large lifting tasks. Hearing protection is required for use when personnel are exposed to noise levels exceeding 85 dBA or a level that commonly results in difficult conversation. Air monitoring (as described in Section 6) will be implemented to evaluate the airborne exposure levels and adequacy of specified PPE.

3.2.9 Drum Handling Procedures

It may be necessary to stage waste drums throughout the area to containerize waste materials for subsequent disposal. These drums will be removed for disposal to an off-site facility by the waste vendor. It is anticipated that all materials will be handled in bulk containers; however, if waste drums are required, the following procedures will be followed.

Physical Hazards – The physical hazards involved with drum handling relate to work done with powered equipment, hand tools, or a drum truck. There exists a potential for incidents involving personnel struck by or struck against powered equipment, a drum truck, or drums, which could result in fractures, cuts, punctures, or abrasions. To minimize the potential for these types of injuries, any drum weighing more than 40 pounds will be handled using a drum truck or powered equipment.

Powered Equipment Operations – Site workers are exposed to serious hazards during drum moving when using powered equipment. Workers may be struck by the machinery or by the drums carried by the machinery. Workers will remain in view of the machine operator and will remain outside the swing area. Drums carried by heavy machinery will be secured in the machine’s bucket by using a rope or other means.

Drum Handling – The most common type of accident that occurs in drum-handling operations is the “caught between” situation when a load is being handled, and a finger or toe gets caught between two objects. Extreme care must be taken when loading and unloading drums. Proper lifting technique must be employed, and mechanical means must be used to lift drums whenever possible. To minimize the potential of injuries, drums weighing more than 40 pounds will be handled using a drum truck or powered equipment.

Health Hazards – Due to the type of work involved in drum handling activities, the primary health hazards involve repetitive motion disorders, lifting, and other ergonomic stressors.

Control – Prior to the start of material handling activities, the operation will be explained to all employees. Hazards will be identified, and protective measures will be explained. Equipment will be inspected and in proper working condition. Employees should receive training to address the equipment and its operation and care. Only trained qualified personnel will be allowed to operate equipment. Personnel should be scheduled in a manner to reduce the likelihood of performing repetitive tasks for prolonged periods. Mechanical means of lifting and moving material should be substituted for manual movement of material whenever possible.

3.2.10 Cleanup and Site Restoration

Site restoration will involve cleanup and removal of any contaminated materials generated during RD activities. After complete removal of all contaminated materials, the areas of the Site in which work was completed will be restored to previous conditions (e.g., grading, surface cover).

Physical Hazards – The primary physical hazards associated with this task include working with relatively large heavy equipment that utilizes high pressure for cleaning. Ergonomic strain from forceful exertion and awkward posture will pose a risk to affected employees.

Health Hazards – There is very limited risk of exposure to hazardous materials from this task. Health hazards are primarily associated with heat stress and physical activity.

Control – Prior to the start of cleanup and restoration activities, the operation will be reviewed with all employees. Hazards will be identified, and protective measures will be explained, including the appropriate level of PPE. Equipment will be inspected and in proper working condition prior to use. Inspections will be conducted at the beginning of each shift and documented on the attached Equipment Inspection Form. Employees will receive training to address the equipment and its operation and care. Personnel should be scheduled in a manner to reduce the likelihood of performing repetitive tasks for prolonged periods. Technical assistance should be provided for large lifting tasks. Hearing protection is required for use when personnel are exposed to noise levels exceeding 85 dBA or a level that commonly results in difficult conversation. Air monitoring (as described in Section 6) will be implemented to evaluate the airborne exposure levels and adequacy of specified PPE.

3.2.11 Soil Gas Sampling

If determined necessary, soil gas samples will be collected outside existing buildings where shallow overburden groundwater volatile organic compound (VOC) concentrations result in excess cancer risks and/or non-cancer hazards above USEPA’s target risk range. Soil gas samples will be collected in either 1-liter or 6-liter SUMMA® canisters for the analysis of site-specific VOCs using USEPA Method TO-15. The list of site-specific VOCs will be identified based on the constituents previously detected in groundwater in or near the specific investigation area. Soil vapor samples will be installed as temporary points using the methodology described in the SOP provided in the QAPP, which is provided as Attachment C to the *Remedial Design Project Operations Plan*. Prior to collecting any samples, a helium test will be conducted to ensure the integrity of the seal around the probe point. The helium SOP is also provided in the QAPP. The location and number of soil gas samples will be determined based on the delineation of COCs within the shallow overburden groundwater plume, accessibility, and the proximity of occupied structures.

Sub-slab soil gas samples may be collected from buildings, if determined necessary based on soil gas results. Sub-slab soil gas samples will be collected in either 1-liter or 6-liter SUMMA® canisters for the analysis of site-specific VOCs using USEPA Method TO-15. The list of site-specific VOCs will be identified based on the constituents previously detected in groundwater or soil gas in the vicinity of the structure(s) being investigated. All sub-slab soil gas samples will be collected as temporary points unless soil gas data indicate that more than one round of sampling may be necessary (e.g., soil gas concentrations are higher than screening benchmarks). Under these conditions permanent sampling points may be established to allow for additional sub-slab samples to be collected. Sub-slab soil gas samples will be collected using the SOP for temporary sub-slab sampling points. If sub-slab soil gas samples are collected from permanent sampling points, the SOP for permanent sub-slab sampling points will be followed instead. Prior to collecting any samples, a helium test will be conducted to ensure the integrity of the seal around the probe point. All SOPs are included in the QAPP.

The location and number of sub-slab soil gas samples will be determined based on the delineation of COCs within the shallow overburden groundwater plume and the results of soil gas sampling. Once sampling is completed and prior to closing any temporary sample ports, a pressure differential reading will be collected at each sample location using a micro-manometer. All measurements will be collected consistent with the manufacturer's instructions.

Hazards – Inhalation and absorption (contact) of COCs are the primary routes of entry associated with soil gas sampling due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. The collection of soil gas samples will involve the use of direct push type boring equipment. The equipment poses a hazard if it is not properly operated. The equipment is hydraulically powered, and uses static force and dynamic percussion force to advance small-diameter sampling tools. The hazards directly associated with soil gas sampling procedures are generally limited to strains/sprains and potential eye hazards. Exposure to soil and water containing COCs is also possible. In addition to the safety hazards specific to sampling operations, hazards associated with the operation of vehicles are a concern. Of particular concern will be the backing up of trucks and other support vehicles. The presence of overhead utilities and underground obstacles poses a hazard if boring equipment contacts them.

The flora and fauna of the site may present hazards of poison ivy, poison oak, ticks, fleas, mosquitoes, wasps, spiders, and snakes (see Section 4.6). The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil.

Control – To control dermal exposure during soil gas sampling activities, a minimum of Modified Level D protection will be worn. Air monitoring will be conducted during soil gas sampling activities to assess the potential for exposure to airborne COCs. All soil gas extraction exhaust gases will be released a safe distance away from employees. If the results of air monitoring indicate the presence of organic vapors at a concentration causing concern, personnel will upgrade to Level C protection. Refer to Section 6.1 (Air Monitoring) for a description of air monitoring requirements and action levels. A description of each level of personal protection is included in Section 5 (Personal Protective Equipment). Control procedures for environmental and general hazards are discussed in Section 4 (General Safety Practices).

3.2.12 Indoor Air Sampling

Based on the results of sub-slab soil gas sampling, indoor air samples may be collected within target buildings. Indoor air samples will be collected in 6-liter SUMMA® canisters and analyzed for site-specific VOCs using USEPA Method TO-15. The list of site-specific VOCs will be identified based on the constituents previously detected in either groundwater or soil gas in the vicinity of the structure(s) being investigated. Prior to the collection of indoor air samples, a building inventory will be conducted to identify the presence of items or materials that may produce or emit constituents of concern (i.e., background sources) and therefore contribute to indoor air concentrations. Indoor air samples will be collected from the breathing zone (i.e., 3 to 5 feet above ground surface) from the lowest level of the building (i.e., basement or first floor for slab-on-grade buildings). Samples will be collected for a duration of 24 hours for residential buildings and 8 hours for commercial/industrial buildings. Attempts will be made to collect indoor air samples during the heating season (i.e., November 15 to March 31) because this represents the period of greatest vapor intrusion (VI) potential. Indoor air samples may be collected coincident with sub-slab soil gas samples and multiple sampling events may be employed if indoor air concentrations are above screening benchmarks. The SOP for indoor air sampling is presented in the QAPP*.*

The location and number of indoor air samples will be determined based on the delineation of COCs within the shallow overburden groundwater plume. Hazards for soil vapor, indoor air and ambient air sample collections are provided below.

Hazards – The primary physical hazards for air sampling activities involve slip, trip and fall hazards and inhalation, ingestion or transdermal exposure to potentially toxic constituents. Appropriate PPE, as specified in the HASP, must be worn.

Working Surfaces – Slippery or uneven work surfaces can increase the likelihood of back injuries, over extension injuries, and slips, trips and falls. All personnel should frequently inspect working surfaces and keep working surfaces clear of debris.

Material Handling – The most common type of accident that occurs in material handling operations is the “caught between” situations when a finger or toe gets caught between two objects. In addition, proper lifting techniques must be employed when handling the Summa® air canisters.

Control – A Risk Self Assessment (RSA) as described in the HASP will be performed prior to conducting soil vapor, indoor air or ambient air sampling activities. Appropriate PPE, as specified in the HASP, must be worn.

3.2.13 Equipment Decontamination

All equipment (e.g., hand tools, heavy equipment, etc.) that comes in contact with contaminated media (will be decontaminated and subject to visual inspection before it is removed from the site. In addition, all operations that have the potential to generate or release hazardous material will be conducted in a controlled area using the appropriate engineering controls. Specific decontamination techniques will be established based on site conditions. Decontamination procedures will be reviewed with all on-site personnel. The construction of a decontamination pad on a suitable surface (concrete or paved area) with polyethylene sheeting or other appropriate containment system is anticipated. Pressure washing with manual scrub brushing, as needed, will be used to decontaminate equipment. COC-impacted equipment will be determined “clean” through visual inspection.

The decontamination facility will be inspected on a daily basis for evidence of leaks or loss of integrity to the containment system. If any deficiencies are noted, they will be corrected immediately and documented. All wastewater that is generated by the decontamination system will be treated using the on-site treatment facility.

Personnel involved in decontamination activities may be exposed to skin contact with contaminated materials and chemicals brought to the site as part of the project work. All personnel will review the operating procedures and PPE prior to decontamination. The pressure washer and decontamination containment facility will be inspected daily prior to use. Personnel involved in decontamination activities must wear PPE that is one level below the level worn by personnel working in the EZ.

3.2.14 Demobilization

Demobilization involves removing all tools, equipment, supplies, and vehicles brought to the site. The hazards of this phase of activity are associated with heavy equipment operation and manual materials handling.

Hazards – Manual materials handling may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces, and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

Environmental hazards include plants such as poison ivy and poison oak; aggressive fauna such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens such as rabies, Lyme disease, and blood-borne pathogens.

Control – Control procedures for these hazards are discussed in Section 4 (General Safety Practices).

3.2.15 Field Observation

Field observation activities involve watching the work of others. Such activities may involve a potential for exposure to physical and health hazards. Hazards may be associated with the site, the equipment being used and environmental conditions.

Hazards – There exists a potential for incidents involving personnel being struck by or struck against equipment or objects, which could result in fractures, lacerations, punctures, or abrasions. Walking and working surfaces during activities may involve slip, trip, or fall hazards. Slippery walking/working surfaces can increase the possibility of back injuries, overexertion injuries, and slips and falls. Material-handling operations may result in “caught between” situation when a load is being handled, and a finger or toe gets caught between two objects. Material handling also exposes employees to sprains/strains if proper lifting techniques are not used. Noise may also present a hazard. Heavy equipment operation frequently results in high noise levels.

Environmental hazards include plants such as poison ivy and poison oak; aggressive fauna such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather such as sunburn, lightning, rain, and heat-related illnesses; and pathogens such as rabies, Lyme disease, and blood-borne pathogens.

Control – Prior to the start of any field activity, the site conditions will be discussed with all affected employees. Hazards will be identified, and protective measures will be explained. Control procedures for these hazards are discussed in Section 4 (General Safety Practices), and in task-specific sections of this HASP. Decisions regarding PPE will be based on the potential chemical and physical hazards on site, and measurements and observations made prior to and during work activities. A minimum of Level D protection will be worn by personnel conducting observation activities. See Section 5 (Personal Protective Equipment), for a description of PPE requirements. Personnel conducting observation activities will do so from a safe distance.

3.2.16 Chemical Hazards

The chemical hazards associated with site operations are related to inhalation, ingestion, and skin exposure to site COCs. Concentrations of airborne COCs during site tasks may be measurable, and will require air monitoring during certain operations. Air monitoring requirements for site tasks are outlined in Section 6.1.

Site COCs include various metals, VOCs/NAPL, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and organic compounds, including halogenated compounds.

The potential for inhalation of site COCs is low under normal conditions, but is elevated in the case of excavations within the Operations Area. The potential for dermal contact with soils and groundwater containing site COCs during sampling operations is moderate to high. The Chemical Hazard Data Table in Appendix D-5 lists the chemical, physical, and toxicological properties of the primary site COCs. Material Safety Data Sheets (MSDS) for the COCs and chemicals in use at the site are included in Appendix D-6.

4. General Safety Practices

4.1 General Safety Rules

At least one copy of this HASP must be in a location at the site that is readily available to personnel, and all project personnel shall review the plan prior to starting work. General safety rules for site activities include, but are not limited to, the following:

- Consume or use food, beverages, chewing gum, and tobacco products only in the SZ or other designated area outside the EZ and CRZ. Cosmetics shall not be applied in the EZ or CRZ.

- Wash hands before eating, drinking, smoking, or using toilet facilities.

- Wear all PPE as required, and stop work and replace damaged PPE immediately.

- Secure disposable coveralls, boots, and gloves at the wrists and legs and confirm closure of the suit around the neck.

- Upon skin contact with materials that may be impacted by COCs, remove contaminated clothing and wash the affected area immediately. Contaminated clothing must be changed. Any skin contact with materials potentially impacted by COCs must be reported to the SS or HSS immediately. If necessary, seek medical attention.

- Practice contamination avoidance. Avoid contact with surfaces either suspected or known to be impacted by COCs, such as standing water, mud, or discolored soil. Store equipment on elevated or protected surfaces to reduce the potential for incidental contamination.

- Remove PPE as required in the CRZ to limit the spread of COC-containing materials.

- At the end of each shift or as required, dispose of all single-use coveralls, soiled gloves, and respirator cartridges in designated receptacles designated for this purpose.

- Do not remove soil containing site COCs from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air.

- Inspect all non-disposable PPE for contamination in the CRZ. Decontaminate and dispose of properly any PPE found to be contaminated.

- Recognize emergency signals (e.g., for evacuation, injury, fire).

- Report all injuries, illnesses, near misses, and unsafe conditions or work practices to the SS or HSS.

- Use the “buddy system” during all operations requiring Level C PPE and, when appropriate, during Modified Level D operations.

- Obey all warning signs, tags, and barriers. Do not remove any warnings unless authorized to do so.

- Use, adjust, alter, and repair equipment only if trained and authorized to do so, and in accordance with the manufacturer’s directions.

- Perform only tasks for which you have been properly trained; advise your supervisor if you have been assigned a task for which you are not trained.

- Do not take prescription or over-the-counter drugs when assigned to tasks with the potential for absorption, inhalation, or ingestion of hazardous substances, unless given written approval by an appropriate health care professional. The presence or consumption of alcoholic beverages or illicit drugs during the work day, including breaks, is strictly prohibited.

- Remain upwind during site activities whenever possible.

4.2 Incident Investigation

An incident is any of the following events: first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, fires, and business interruptions. All incidents shall be investigated within 24 hours and reported to the Project Coordinator, PM and the HSO.

The purpose of an II is to prevent the recurrence of a similar hazardous event. All incidents are investigated in the same manner. The information gathered during an II will be used to create appropriate measures to protect personnel from the hazard in question. An example II Form is included in Appendix D-7.

4.3 Buddy System

On-site personnel must use the buddy system required by operations. Use of the buddy system is required during all operations requiring Level C to Level A PPE and, when appropriate, during Level D operations. Crew members must observe each other for signs of chemical exposure and heat or cold stress. Indications of adverse effects include, but are not limited to:

- Changes in complexion and skin coloration
- Changes in coordination
- Changes in demeanor
- Excessive salivation and pupillary response
- Changes in speech pattern

Crew members must also be aware of unsafe acts, non-compliance with safety procedures, and the potential exposure to possible safety hazards.

Field personnel must inform their partners or fellow crewmembers of non-visible effects of exposure to toxic materials that they may be experiencing. The symptoms of such exposure may include, but are not limited to:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory tract

If protective equipment or noise levels impair communications, prearranged hand signals must be used for communication. Personnel must stay within line of sight of another team member.

4.4 Heat Stress

Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, and workload, as well as the physical and conditioning characteristics of the individual. Since heat stress is one of the most common illnesses associated with heavy outdoor work conducted with direct solar load and, in particular, because wearing PPE can increase the risk of developing heat stress, workers must be capable of recognizing the signs and symptoms of heat-related illnesses. Personnel must be aware of the types and causes of heat-related illnesses and be able to recognize the signs and symptoms of these illnesses in both themselves and their co-workers.

Heat rashes are one of the most common problems in hot work environments. Commonly known as prickly heat, a heat rash is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

Heat cramps are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused both by too much or too little salt.

Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (plus or minus 0.3% NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Drinking commercially available carbohydrate electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

Heat exhaustion occurs from increased stress on various body organs due to inadequate blood circulation, cardiovascular insufficiency, or dehydration. Signs and symptoms include pale, cool, moist skin; heavy sweating; dizziness; nausea; headache, vertigo, weakness, thirst, and giddiness. Fortunately, this condition responds readily to prompt treatment.

Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, which is a medical emergency.

Workers suffering from heat exhaustion should be removed from the hot environment, be given fluid replacement, and be encouraged to get adequate rest.

Heat stroke is the most serious form of heat stress. Heat stroke occurs when the body’s system of temperature regulation fails and the body’s temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict.

Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature (e.g., a rectal temperature of 41°C [105.8°F]). If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of workload and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area, and the outer clothing should be removed. The worker’s skin should be moistened and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated, and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim’s physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker’s protests, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because, once someone suffers from heat stroke or exhaustion, that person may be predisposed to additional heat injuries.

Heat Stress Safety Precautions

Heat stress monitoring and work/rest cycle implementation should commence when the ambient adjusted temperature exceeds 72°F. A minimum work/rest regimen and procedures for calculating ambient adjusted temperature are described in Table 4, below.

Table 4 – Work/Rest Schedule

Adjusted Temperature[b]	Work/Rest Regimen Normal Work Ensemble[c]	Work/Rest Regimen Impermeable Ensemble
90ºF (32.2ºC) or above	After each 45 minutes of work	After each 15 minutes of work
87.5º - 90ºF (30.8º-32.2ºC)	After each 60 minutes of work	After each 30 minutes of work
82.5º - 87.5ºF (28.1º - 30.8ºC)	After each 90 minutes of work	After each 60 minutes of work
77.5º - 82.5ºF (25.3º - 28.1ºC)	After each 120 minutes of work	After each 90 minutes of work
72.5º - 77.5ºF (30.8º - 32.2ºC)	After each 150 minutes of work	After each 120 minutes of work

a. For work levels of 250 kilocalories/hour (Light-Moderate Type of Work)

b. Calculate the adjusted air temperature (ta adj) by using this equation: ta adj ^{o}F = ta ^{o}F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

c. A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

d. The information presented above was generated using the information provided in the ACGIH Threshold Limit Values (TLV) Handbook.

In order to determine whether the work rest cycles are adequate for the personnel and specific site conditions, additional monitoring of individual heart rates will be conducted during the rest cycle. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period; multiply by 2. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

Additionally, one or more of the following control measures can be used to help control heat stress and are mandatory if any site worker has a heart rate (measured immediately prior to rest period) exceeding 115 beats per minute:

- Site workers will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day.
- On-site drinking water will be kept cool (50 to 60°F).
- A work regimen that will provide adequate rest periods for cooling down will be established, as required.
- All personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps.
- Cooling devices, such as vortex tubes or cooling vests, should be used when personnel must wear impermeable clothing in conditions of extreme heat.
- Employees should be instructed to monitor themselves and co-workers for signs of heat stress and to take additional breaks, as necessary.
- A shaded rest area must be provided. All breaks should take place in the shaded rest area.
- Employees must not be assigned to other tasks during breaks.

- Employees must remove impermeable garments during rest periods. This includes white Tyvek®-type garments.

All employees must be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

4.5 Cold Stress

Cold stress normally occurs in temperatures at or below freezing or, under certain circumstances, in temperatures of 40°F. Extreme cold for a short time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death. Areas of the body that have high surface-area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible. Two factors influence the development of a cold weather injury: ambient temperature and the velocity of the wind. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F. An equivalent chill temperature chart relating the actual dry bulb temperature and wind velocity is presented in Table 5.

Table 5 – Chill Temperature Chart

Estimated Wind Speed (in mph)	**Actual Temperature Reading (ºF)**											
	50	**40**	**30**	**20**	**10**	**0**	**-10**	**-20**	**-30**	**-40**	**-50**	**-60**
	Equivalent Chill Temperature (ºF)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	**LITTLE DANGER** **Maximum danger of false sense of security.**				**INCREASING DANGER** **Danger from freezing of exposed flesh within one minute.**			**GREAT DANGER** **Flesh may freeze within 30 seconds.**				
	Trench foot and immersion foot may occur at any point on this chart.											

[This chart was developed by the U.S. Army Research Institute of Environmental Medicine, Natick, MA (Source: ACGIH Threshold Limit Values for Chemical Substances and Physical Agents)].

Local injury resulting from cold is included in the generic term *frostbite*. There are several degrees of tissue damage associated with frostbite. Frostbite of the extremities can be categorized into:

- *Frost Nip or Incipient Frostbite* - characterized by sudden blanching or whitening of skin.
- *Superficial Frostbite* - skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- *Deep Frostbite* - tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. It can be fatal. Its symptoms are usually exhibited in five stages: (1) shivering; (2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F; (3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; (4) freezing of the extremities; and (5) death. Trauma sustained in freezing or sub-zero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing for first aid treatment. To avoid cold stress, site personnel must wear protective clothing appropriate for the level of cold and physical activity. In addition to protective clothing, preventive safe work practices, additional training, and warming regimens may be utilized to prevent cold stress.

Safety Precautions for Cold Stress Prevention

For air temperature of 0°F or less, mittens should be used to protect the hands. For exposed skin, continuous exposure should not be permitted when air speed and temperature results in a wind chill temperature of -25°F.

At air temperatures of 36°F or less, field personnel who become immersed in water or whose clothing becomes wet must be immediately provided with a change of clothing and be treated for hypothermia.

If work is done at normal temperature or in a hot environment before entering the cold, field personnel must confirm that their clothing is not wet as a consequence of sweating. If clothing is wet, field personnel must change into dry clothes prior to entering the cold area.

If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work must be modified or suspended until adequate clothing is made available or until weather conditions improve.

Field personnel handling evaporative liquid (e.g., gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F must take special precaution to avoid soaking clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling.

Safe Work Practices

Direct contact between bare skin and cold surfaces (< 20°F) should be avoided. Metal tool handles and/or equipment controls should be covered by thermal insulating material.

For work performed in a wind chill temperature at or below 10°F, workers should be under constant protective observation (buddy system). The work rate should be established to prevent heavy sweating that will result in wet clothing. For heavy work, rest periods must be taken in heated shelters, and workers should be provided with an opportunity to change into dry clothing, if needed.

Field personnel should be provided the opportunity to become accustomed to cold-weather working conditions and required protective clothing.

Work should be arranged in such a way that sitting or standing still for long periods is minimized.

During the warming regimen (rest period), field personnel should be encouraged to remove outer clothing to permit sweat evaporation or to change into dry work clothing. Dehydration, or loss of body fluids, occurs insidiously in the cold environment and may increase susceptibility to cold injury due to a significant change in blood flow to the extremities. Fluid replacement with warm, sweet drinks and soups is recommended. The intake of coffee should be limited because of diuretic and circulatory effects.

4.6 Biological Hazards

Biological hazards may include poison ivy, snakes, thorny bushes and trees, bees, mosquitoes, and other pests.

4.6.1 Tick-Borne Diseases

Lyme Disease – This disease commonly occurs in summer and is transmitted by the bite of infected ticks. “Hot spots” in the United States include New York, New Jersey, Pennsylvania, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin.

Erlichiosis – This disease also commonly occurs in summer and is transmitted by the bite of infected ticks. “Hot spots” in the United States include New York, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin.

These diseases are transmitted primarily by the deer tick, which is smaller and redder than the common wood tick. The disease may be transmitted by immature ticks, which are small and hard to see. The tick may be as small as a period on this page.

Symptoms of Lyme disease include a rash or a peculiar red spot, like a bull’s eye, which expands outward in a circular manner. The victim may have headache, weakness, fever, a stiff neck, and swelling and pain in the joints, and eventually, arthritis. Symptoms of erlichiosis include muscle and joint aches, and flu-like symptoms, but there is typically no skin rash.

Rocky Mountain Spotted Fever (RMSF) – This disease is transmitted via the bite of an infected tick. The tick must be attached 4 to 6 hours before the disease-causing organism (*Rickettsia rickettsii*) becomes reactivated and can infect humans. The primary symptom of RMSF is the sudden appearance of a moderate-to-high fever. The fever may persist for 2 to 3 weeks. The victim may also have a headache, deep muscle pain, and chills. A rash appears on the hands and feet on about the third day and eventually spreads to all parts of the body. For this reason, RMSF may be confused with measles or meningitis. The disease may cause death, if untreated, but, if identified and treated promptly, death is uncommon.

Control – Tick repellant containing diethyltoluamide (DEET) should be used when personnel are working in tick-infested areas, and pant legs should be tucked into boots. In addition, workers should search the entire body every 3 or 4 hours for attached ticks. Ticks should be removed promptly and carefully without crushing, since crushing can squeeze the disease-causing organism into the skin. A gentle and steady pulling action should be used to avoid leaving the head or mouth parts in the skin. Hands should be protected with surgical gloves when removing ticks.

4.6.2 Poisonous Plants

Poisonous plants may be present in the work area. Personnel should be alerted to their presence and instructed on methods to prevent exposure.

Control – The main control is to avoid contact with the plant, cover arms and hands, and frequently wash potentially exposed skin. Particular attention must be given to avoiding skin contact with objects or protective clothing that have touched the plants. Treat every surface that may have touched the plant as contaminated, and practice contamination avoidance. If skin contact is made, the area should be washed immediately with soap and water, and observed for signs of reddening.

4.6.3 Snakes

Although the occurrence of poisonous snakes in Connecticut is extremely rare, the possibility of encountering snakes exists, specifically for personnel working in wooded/vegetated areas. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation; and effects from local release of substances by enzymatic actions. Other noticeable effects of venomous snakebites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

Control – To minimize the threat of snakebites, all personnel walking through vegetated areas must be aware of the potential for encountering snakes and the need to avoid actions potentiating encounters, such as turning over logs. If a snakebite occurs, an attempt should be made to safely kill the snake for identification. The victim must be transported to the nearest hospital within 30 minutes. First aid consists of applying a constriction band and washing the area around the wound to remove any unabsorbed venom.

4.6.4 Spiders

The possibility of personnel encountering spiders exists during work activities.

Two spiders are of concern: the black widow and the brown recluse. Both prefer dark, sheltered areas such as basements, equipment sheds and enclosures, and around woodpiles or other scattered debris. The black widow is shiny black, approximately 1 inch long, and found throughout the United States. There is a distinctive red hourglass marking on the underside of the black widow’s body. The bite of a black widow is seldom fatal to healthy adults, but effects include respiratory distress, nausea, vomiting, and muscle spasms.

The brown recluse is smaller than the black widow and gets its name from its brown coloring and behavior. The brown recluse is more prevalent in the southern United States. It has a distinctive violin shape on the top of its body. The bite of the brown recluse is painful, and the bite site ulcerates and takes many weeks to heal completely.

Control – To minimize the threat of spider bites, all personnel walking through vegetated areas must be aware of the potential for encountering these arachnids. Personnel need to avoid actions that may result in encounters, such as turning over logs and placing hands in dark places such as behind equipment or in corners of equipment sheds or enclosures. If a spider bite occurs, the victim must be transported to the nearest hospital as soon as possible. First aid consists of applying ice packs and washing the area around the wound to remove any unabsorbed venom.

4.7 Noise

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication, thereby increasing the risk of accidents on site.

Control – All personnel must wear hearing protection, with a Noise Reduction Rating (NRR) of at least 20, when noise levels exceed 85 dBA. When it is difficult to hear a co-worker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss. Noise monitoring is discussed in Section 6.3.

Whenever possible, equipment that does not generate excessive noise levels will be selected for this project. If the use of noisy equipment is unavoidable, barriers or increased distance will be used to minimize worker exposure to noise, if feasible.

4.8 Spill Control

All personnel must take every precaution to minimize the potential for spills during site operations. All on-site personnel shall immediately report any discharge, no matter how small, to the SS.

Spill control equipment and materials will be located on site at locations that present the potential for discharge. All sorbent materials used for the cleanup of spills will be containerized and labeled appropriately. In the event of a spill, the SS will follow the provisions in Section 9 (Emergency Procedures) to contain and control released materials and to prevent their spread to off-site areas.

4.9 Sanitation

Site sanitation will be maintained according to OSHA requirements, as outlined in the following sections.

4.9.1 Break Area

Breaks must be taken in the SZ, away from the active work area, after site personnel go through decontamination procedures. There will be no smoking, eating, drinking, or chewing gum or tobacco in any area other than the SZ.

4.9.2 Potable Water

The following rules apply to all field operations:

- An adequate supply of potable water will be provided at each project site. Potable water must be kept away from hazardous materials or media, and contaminated clothing or equipment.

- Portable containers used to dispense drinking water must be capable of being tightly closed, and must be equipped with a tap dispenser. Water must not be consumed directly from the container (drinking from the tap is prohibited), nor may it be removed from the container by dipping.

- Containers used for drinking water must be clearly marked and shall not be used for any other purpose.

- Disposable drinking cups must be provided. A sanitary container for dispensing cups and a receptacle for disposing of used cups is required.

4.9.3 Sanitary Facilities

Access to facilities for washing before eating, drinking, or smoking, or alternate methods such as waterless hand-cleaner and paper towels, must be provided for all personnel working at the site.

4.9.4 Lavatory

Toilet facilities are available within the existing treatment facility building, and a portable chemical toilet may be provided during periods of extended field work.

4.10 Emergency Equipment

Adequate emergency equipment for the activities being conducted on site, and as required by applicable sections of 29 CFR 1910 and 29 CFR 1926, will be provided by the contractor responsible for each activity prior to the commencement of project activities. Emergency equipment shall be inspected during mobilization to the site and periodically during site operations to assure that these tools and materials are in proper working order and condition.

Personnel will be provided with access to emergency equipment, including, but not limited to, the following:

- Fire extinguishers of adequate size, class, number, and location as required by applicable sections of 29 CFR 1910 and 1926.
- Industrial first aid kits of adequate size for the number of personnel on site.
- Emergency eyewash and/or shower, if required by operations being conducted on site.

4.11 Lockout/Tagout Procedures

Only fully qualified and trained personnel will perform maintenance procedures on electrical or motorized equipment. Before maintenance begins, LOTO procedures per OSHA 29 CFR 1910.147 will be followed.

Lockout is the placement of a device that uses a positive means, such as lock, to hold an energy- or material-isolating device such that the equipment cannot be operated until the lockout device is removed. If a device cannot be locked out, a tagout system shall be used. Tagout is the placement of a warning tag on an energy- or material-isolating device indicating that the equipment controls may not be operated until the tag is removed by the personnel who attached the tag. A LOTO equipment-specific energy control procedure form is included in Appendix D-8.

4.12 Electrical Safety

Electricity may pose a particular hazard to site workers due to the use of portable electrical equipment. Wiring or other electrical work must be performed by a qualified electrician.

General electrical safety requirements include:

- All electrical wiring and equipment must be a type listed by Underwriters Laboratories (UL), Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency.

- All installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or USCG regulations.

- Portable and semi-portable tools and equipment must be grounded by a multi-conductor cord having an identified grounding conductor and a multi-contact polarized plug-in receptacle.

- Tools protected by an approved system of double insulation, or its equivalent, need not be grounded. Double-insulated tools must be distinctly marked and listed by UL or FM.

- Live parts of wiring or equipment must be guarded to prevent persons or objects from touching them.

- Electric wire or flexible cord passing through work areas must be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching.

- All circuits must be protected from overload.

- Temporary power lines, switchboxes, receptacle boxes, metal cabinets, and enclosures around equipment must be marked to indicate the maximum operating voltage.

- Plugs and receptacles must be kept out of water unless they are of an approved submersible construction.

- All extension cord outlets must be equipped with ground fault circuit interrupters (GFCIs).

- Attachment plugs or other connectors must be equipped with a cord grip and be constructed to endure rough treatment.

- Extension cords or cables must be inspected prior to each use and replaced if worn or damaged. Cords and cables must not be fastened with staples, hung from nails, or suspended by bare wire.

- Flexible cords must be used only in continuous lengths without splice, with the exception of molded or vulcanized splices made by a qualified electrician.

4.13 Lifting Safety

Using proper lifting techniques may prevent back strain or injury. The fundamentals of proper lifting include:

- Consider the size, shape, and weight of the object to be lifted. A mechanical lifting device or additional persons must be used to lift an object if it cannot be lifted safely alone.
- The hands and the object should be free of dirt or grease that could prevent a firm grip.
- Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, or rough or slippery surfaces.
- Fingers must be kept away from points that could crush or pinch them, especially when putting an object down.
- Feet must be placed far enough apart for balance. The footing should be solid, and the intended pathway should be clear.
- The load should be kept as low as possible, close to the body with the knees bent.
- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.
- A worker should not carry a load that he or she cannot see around or over.
- When putting an object down, the stance and position are identical to that for lifting: the legs are bent at the knees, and the back is straight as the object is lowered.

4.14 Heavy Equipment

To protect on-site personnel against hazards associated with heavy equipment operations, and to prevent injury due to unsafe heavy equipment operation, only properly trained and authorized personnel will be allowed to operate heavy equipment. All material-handling equipment will be maintained in a safe operating condition and inspected daily prior to use. Personnel operating forklifts shall be trained and certified in accordance with 29 CFR 1910.178(l). Certification shall be made available to the SS upon request.

Hazards – The physical hazards involved with heavy equipment operations relate to the work done with heavy equipment and the site environment itself. There exists a potential for incidents involving personnel being struck by or struck against heavy equipment or materials that could result in fractures, cuts, punctures, or abrasions. Heavy equipment operation may present noise hazards, vibration hazards, and a potential for contact with moving parts or hot surfaces to equipment operators. Walking and working surfaces may involve slip, trip, and fall hazards. Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls. Noise may also present a hazard. Heavy equipment operation frequently results in high noise levels.

4.14.1 Audible Alarms

Every vehicle used to haul dirt, rock, concrete, or other construction material shall be equipped with a warning device that operates automatically while the vehicle is backing. The warning sound shall be of such volume that it will normally be audible from a distance of 200 feet and will sound immediately on backing. In congested areas or areas with high ambient noise that obscures the audible alarm, a signaler, in clear view of the operator, shall direct the backing operation. Other vehicles, if operating in areas where their backward movement would constitute a hazard to employees working in the area on foot, and where the operator's vision is obstructed to the rear of the vehicle, shall be equipped with an effective device or method to safeguard employees, such as:

- An automatic backup audible alarm that would sound immediately on backing.

- An automatic braking device at the rear of the vehicle that will apply the service brake immediately on contact with any obstruction to the rear.

- In lieu of the above requirements, administrative controls such as:
    - A spotter or flagger in clear view of the operator who shall direct the backing operation.
    - Other procedures that will require the operator to dismount and circle the vehicle immediately prior to starting a backup operation.
    - All foot traffic prohibited in the work area.
    - Other means that will furnish safety equivalent to the foregoing for personnel working in the area.

No vehicle operator shall leave the controls of the vehicle while it is moving under its own engine power. Hauling or earth-moving operations shall be controlled in such a manner as to provide that equipment or vehicle operators know of the presence of other personnel in the areas of their operations.

4.14.2 Equipment Inspection and Maintenance

All vehicles in use shall be checked at the beginning of each shift to confirm that the following parts, equipment, and accessories are in safe operating condition and free of apparent damage that could cause failure while in use: service brakes, including trailer brake connections; parking system (hand brake); emergency stopping system (brake); tires; horn; steering mechanism; coupling devices; seat belts; operating controls; and safety devices. All defects affecting safe operation shall be corrected before the vehicle is placed into service. These requirements also apply to equipment such as lights, reflectors, windshield wipers, defrosters, and fire extinguishers, where such equipment is necessary.

Vehicle engines shall not be allowed to run in closed garages or other enclosed places unless vents are provided that effectively remove the exhaust gases from the building.

Except for emergency field repairs, a safety tire rack, cage, or equivalent protection shall be used when inflating truck or equipment tires after mounting on a rim, if such tires depend upon a locking ring or similar device to hold them on the rim.

No repairs shall be attempted on power equipment until arrangements are made to eliminate possibility of injury caused by sudden movements or operation of the equipment or its parts. When the equipment being repaired is a bulldozer, carryall, ripper, or other machine having sharp or heavy moving parts such as blades, beds, or gates, such parts shall be lowered to the ground or securely and positively blocked in an inoperative position.

All controls shall be in a neutral position, with the engine(s) stopped and brakes set, unless work being performed requires otherwise. Trucks with dump bodies shall be equipped with positive means of support, permanently attached and capable of being locked in position to prevent accidental lowering of the body while maintenance or inspection work is being done. In all cases where the body is raised for any work, the locking device shall be used.

4.14.3 Equipment Parking and Loading

Whenever the equipment is parked, the parking brake shall be set. Equipment parked on inclines shall have the wheels chocked and the parking brake set, or be otherwise prevented from moving by effective mechanical means.

Scissor points on all front-end loaders that constitute a hazard to the operator shall be adequately guarded. A loader shall not travel without adequate visibility for the driver and stability of the equipment. No loading device shall be left unattended until the load or bucket is lowered to the ground, unless proper precautions such as blocking are taken to prevent accidental lowering.

4.14.4 Equipment Fueling

No internal combustion engine fuel tank shall be refilled with a flammable liquid while the engine is running. Fueling shall be done in such a manner that the likelihood of spillage is minimal. If a spill occurs, it shall be contained and cleaned, or equivalent action shall be taken to control vapors before restarting the engine. Fuel tank caps shall be replaced before starting the engine.

A good metal-to-metal contact shall be kept between fuel supply tank or nozzle of supply hose and the fuel tank. No open lights, welding, or sparking equipment shall be used near internal combustion equipment being fueled or near storage tanks. No smoking shall be permitted at or near the gasoline storage area or on equipment being fueled. Post a conspicuous sign in each fuel storage and fueling area stating: “NO SMOKING WITHIN 50 FEET.” Class I liquids shall not be dispensed by pressure from drums, barrels, or similar containers. Approved pumps taking suction through the top of the container or approved self-closing faucets shall be used. No repairs shall be made to equipment while it is being fueled.

Each fuel storage tank or drum shall have the word Flammable conspicuously marked thereon and should also have a similarly sized statement indicating the contents of the container. A fire extinguisher rated 20:BC or larger shall be in a location accessible to the fueling area. All fuel storage tanks, drums, or safety cans shall be properly marked and of the proper type.

4.14.5 Additional Safety Requirements

To protect on-site personnel against hazards associated with materials handling, and to prevent injury due to unsafe heavy equipment operation, only properly trained and authorized personnel will be allowed to operate heavy equipment. All material-handling equipment will be maintained in a safe operating condition and inspected daily prior to use.

Additional heavy equipment safety requirements include, but are not limited to:

- Prior to operating any heavy equipment, the authorized operator must conduct a pre-operation inspection to confirm that the heavy equipment is in safe operating condition.

- All mobile equipment shall be equipped with an audible back-up alarm.

- Personnel will not be allowed to stand or pass under the elevated portion of any heavy equipment, whether loaded or empty.

- Personnel will not place arms and legs between pinch or scissor points of the equipment or outside the operator enclosure.

- A safe distance shall be maintained from the edge of excavations, ditches, ramps, or platforms.

- Operators will maintain sufficient clearance under objects such as overhead utilities, installations, lights, and pipes.

- Heavy equipment must never be used for lifting or transporting personnel.
- The operator is required to look in the direction of, and maintain a clear view of, the path of travel.
- Heavy equipment shall not be operated without an overhead guard and roll-over device that protect the operator against falling objects and equipment roll-over.
- Heavy equipment must not be driven up to anyone standing in front of any object.
- Stunt driving and horseplay are strictly prohibited.
- Operators will yield the right-of-way to other site vehicles.
- Other heavy equipment traveling in the same direction must not be passed at intersections, blind spots, or other dangerous locations.
- A safe distance must be maintained from other heavy equipment, and the equipment must be kept under control at all times.
- The heavy equipment operator must slow down for wet and slippery conditions. Under all travel conditions, the equipment will be operated at a speed that will permit it to be brought to a stop in a safe manner.
- Operators will avoid running over loose objects on operating surfaces.
- Grades and ramps must be ascended and descended slowly.
- On all grades, the load will be tilted back and raised only as far as necessary to clear the operating surface.
- The operator will slow down and sound the horn at intersections, when entering buildings, and at other locations where vision may be obstructed.
- If the load being carried obstructs forward view, the operator will travel with the load trailing.

- While negotiating turns, speed will be reduced to a safe rate, and turning will be in a smooth, sweeping motion to avoid abrupt turns and potential equipment or load upset.

- Authorized operators will handle only stable or safely arranged loads that are within the rated capacity of the heavy equipment and will not affect the stability of the heavy equipment.

- When a piece of heavy equipment is left unattended, hydraulics will be fully lowered, controls will be neutralized, power will be shut off, and brakes will be set. Wheels will be blocked or chocked if the heavy equipment is parked on an incline. When heavy equipment powered by an internal combustion engine is utilized indoors, near confined spaces, or near excavations, carbon monoxide levels shall be monitored to prevent personnel exposure.

5. Personal Protective Equipment

5.1 Levels of Protection

PPE is required to safeguard site personnel from various hazards. Varying levels of protection may be required, depending on the levels of COCs and the degree of physical hazard. It is not anticipated that PPE will need to be upgraded beyond Level C during RD activities. Upgrade to Level B would require coordination with the Contractor HSO. This section presents the various levels of protection and defines the conditions of use for each level.

5.1.1 Level D Protection

The minimum level of protection that will be required of site personnel will be Level D, which will be worn when conditions or air monitoring indicates that no inhalation hazard exists. The following equipment will be used:

- Work clothing, as prescribed by weather.
- Steel-toe work boots, meeting ASTM F2412 and F2413.
- Safety glasses or goggles, meeting American National Standards Institute (ANSI) Z87.
- Hard hat, meeting ANSI Z89, when falling object hazards are present.
- Hearing protection. If noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used.

5.1.2 Modified Level D Protection

Modified Level D will be used when airborne contaminants are not present at levels of concern, but site activities present an increased potential for skin contact with contaminated materials. Modified Level D consists of Level D plus any of the following:

- Tyvek® coveralls (polyethylene-coated Tyvek® suits for handling liquids) when skin contact with COC-impacted media is anticipated.

- Latex/ polyvinyl chloride (PVC) overboots when contact with COC-impacted media is anticipated.

- Face shield in addition to safety glasses or goggles when projectiles or splash hazards exist.

- Nitrile gloves worn over nitrile surgical gloves.

5.1.3 Level C Protection

Level C protection will be required when the airborne concentration of COC reaches one-half of the OSHA Permissible Exposure Limit (PEL) or the ACGIH TLV. In addition, Level C protection will be determined by the HSS. Air purifying respirators shall only be used when monitoring indicates that there is sufficient oxygen, the contaminants of concern have been identified and the concentrations are known, there are adequate warning properties and the proper cartridges are available for the contaminants of concern. Only personnel with current fit tests and medical clearance will be allowed to work in respirators. The following equipment will be used for Level C protection:

- Full-face, air-purifying respirator with the appropriate cartridges for the known contaminants.

- Polyethylene-coated Tyvek® suit, with ankles and cuffs taped to boots and gloves.

- Nitrile gloves worn over nitrile surgical gloves.

- Steel-toe work boots, meeting ASTM F2412 and F2413.

- Chemical resistant boots with steel toes, or latex/PVC overboots over steel-toe boots.

- Hard hat, meeting ANSI Z89.

- Hearing protection. If noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used.

5.2 Selection of PPE

Equipment for personal protection will be selected based on the potential for contact, site conditions, ambient air quality, and the judgment of supervising contractor personnel and contractor health and safety professionals. The PPE used will be chosen to be effective against the COCs present on the site.

5.3 Site Respiratory Protection Program

Respiratory protection is an integral part of employee health and safety at the site due to potentially hazardous concentrations of airborne COCs. The contractor's site respiratory protection program will meet the following minimum requirements:

- All on-site personnel who may use respiratory protection will have an assigned respirator.

- All on-site personnel who may use respiratory protection will have been fit-tested and trained in the use of the respirator to be used within the past 12 months.

- All on-site personnel who may use respiratory protection must, within the past year, have been medically certified as being capable of wearing a respirator. Documentation of the medical certification must be provided to the HSS, prior to commencement of site work.

- Only cleaned, maintained, NIOSH-approved respirators will be used.

- If respirators are used, the respirator cartridge is to be properly disposed of at the end of each work shift, or when load-up or breakthrough occurs.

- Contact lenses are not to be worn when a ½-face respirator is worn.

- All on-site personnel who may use respiratory protection must be clean-shaven. Mustaches and sideburns are permitted, but they must not touch the sealing surface of the respirator.

- Respirators will be inspected, and a negative pressure test will be performed prior to each use.

- After each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag, away from direct sunlight in a clean, dry location, in a manner that will not distort the face piece.

5.4 Using PPE

Depending upon the level of protection selected, specific donning and doffing procedures may be required. The procedures presented in this section are mandatory if Modified Level D or Level C PPE is used. All personnel entering the EZ must put on the required PPE in accordance with the requirements of this HASP. When leaving the EZ, PPE will be removed in accordance with the procedures listed, to minimize the spread of COCs.

5.4.1 Donning Procedures

These procedures are mandatory only if Modified Level D or Level C PPE is used on the site:

- Remove bulky outerwear. Remove street clothes and store in clean location.

- Put on work clothes or coveralls.

- Put on the required chemical protective coveralls.

- Put on the required chemical protective boots or boot covers.

- Tape the legs of the coveralls to the boots with duct tape.

- Put on the required chemical protective gloves.

- Tape the wrists of the protective coveralls to the gloves.

- Don the required respirator and perform appropriate fit check (Level C).

- Put hood or head covering over head and respirator straps and tape hood to facepiece (Level C).

- Don remaining PPE, such as safety glasses or goggles and hard hat.

When these procedures are instituted, one person must remain outside the work area to confirm that each person entering has the proper protective equipment.

5.4.2 Doffing Procedures

The following procedures are mandatory only if Modified Level D or Level C PPE is required for the site. Whenever a person leaves the work area, the following decontamination sequence will be followed:

- Upon entering the CRZ, rinse contaminated materials from the boots or remove contaminated boot covers.

- Clean reusable protective equipment.

- Remove protective garments, equipment, and respirator (Level C). All disposable clothing must be placed in plastic bags that are labeled with “contaminated waste” labels.

- Wash hands, face, and neck (or shower, if necessary).

- Proceed to clean area and dress in clean clothing.

- Clean and disinfect respirator (Level C) for next use.

All disposable equipment, garments, and PPE must be bagged in plastic bags and labeled for disposal. See Section 7 (Work Zones and Decontamination) for detailed information on decontamination stations.

6. Monitoring

6.1 Air Monitoring

Air monitoring will be conducted to determine employee exposure to airborne constituents. The monitoring results will dictate work procedures and the selection of PPE. The monitoring devices to be used are an MIE PDR 1000 particulate monitor (or equivalent) and a Rae Systems MultiRAE detector (photoionization detector [PID] with an 11.7 eV lamp). The HSS will be responsible for utilizing the air monitoring results to determine appropriate health and safety precautions for on-site personnel and subcontractors.

If PID readings above 0.5 part per million (ppm) for a duration of 15 minutes are noted, colorimetric tubes for benzene and vinyl chloride will be used to check the airborne levels of these substances. If readings of benzene or vinyl chloride are above 0.5 ppm but below 5 ppm, then Level C PPE will be donned. If readings are above 5 ppm for benzene or vinyl chloride, work will be halted and the source of the readings will be evaluated. Air monitoring will be conducted every 15 minutes with the LEL and oxygen meter in areas where flammable vapors or gases are suspect. All work activity must stop where tests indicate that the concentration of flammable vapors exceeds 10% of the LEL at a location with a potential ignition source. Such an area must be ventilated to reduce the concentration to an acceptable level.

Monitoring data will be recorded on the Air Monitoring Form (Appendix D-9).

6.2 Personal Air Monitoring for Vinyl Chloride

To quantify the potential exposure of site personnel to vinyl chloride in air during this project (if any), a personal air sampling plan to determine airborne concentrations of vinyl chloride may be implemented if survey instrument readings (colorimetric tubes) indicate the potential for an 8 hour time-weighted average exposure exceeding 1 ppm. The following paragraphs outline the frequency, sampling, analytical, and record-keeping requirements associated with personal air sampling during this project. The requirements of 29 CFR 1910.1017 must also be met for vinyl chloride.

If the action level of 0.5 ppm for vinyl chloride (as determined with colorimetric tube monitoring) is exceeded, personal air sampling will be conducted in the areas of the site during the next full shift of the activity in the area where the action level for vinyl chloride was exceeded. Personal air samples for vinyl chloride will be collected for at least 20% of representative employees working in or around the site activities. Additional personal sampling may be required during on-site activities based on the results of the initial personal air monitoring assessment. Monitoring frequency for vinyl chloride will be based on the requirements of 29 CFR 1910.1017.

Personal samples for vinyl chloride will be collected (if necessary) according to NIOSH Method #1007 (Appendix D-10) or equivalent. Samples will be collected utilizing a personal sample pump equipped with two charcoal tubes or an equivalent passive organic vapor dosimeter badge. The sample pump must be calibrated prior to and following sample collection to a flow rate of 0.05 L/min with a representative sampler in place. Organic vapor dosimeter badges do not require calibration prior to use.

All personal samples will be submitted to an independent, American Industrial Hygiene Association-accredited laboratory for analysis. Accompanying media blanks also will be submitted to the laboratory for analysis at a rate of one blank for every five samples. Holding time requirements and field preparation procedures as specified in the respective NIOSH method will be followed.

6.3 Noise Monitoring

Noise monitoring may be conducted as required. Hearing protection is mandatory for all employees in noise hazardous areas, such as around heavy equipment. As a general rule, sound levels that cause speech interference at normal conversation distance should require the use of hearing protection.

6.4 Monitoring Equipment Maintenance and Calibration

All direct-reading instrumentation calibrations should be conducted under the approximate environmental conditions that the instrument will be used. Instruments must be calibrated before and after use, noting the reading(s) and any adjustments that are necessary. All air monitoring equipment calibrations, including the standard used for calibration, must be documented on a calibration log or in the field notebook. All completed health and safety forms must be reviewed by the HSS and maintained by the SS.

All air-monitoring equipment will be maintained and calibrated in accordance with the specific manufacturer's procedures. Preventive maintenance and repairs will be conducted in accordance with the respective manufacturer's procedures. When applicable, only manufacturer-trained and/or authorized personnel will be allowed to perform instrument repairs or preventive maintenance.

If an instrument is found to be inoperative or suspected of giving erroneous readings, the HSS must be responsible for immediately removing the instrument from service and obtaining a replacement unit. If the instrument is essential for safe operation during a specific activity, that activity must cease until an appropriate replacement unit is obtained. The HSS will be responsible for confirming that a replacement unit is obtained and/or repairs are initiated on the defective equipment.

6.5 Action Levels

Table 6 presents airborne contaminant action levels that will be used to determine the procedures and protective equipment necessary based on conditions as measured at the site.

Table 6 – Airborne Contaminant Action Levels

Parameter	Reading in Work Area/ Worker Breathing Zone	Action
Total Organic Vapors (TOV)[1]	0 ppm to ≤ 0.5 ppm	Normal operations; Continue hourly breathing zone monitoring.
	>0.5 ppm to ≤ 25 ppm	Continue breathing zone monitoring and implement benzene and vinyl chloride-specific monitoring with the appropriate colorimetric tubes.
	>25 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.
Benzene (as determined with colorimetric tube)	0 ppm to ≤ 0.5 ppm	Normal operations; Continue hourly breathing zone monitoring with PID.
	>0.5 ppm to ≤ 5 ppm	Upgrade to Level C; Increase PID monitoring frequency to every 15 minutes.
	> 5 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.

Parameter	Reading in Work Area/ Worker Breathing Zone	Action
Vinyl Chloride (measured with colorimetric tubes)	0 ppm to ≤ 0.5 ppm	Normal operations; Continue hourly breathing zone monitoring with PID.
	>0.5 ppm to ≤ 5 ppm	Upgrade to Level C; Increase PID monitoring frequency to every 15 minutes.
	> 5 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.
Airborne Particulates	0 to ≤0.5 mg/m3	Normal operations.
	0.5 to ≤ 1 mg/m3	Begin soil wetting procedure (Level C protection would be needed beyond this point).
	> 1 mg/m3	Stop work, fully implement dust control plan.
Flammable Vapors (LEL)	< 10% LEL	Normal operations.
	≥ 10% LEL	Stop work; evacuate work area, ventilate work area; investigate source of vapors.
Carbon Monoxide	0 ppm to 20 ppm	Normal operations; continue monitoring.
	> 20 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.
Oxygen	19.5% to 23.5%	Normal operations.
	< 19.5% or >23.5%	Stop work; evacuate work area, ventilate work area; investigate source of readings.
Hydrogen Sulfide	0 ppm to 5 ppm	Normal operations; continue monitoring.
	> 5 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.

Notes:

1) PID readings are sustained for a period of two minutes at breathing zone height, measured with a calibrated PID with an 11.7 eV lamp.

7. Work Zones and Decontamination

7.1 Work Zones

7.1.1 Authorization to Enter

Only personnel with the appropriate training and medical certifications (if respirators are required) will be allowed to work at the project site. The SS will maintain a list of authorized persons; only personnel on the authorized persons list will be allowed to enter the site work areas.

7.1.2 Site Orientation and Hazard Briefing

No person will be allowed in the work area during site operations without first being given a site orientation and hazard briefing. This orientation will be presented by the contractor’s SS or HSS and will consist of a review of this HASP. This review must cover the chemical, physical, and biological hazards, protective equipment, safe work procedures, and emergency procedures for the project. Following this initial meeting, daily safety meetings will be held each day before work begins.

All people entering the site work areas, including visitors, must document their attendance at this briefing, as well as the daily safety meetings, on the forms included with this plan.

7.1.3 Certification Documents

A training and medical file may be established for the project and kept on site during all site operations. Specialty training, such as first aid/cardiopulmonary resuscitation (CPR) certificates, as well as current medical clearances for all project field personnel required to wear respirators, will be maintained within that file. All personnel must provide their training and medical documentation to the HSS prior to starting work.

7.1.4 Entry Log

A log-in/log-out sheet (included as Appendix A-1 of the Site Management Plan) will be maintained at the site by the contractor’s SS. Personnel must sign in and out on this log sheet as they enter and leave the work area, and the SS may document entry and exit in the field notebook.

7.1.5 Entry Requirements

In addition to complying with the authorization, hazard briefing, and certification requirements listed above, no person will be allowed in any work area unless they are wearing the minimum PPE as described in Section 5 (Personal Protective Equipment).

7.1.6 Emergency Entry and Exit

All personnel who must enter the work area on an emergency basis will be briefed of the hazards by the contractor’s SS. All activities will cease in the event of an emergency. People exiting the work area because of an emergency will gather in a safe area for a head count. The SS is responsible for confirming that all people who entered the work area have exited in the event of an emergency.

7.1.7 Contamination Control Zones

Contamination control zones are maintained to prevent the spread of contamination and to prevent unauthorized people from entering hazardous areas.

7.1.7.1 Exclusion Zone

The EZ is the defined area where there is a possible respiratory and/or contact health hazard. Depending on the specific work area and activity, an EZ may consist of a specific work area or may be the entire area of potential contamination. All employees entering an EZ must use the required PPE and must have the appropriate training and medical clearance for hazardous waste work. Cones, caution tape, or a site diagram, as appropriate for a given work activity, will identify the location of each EZ.

7.1.7.2 Contamination Reduction Zone

The CRZ or transition area will be established, if necessary, to perform decontamination of personnel and equipment. All personnel entering or leaving the EZ will pass through the CRZ to prevent any cross-contamination. Tools, equipment, and machinery will be decontaminated in a specific location. The decontamination of all personnel will be performed on site adjacent to the EZ. Personal protective outer garments and respiratory protection will be removed in the CRZ and prepared for cleaning or disposal. This zone is the only appropriate corridor between the EZ and the SZ.

7.1.7.3 Support Zone

The SZ is a clean area outside the CRZ located to prevent employee exposure to hazardous substances. Eating and drinking will be permitted in the support area only after proper decontamination. Smoking may be permitted in the SZ, subject to site requirements.

7.1.8 Posting

Work areas will be prominently marked and delineated using cones, caution tape, or a site diagram.

7.1.9 Site Inspections

Each contractor’s HSS will conduct a daily inspection of site activities, equipment, and procedures to verify that the required elements are in place. The Health and Safety Inspection Form in Appendix D-11 may be used as a guide for daily inspections.

7.2 Decontamination

7.2.1 Personnel Decontamination

All personnel wearing Modified Level D or Level C protective equipment in the EZ must undergo personal decontamination prior to entering the SZ. The personnel decontamination area will consist of the following stations at a minimum:

- *Station 1*: Personnel leaving the contaminated zone will remove the gross contamination from their outer clothing and boots.

- *Station 2*: Personnel will remove their outer garment and gloves and dispose of them in properly labeled containers. Personnel will then decontaminate their hard hats and boots with an aqueous solution of detergent or other appropriate cleaning solution. These items are then hand-carried to the next station.

- *Station 3*: Personnel will thoroughly wash their hands and face before leaving the CRZ. Respirators will be sanitized and then placed in a clean plastic bag.

7.2.2 Equipment Decontamination

All vehicles that have entered the EZ will be decontaminated at the decontamination pad prior to leaving the zone. If the level of vehicle contamination is low, decontamination may be limited to the rinsing of tires and wheel wells with water. If the vehicle is significantly contaminated, steam cleaning or pressure washing of vehicles and equipment may be required. Decontamination wastes will be collected and staged in the properly labeled containers prior to disposal.

7.2.3 Personal Protective Equipment Decontamination

Where- and whenever possible, single-use, external protective clothing must be used for work within the EZ or CRZ. This protective clothing must be disposed of in properly labeled containers. Reusable protective clothing will be rinsed at the site with detergent and water. The rinsate will be collected and placed in a labeled container for disposal.

When removed from the CRZ, the respirator will be thoroughly cleaned with soap and water. The respirator face piece, straps, valves, and covers must be thoroughly cleaned at the end of each work shift, and be ready for use prior to the next shift. Respirator parts may be disinfected with a solution of bleach and water, or by using a spray disinfectant.

8. Training and Medical Surveillance

8.1 Training

8.1.1 General

All on-site personnel who work in areas where they may be exposed to site contaminants must be trained as required by OSHA Regulation 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response Standard [HAZWOPER]). Field employees also must receive a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Personnel who completed their initial training more than 12 months prior to the start of the project must have completed an 8-hour refresher course within the past 12 months. Each contractor's SS must have completed an additional eight hours of supervisory training, and must have a current first aid/CPR certificate.

8.1.2 Basic 40-Hour Course

The following is a list of the topics typically covered in a 40-hour HAZWOPER training course:

- General safety procedures.
- Physical hazards (fall protection, noise, heat stress, cold stress).
- Names and job descriptions of key personnel responsible for site health and safety.
- Safety, health, and other hazards typically present at hazardous waste sites.
- Use, application, and limitations of PPE.
- Work practices by which employees can minimize risks from hazards.
- Safe use of engineering controls and equipment on site.

- Medical surveillance requirements.
- Recognition of symptoms and signs that might indicate overexposure to hazards.
- Worker right-to-know information (Hazard Communication OSHA 1910.1200).
- Routes of exposure to contaminants.
- Engineering controls and safe work practices.
- Components of a health and safety program and a site-specific HASP.
- Decontamination practices for personnel and equipment.
- Confined-space entry procedures.
- General emergency response procedures.

8.1.3 Supervisor Course

Management and supervisors must receive an additional 8 hours of training that typically includes:

- General site safety and health procedures.
- PPE programs.
- Air monitoring techniques.

8.1.4 Site-Specific Training

Site-specific training will be performed by each contractor. Possible methods of training include having on-site personnel read this HASP, or conducting a thorough site briefing by the PM, SS, or HSS on the contents of this HASP before work begins. The review must include a discussion of the chemical, physical, and biological hazards; the protective equipment and safety procedures; and emergency procedures.

8.1.5 Daily Safety Meetings

Twice daily safety meetings will be held to cover the work to be accomplished, the hazards anticipated, the PPE and procedures required to minimize site hazards, and emergency procedures. Meetings will be held first thing in the morning and again after lunch. Each contractor's SS or HSS should present these meetings prior to beginning the day's fieldwork. No work will be performed in an EZ before the daily safety meeting has been held. A safety meeting must also be held prior to new tasks and repeated if new hazards are encountered. The meeting should be documented; an example Daily Safety Meeting Log is included in Appendix D-12.

8.1.6 First Aid and CPR

At least one employee currently certified in first aid/CPR should be assigned to each contractor's work crew and will be on site during operations. Refresher training in first aid (triennially) and CPR (annually) (American Red Cross) or, biennially if using the American Heart Association Protocol is required to keep the certificate current. These individuals must also receive training regarding the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

8.2 Medical Surveillance

8.2.1 Medical Examination

All personnel who are potentially exposed to site contaminants must participate in a medical surveillance program as defined by OSHA at 29 CFR 1910.120 (f).

8.2.2 Pre-placement Medical Examination

All potentially exposed personnel must have completed a comprehensive medical examination prior to assignment, and periodically thereafter as defined by applicable regulations. The pre-placement and periodic medical examinations typically include the following elements:

- Medical and occupational history questionnaire.
- Physical examination.
- Complete blood count, with differential.
- Liver enzyme profile.
- Chest X-ray, at a frequency determined by the physician.
- Pulmonary function test.
- Audiogram.
- Electrocardiogram for persons older than 45 years of age, or if indicated during the physical examination.
- Drug and alcohol screening, as required by job assignment.
- Visual acuity.
- Follow-up examinations, at the discretion of the examining physician or the corporate medical director.

The examining physician provides the employee with a letter summarizing his findings and recommendations and confirming the worker’s fitness for work and ability to wear a respirator. Documentation of medical clearance will be available for each employee during all project site work.

Contractors will certify that all their employees have successfully completed a physical examination by a qualified physician. The physical examinations must meet the requirements of 29 CFR 1910.120 and 29 CFR 1910.134. Contractors will supply copies of the medical examination certificate for each on-site employee.

8.2.3 Other Medical Examinations

In addition to pre-employment, annual, and exit physicals, personnel may be examined:

- At employee request after known or suspected exposure to toxic or hazardous materials.
- At the discretion of the contractor’s HSS, HSO, or occupational physician in anticipation of, or after, known or suspected exposure to toxic or hazardous materials.

8.2.4 Periodic Exam

Following the placement examination, all employees must undergo a periodic examination, similar in scope to the placement examination. For employees potentially exposed over 30 days per year, the frequency of periodic examinations will be annual. For employees potentially exposed less than 30 days per year, the frequency for periodic examinations will be 18 months.

8.2.5 Medical Restriction

When the examining physician identifies a need to restrict work activity, the employee’s supervisor must communicate the restriction to the employee and the HSS. The terms of the restriction will be discussed with the employee and the supervisor.

9. Emergency Procedures

9.1 General

Prior to the start of operations, the work area will be evaluated for the potential for fire, contaminant release, or other catastrophic event. Unusual conditions or events, activities, chemicals, and conditions will be reported to the contractor's SS/HSS immediately.

The contractor's SS/HSS will be familiar with SRSNE's Contingency Plan and establish evacuation routes and assembly areas for the site. All personnel entering the site will be informed of this route and the assembly area.

9.2 Emergency Response

If an incident occurs, the following steps will be taken:

- The contractor's SS/HSS will evaluate the incident and assess the need for assistance and/or evacuation.

- The contractor's SS/HSS will call for outside assistance, as needed.

- The contractor's SS/HSS will ensure the PM and Project Coordinator are notified promptly of the incident.

- The contractor's SS/HSS will take appropriate measures to stabilize the incident scene.

In the case of a fire at the site, the contractor's SS/HSS will assess the situation and direct fire-fighting activities. The contractor's SS/HSS will ensure that the PM is immediately notified of any fires. Site personnel will attempt to extinguish the fire with available extinguishers, if safe to do so. In the event of a fire that site personnel are unable to safely extinguish with one fire extinguisher, the local fire department will be summoned.

9.3 Medical Emergency

All employee injuries must be promptly reported to the contractor's HSS/SS, who will:

- Confirm that the injured employee receives prompt first aid and medical attention.

- In emergency situations, confirm that the worker is transported by appropriate means to the nearest urgent care facility (normally a hospital emergency room).

9.3.1 Emergency Care Steps

- Survey the scene. Determine whether it is safe to proceed. Try to determine whether the conditions that caused the incident are still a threat. Protect yourself from exposure before attempting to rescue the victim.

- Do a primary survey of the victim. Check for airway obstruction, breathing, and pulse. Assess likely routes of chemical exposure by examining the eyes, mouth, nose, and skin of the victim for symptoms.

- Phone Emergency Medical Services (EMS) 911. Give the location, telephone number used, caller’s name, what happened, number of victims, victim’s condition, and help being given.

- Maintain airway and perform rescue breathing, as necessary.

- Perform CPR, as necessary.

- Do a secondary survey of the victim. Check vital signs and do a head-to-toe exam.

- Treat other conditions as necessary. If the victim can be moved, take him/her to a location away from the work area where EMS can gain access.

9.4 First Aid – General

All persons must report any injury or illness to their immediate supervisor or the contractor’s SS. Trained personnel will provide first aid. Injuries and illnesses requiring medical treatment must be documented. The contractor’s SS and HSS must conduct an investigation as soon as emergency conditions no longer exist and first aid and/or medical treatment has been provided. Incident investigations must be completed and submitted to the Project Coordinator, HSO, and PM within 24 hours after the incident.

If first aid treatment is required, first aid kits are kept at the CRZ. If treatment beyond first aid is required, the injured person(s) should be transported to the designated medical facility. If the injured person is not ambulatory, or shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedics should be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service examine and transport the worker.

9.4.1 First Aid – Inhalation

Any employee complaining of symptoms of chemical overexposure as described in Section 4 (General Safety Practices), will be removed from the work area and transported to the designated medical facility for examination and treatment.

9.4.2 First Aid – Ingestion

Call EMS at 911 and consult a poison control center for advice. Refer to the MSDS (if available) for treatment information. If the victim is unconscious, keep him/her on his/her side and clear the airway if vomiting occurs.

9.4.3 First Aid – Skin Contact

Project personnel who have had skin contact with contaminants will, unless the contact is severe, proceed through the CRZ, to the wash area. Personnel will remove any contaminated clothing and then flush the affected area with water for at least 15 minutes. The worker should be transported to the designated medical facility if he/she shows any sign of skin reddening, irritation, or if he/she requests a medical examination.

9.4.4 First Aid – Eye Contact

Project personnel who have had contaminants splashed in their eyes or who have experienced eye irritation while in the EZ must immediately proceed to the eyewash station in the CRZ. Do not decontaminate prior to using the eyewash. Remove whatever protective clothing is necessary to use the eyewash. Flush the eye with clean, running water for at least 15 minutes. Arrange prompt transport to the designated medical facility.

9.5 Reporting Injuries, Illnesses, and Near Miss Incidents

Injuries and illnesses, however minor, will be reported to the contractor's SS immediately. The contractor's SS will complete an injury report and submit it to the Project Coordinator, HSO, and PM within 24 hours.

Near-miss incidents are situations during which no injury or property damage occurred, but during which, under slightly different circumstances, an injury or property damage could have occurred. Near misses are caused by the same factors as injuries; therefore, they must be reported and investigated in the same manner. An RSA must be conducted immediately after an injury, illness, near miss, or other incident to determine whether it is safe to proceed with the work.

9.6 Emergency Information and Hospital Directions

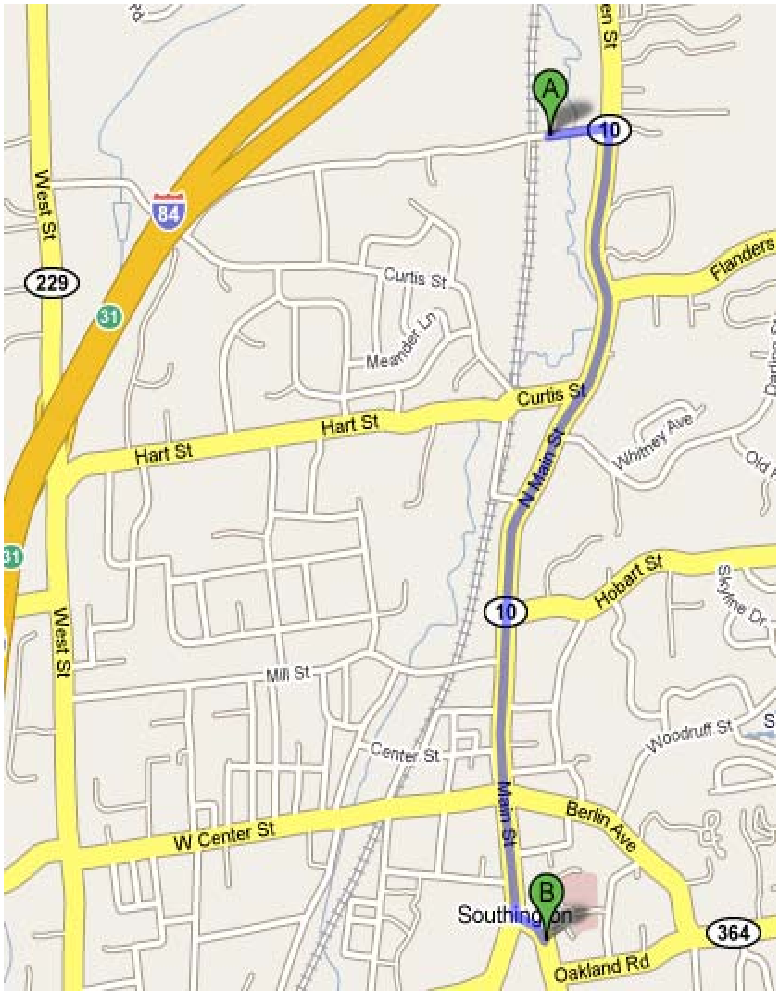
The means to summon local public response agencies such as police, fire, and ambulance will be reviewed in the daily safety meeting. These agencies are identified in Table 7.

Table 7 – Emergency Contacts

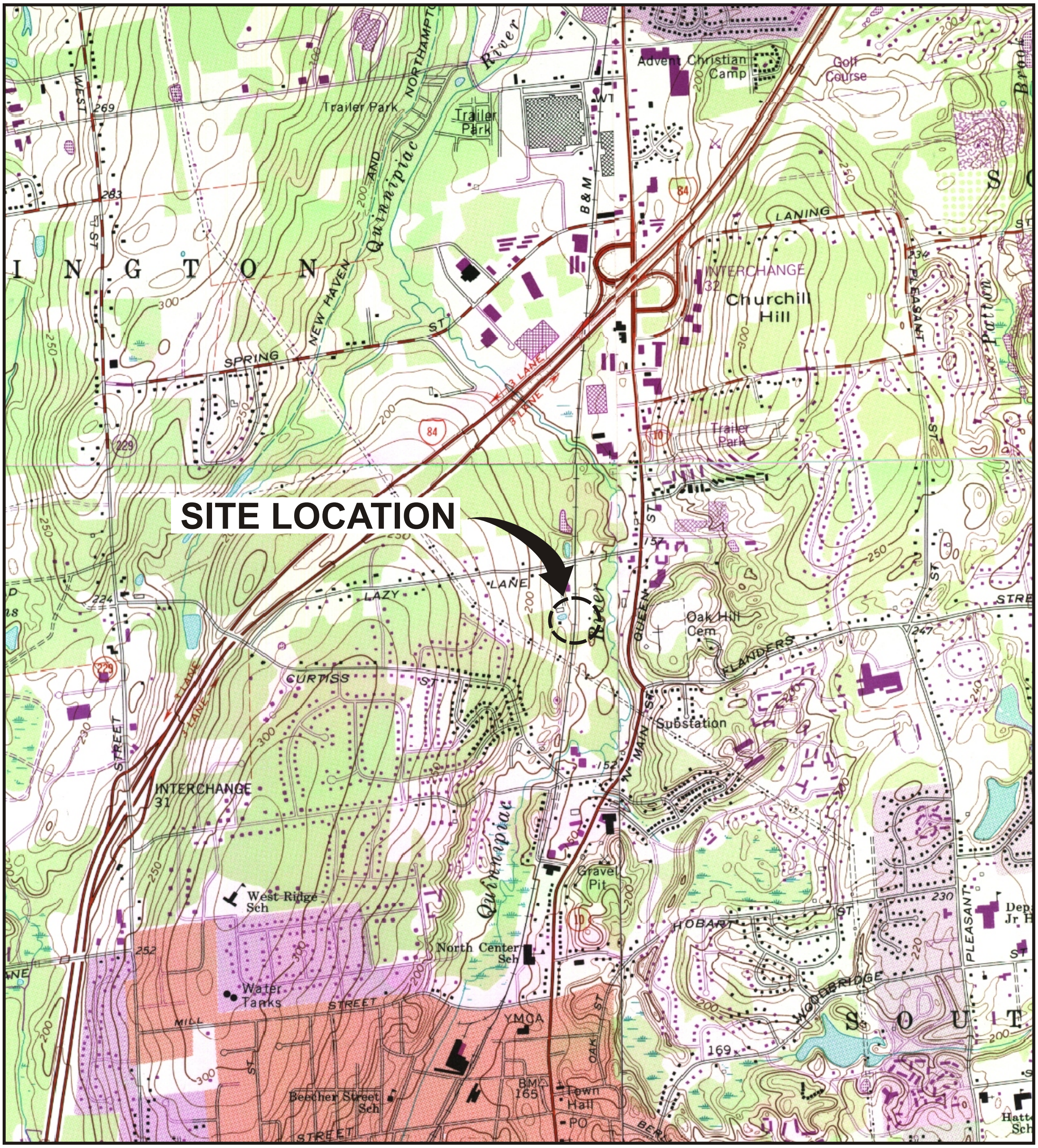
Agency	Telephone No.
Fire	911
Police	911
Ambulance	911
Hospital: Bradley Memorial Hospital 81 Meriden Avenue Southington, CT	860-276-5000
State Environmental Agency:	860-424-3000
USEPA – Region 1:	888-372-7341
Poison Control:	800-222-1222

Directions to Hospital

Driving directions to 81 Meriden Ave, Southington, CT 06489 - **2.0 mi** – about **5 mins**			
A	90 Lazy Lane, Southington, CT 06489		
1.	Head **east** on **Lazy Lane** toward **CT-10/Queen Street**	📷	0.1 mi
2.	Turn **right** at **CT-10/Queen Street** Continue to follow CT-10	📷	1.8 mi
3.	Turn **left** at **CT-120/Meriden Avenue** Destination will be on the left	📷	0.1 mi
B	81 Meriden Avenue Southington, CT 06489	📷	



Figures



REFERENCE: SOUTHINGTON, CONN. USGS QUAD. 1968 PR 1992, MERIDEN, CONN. USGS QUAD. 1966 PR 1984, NEW BRITAIN, CONN. USGS QUAD. 1966 PR 1984, & BRISTOL, CONN. USGS QUAD 1967 PR 1984.

2000' 0 2000'

Approximate Scale: 1" = 2000'

Area Location

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

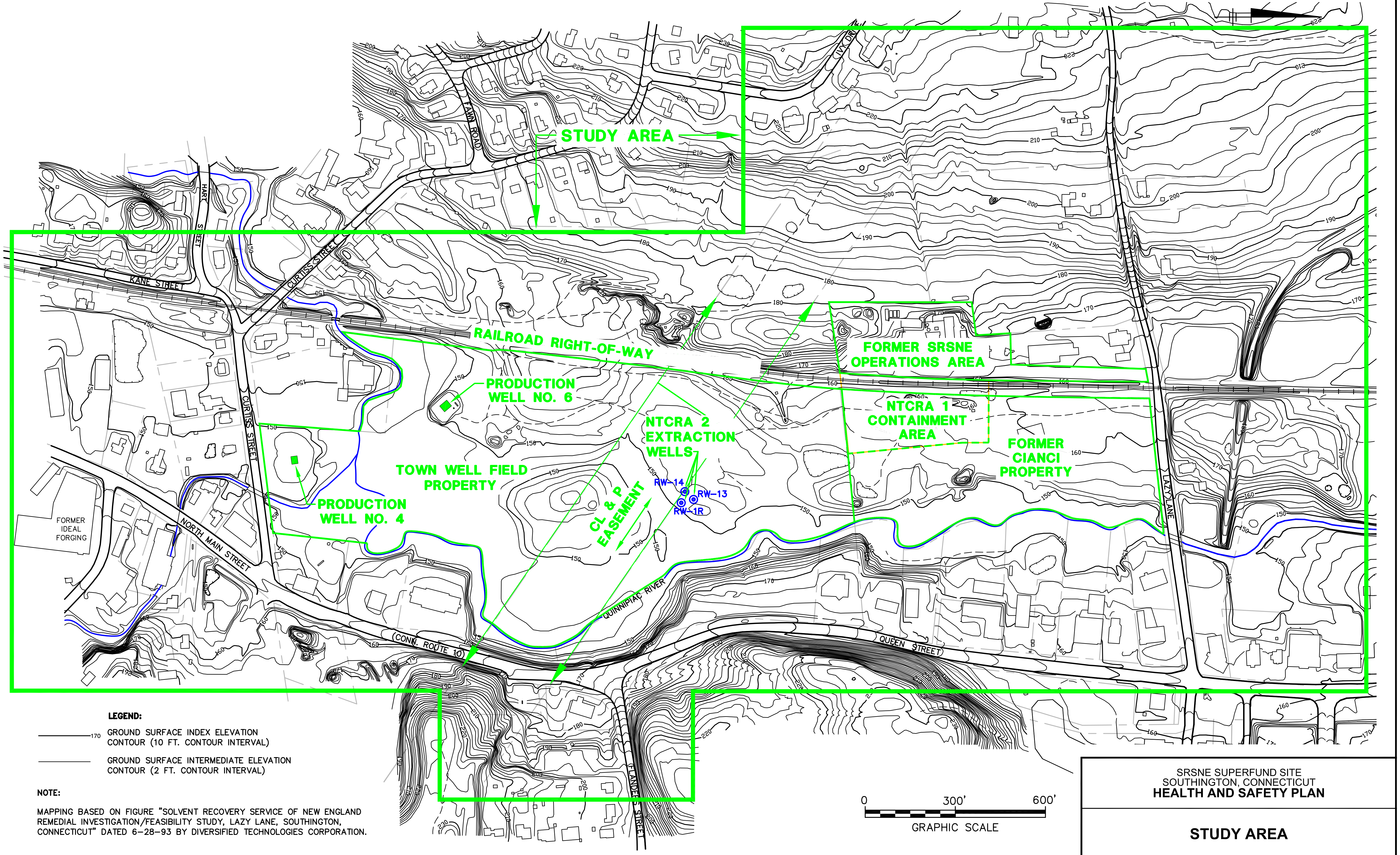
HEALTH AND SAFETY PLAN

SITE LOCATION MAP

ARCADIS

FIGURE
D-1

03/31/09 SYRACUSE, NY-ENV/CAD-DJH
B0054634/0000/20003/CDR/54634N01.CDR



LEGEND:

170	GROUND SURFACE INDEX ELEVATION CONTOUR (10 FT. CONTOUR INTERVAL)
	GROUND SURFACE INTERMEDIATE ELEVATION CONTOUR (2 FT. CONTOUR INTERVAL)

NOTE:

MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
HEALTH AND SAFETY PLAN

STUDY AREA

ARCADIS

FIGURE
D-2

CITY: SYRACUSE, NY GROUP: ENVCAD DB: PGL GMS RCB PM: M. GEFELL LYR: ON=*;OFF=REF
G:\ENVCAD\SYRACUSE\ACT\B0054634\0000\20003\DWG\54634B01.DWG LAYOUT: D-2 SAVED: 3/31/2009 9:50 AM ACADVER: 17.0S (LMS TECH) PAGESETUP: ################ PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 3/31/2009 9:51 AM BY: BASSETT, RICHARD
XREFS: IMAGES: PROJECTNAME: ----
54634X01

Appendices

ARCADIS

Appendix D-1

Task Safety Analysis

Task Safety Analysis

JSA Type: ☐ Transport ☐Office ☐ Construction | New X Revised | Date:

Co: | Dept: | Div: | Org Unit: | Loc:

Work Type: | Work Activity:

Personal Protective Equipment (PPE):

Development Team	**Position/Title**	**Reviewed By**	**Position/Title**	**Date**

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g. site managers, inspectors, clients, subcontractors, etc.). A tailgate safety meeting must be performed and documented at the beginning of each work day. Risk Self Assessment (RSA) procedures must be used throughout the project. Weather conditions (heat, cold, rain, and lightning) must also be considered.

❶ **Job Steps**	❷ **Potential Hazard**	❸ **Critical Actions**

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Appendix D-2

Equipment Pre-Operation Inspection Form

ARCADIS
Infrastructure, environment, buildings

EQUIPMENT PRE-OPERATION INSPECTION FORM

A manufacturers equipment specific checklist can be used in lieu of this form

Date: ____ Hours Start: ________________________

Unit: ____ Hours End: _________________________

Operator: ____ Shift: ______________________________

CHECK BEFORE OPERATING	OK	NR	COMMENTS
Seat Belts			
Back-up Alarm			
Brakes (service/retarder, secondary, park)			
Low Air Pressure			
Steering Components			
Speedometer			
Tires (flats/lug nuts loose)			
Pins (hoist cylinders/body wiretainers)			
Auto Lube System (is truck lubricated?)			
Fluid Leaks			
Fluid Levels			
Lights (head, tail, brake, retarder, clearance, hazard, panel)			
Fire Extinguisher (portable)			
Glass/Mirrors (On excavators does the windshield stay in up position?			
Is the glass secure in the frame?)			
Horn Operable?			
Wheel Chocks			
Windshield Wipers			
Heater/Air conditioner (circle)			
Grab Irons/Steps/Ladders (circle)			
Frame Cracks/Bed Cracks/Nose Cone Assembly (circle)			
Clean Working Place			
Drain Air Tanks (main, secondary, governor)			
Operator's Seat/Passenger's Seat (circle)			
Suspensions			
Doors			
Safety Chains & Cables			
Exhaust System			
Air Cleaners			
Hoist Cylinders (hard to dumo)			
Canopy & Rock Guards			
Radio			
Automatic Electronic Traction Aid System			
Ducktail on Bed Intact?			
Does Automatic Retarder Work Correctly			
Gauges and All Other Warning Devices			
Starter			
Switches			

NR = Needs Repair

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Appendix D-3

Underground/Overhead Utility Checklist

ARCADIS
Infrastructure, environment, buildings

Underground / Overhead Utility Checklist

Project Name:	**Date:**
Project Number:	**Location:**
Prepared By:	**Project Manager:**

This checklist must be completed for any intrusive subsurface work such as excavation or drilling. It documents that overhead and underground utilities in the work area are identified and located. The Project Manager shall request utility markouts before the start of field operations to allow the client and utility companies sufficient time to provide them. If complete information is not available, a magnetometer or other survey shall be performed to locate obstacles prior to intrusive subsurface activities.

Procedure: A diagram of the work area depicting the proposed location of intrusive subsurface work sites (i.e., boring locations, excavation locations) must be attached to this form. The diagram must clearly indicate the areas checked for underground structures / utilities, and overhead power lines. This form and the diagram must be signed by the Project Manager (if present), the Site Supervisor, and the client representative.

Type of Structure	Present	Not Present	Method of Markout
Electric Power Line			
Natural Gas Line			
Telephone Line			
Water Line			
Product Line			
Sewer Line			
Steam Line			
Drain Line			
Underground Tank			
Underground Cable			
Overhead Power Line			
Overhead Product Line			
Other (Specify)			

Reviewed By

Name	Job Title	Date
	Client Representative	
	Project Manager	
	Site Supervisor	

Appendix D-4

Periodic Excavation Inspection Form

ARCADIS
Infrastructure, environment, buildings

Periodic Excavation Inspection Checklist

Project Name:	**Date / Time:**
Project Number:	**Location:**
Prepared By:	**Project Manager:**

This checklist must be completed for all excavations. It documents that daily and post-event / periodic inspections are conducted.

Soil Classified As: Stable Rock Type A Type B Type C

Soil Classified On: By:

Type of Protective System in Use: Sloping Shoring Other _______________

Description:

Inspection Item	YES	NO	Comments
Is the underground / overhead utilities checklist completed?			
Are underground installations protected from damage?			
Are adequate means of entry / exit available in the excavation?			
If exposed to traffic, are personnel wearing reflective vests?			
Do barriers exist to prevent equipment from rolling into the excavation?			
Was air monitoring conducted prior to and during excavation entry?			
Was the stability of adjacent structures reviewed by a registered P.E.?			
Are spoil piles at least 2 feet from the excavation edge?			
Is fall protection in use near excavations deeper than 6 feet?			
Are work tasks completed remotely if feasible?			
Is a protective system in place and in good repair?			
Is emergency rescue (lifeline / body harness) equipment used due to potential atmospheric hazard?			
Is excavation exposed to vibration?			
Are employees protected from falling / elevated material?			
Is soil classification adequate for current environmental / weather conditions?			
Do portable ladders extend at least 4 feet above the excavation?			
Are portable ladders or ramps secured in place?			
Have all personnel attended safety meeting on excavation hazards?			
Are support systems for adjacent structures in place?			
Is the excavation free from standing water?			
Is water control and diversion of surface runoff adequate?			
Are employees wearing required protective equipment?			

Excavation Competent Person:	**Date/Time:**

Appendix D-5

Chemical Hazard Information

Solvents Recovery Service of New England, Southington, CT
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP^1 (eV)	Odor Threshold (ppm)	Route^2	Symptoms of Exposure	Treatment	TWA^3	STEL^4	Source^5	IDLH (NIOSH)^6
Acetone [67-64-1]	9.7	13-100	Inh Ing Con	Irritated eyes, nose, and throat; headache; dizziness; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1000 ppm 500 ppm 250 ppm		PEL TLV REL	20,000 ppm
Arsenic and soluble inorganic compounds (as As) [7740-38-2]	NA	NA	Inh Abs Ing Con	Ulceration of nasal septum; dermatitis; gastrointestinal disturbances; hyperpigmentation of skin (carcinogenic); peripheral neuropathy; respiratory irritation	Eye: Irrigate immediately (15 min) Skin: Soap wash immediately Swallow: Immediate medical attention	0.01 mg/m^3 0.01 mg/m^3 (Ca-29 CFR 1910.1018)	C0.002 mg/m^3	PEL TLV REL	Ca (5 mg/m^3)
Barium soluble compounds (as Ba) [7440-39-3]	ND	NA	Inh Ing Con	Upper respiratory irritation; gastroenteritis; muscular spasms; slow pulse, extra systoles; hypokalemia; eye and skin irritation; skin burns	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	0.5 mg/m^3 0.5 mg/m^3 0.5 mg/m^3		PEL TLV REL	50 mg/m^3
Benzene [71-43-2]	9.24	34-119	Inh Abs Ing Con	Irritated eyes, nose, and respiratory system; giddiness; headache; nausea; staggered gait; fatigue; anorexia, lassitude; dermatitis; bone marrow depression – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (0.5 ppm) NIC-0.1 skin 0.1 ppm	2.5 ppm	PEL TLV REL	Ca (500 ppm)* *OSHA 29 CFR 1910.1028
Beryllium and compounds (as Be) [7440-41-7]	NA	NA	Inh	Respiratory systems; weakness, fatigue, weight loss – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.002 mg/m^3 0.002 mg/m^3	C0.005 mg/m^3	PEL TLV REL	Ca (4 mg/m^3)
2-Butanol [78-92-2]			Inh Con	throat irritation, cough, and difficulty breathing; headache, nausea and vomiting, diarrhea, muscle weakness, giddiness, ataxia, confusion, delirium, and coma.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	150 ppm 100 ppm 100 ppm,	150 ppm	PEL TLV REL	2000 ppm
2-Butanone (MEK) [78-93-3]	9.54	NE	Inh Ing Con	Irritated eyes, skin, nose; headache dizziness; vomiting; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	200 ppm 200 ppm 200 ppm	300 ppm 300 ppm	PEL TLV REL	3000 ppm
Cis-1,2-Dichloroethene 156-59-2	9.65	17	Inh Ing Con	Irritated eyes, nausea, vomiting, and epigastric distress. Symptoms of exposure-related narcosis including drowsiness, tremor, incoordination, dizziness, and weakness; defatting of skin/dermatitis	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	200 ppm 200 ppm 200 ppm		PEL TLV REL	1000 ppm
Cadmium dust (as Cd) [7440-43-9]	NA	NA	Inh Ing	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscular aches; nausea, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.005 mg/m^3 0.01 mg/m^3 Ca, lowest feasible concentration		PEL TLV REL	Ca (9 mg/m^3)

Solvents Recovery Service of New England, Southington, CT
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Carbon Tetrachloride 56-23-5	11.47	NA	Inh Abs Ing Con	Irritation to eyes, skin; CNS depression; nausea, vomiting, drowsiness, dizziness	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	10 ppm; Ceiling: 25ppm, 200 ppm, 5-minute maximum peak in any 4 hours 5 ppm 2 ppm, 60 minutes	2 ppm, 60 minutes	PEL TLV REL	200 ppm
Chloroethane [75-00-3]			Inh Abs	highly discomforting to the upper respiratory tract and lungs and may be harmful if inhaled. Depression of the central nervous system Ingestion may result in nausea, abdominal irritation, pain and vomiting	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1000 ppm 100 ppm; skin		PEL TLV REL	3800 ppm (10% LEL).
Chromium metal (as Cr) [7440-47-3]	NA	NA	Inh Ing	Histologic fibrosis of lungs	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 0.5 mg/m^3 0.5 mg/m^3		PEL TLV REL	250 mg/m^3
Coal-tar-pitch volatiles (benzene-soluble fraction) (polynuclear aromatic hydrocarbons [PAH]) [65996-93-2]	ND	ND	Ing Con	Eye sensitivity to light; eye and skin irritation, dermatitis, bronchitis; carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m^3 0.2 mg/m^3 0.1 mg/m^3		PEL TLV REL	Ca [80 mg/m^3]
Copper dusts and mists (metal) (copper sulfate) [7440-50-8]	NA	NA	Inh Ing Con	Irritated pharynx and nasal mucous membrane; nasal perforation; eye irritation; metallic taste; dermatitis; in animals: lung, kidney, and liver damage; anemia	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 1 mg/m^3 1 mg/m^3		PEL TLV REL	100 mg/m^4
1,2-Dichloroethane (ethylene dichloride) (107-06-02	11.05	ND	Inh Abs Ing Con	Depressed cns, nausea, vomiting, dermatitis, irritated eyes, corneal opacity. Carcinogenic	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	50 ppm w/ceiling 100ppm 10 ppm 1 ppm	2 ppm 2 ppm	PEL TLV REL	Ca (50 ppm)
1,2 Dichloroethylene (DCE) 540-59-0	9.65		Inh Ing Con	Irritated eyes, respiratory system; CNS depression	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	200 ppm 200 ppm 200 ppm		PEL TLV REL	1000 ppm
1,1-Dichloroethane [75-35-3]	11.06		Inh Ing Con	Irritated skin; CNS depression, liver, kidney, lung damage	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm	300 ppm	PEL TLV REL	
1,1-Dichlorethane 75-34-3			Inh Ing Con	Irritation to eyes, skin and respiratory tract; dizziness, coughing, staggering, disturbed vision, irregular heartbeat, unconsciousness	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Move to fresh air, respiratory support Swallow: Medical support, do not induce vomiting	100 ppm 100 ppm 100 ppm		PEL TLV REL	3000 ppm
1,1-Dichloroethene (vinylidene chloride) [75-35-4]	8.20	ND	Ing Inh Con Abs	Irritated eyes, skin, throat; dizziness, headache, nausea; dyspnea; liver, kidney dysfunction, pneuitis; carcinogen	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	 5 ppm		PEL TLV REL	

Solvents Recovery Service of New England, Southington, CT
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Ethylbenzene [100-41-4]	8.76	0.09-0.6	Inh Ing Con	Irritated eyes, mucous membranes; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	800 ppm
Ethanol [64-17-5]			Inh Con Ing	discomforting to the upper respiratory tract; vapor is discomforting to the eyes; liquid is mildly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention		1000 ppm 1000 ppm	PEL TLV REL	3300 ppm (10% LEL)
Iron oxide, dust and fumes (as Fe) [1309-37-1]	NA	NA	Inh	Non-progressive dust-caused lung disease, with x-ray shadows indistinguishable from progressive fibrous lung disease	Breath: Respiratory support	10 mg/m^3* 5 mg/m^3 5 mg/m^3* *total particulate		PEL TLV REL	2500 mg/m^3
Lead, inorganic dusts and fumes (as Pb) [7439-92-1]	NA	NA	Inh Ing Con	Weakness, lassitude, insomnia; facial pallor; eye pallor; anorexia, low weight, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremors; wrist and ankle paralysis; brain damage; kidney damage; irritated eyes; hypotension	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.05 mg/m^3 0.05 mg/m^3 <0.1 mg/m^3 See 29 CFR 1910.1025		PEL TLV REL	100 mg/m^3
Manganese, dust and compounds (as Mn) [7439-96-5]	NA	NA	Inh Ing	Parkinson's; asthenia, insomnia, mental confusion; metal fume fever; dry throat, cough, tight chest, dyspnea, rales, flu-like fever; low back pain; vomiting; malaise; fatigue	Breath: Respiratory support Swallow: Immediate medical attention	 0.2 mg/m^3 1 mg/m^3	C5 mg/m^3 3 mg/m^3	PEL TLV REL	500 mg/m^3
Magnesium metal [7439-95-4]	ND	ND	Inh Abs Ing Con	Irritated upper respiratory tract, eyes, and skin; coughing, conjunctivitis; small blisters; nausea, vomiting, hypotension	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	NE		PEL TLV REL	
Methyl alcohol (Methanol) 67-56-1	10.84	2000 ppm	Inh Abs Ing Con	Irritated eyes, skin, upper respiratory syst; head drowsiness, dizziness, vertigo, nausea, vomiting;blindness	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	200 ppm 200 ppm 200 ppm	250 ppm	PEL TLV REL	6000 ppm
4-Methyl-2-Pentanone (Methyl isobutyl ketone, hexanone) [108-10-1]	9.3		Inh Ing Con	Irritated eyes, skin, mucous membrane, headache, narcosis, coma; dermatitis; in animals:liver kidney damage	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm 50 ppm			500 ppm
Mercury vapor [7439-97-6]	ND	ND	Inh Abs Con	Coughing, chest pain, dyspnea, bronchial pneumonitis; tremors, insomnia; irritability, indecision; headache; fatigue, weakness, stomatitis, salivation; gastrointestinal disturbance, anorexia, low weight; proteinuria; irritated eyes and skin	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.05 mg/m^3 0.025 mg/m^3 0.05 mg/m^3 (skin)	C0.1 ppm C0.1 ppm	PEL TLV REL	2 mg/m^3
Methylene chloride (dichloromethane) [75-09-2]	11.32	ND	Inh Ing Con	Fatigue, weakness, sleepiness, lightheadedness; numbness and tingling in limbs; nausea; irritated eyes and skin	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	25 ppm 50 ppm	C1,000 ppm C2,000 mg/m^3 (5 min in 2 hrs)	PEL TLV REL	Ca (2300 ppm)

Solvents Recovery Service of New England, Southington, CT
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Naphthalene [91-203]	8.12	ND	Inh Abs Ing Con	Irritated eyes; headache; confusion, excitement, malaise; nausea, vomiting, abdominal pain; irritated bladder, profuse sweating; jaundice, renal shutdown; dermatitis	Eye: Irrigate immediately Skin: Molten flush immediately/ sol-liq soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	10 ppm 10 ppm 10 ppm	 15 ppm	PEL TLV REL	250 ppm
Nickel, metal, and other compounds (as Ni) [7440-02-0]	NA	NA	Inh Ing Con	Headache, vertigo; nausea, vomiting, epigastric pain; substernal pain; coughing, hyperpnea; cyanosis; weakness; leukocytosis, pneumonitis; delirium, convulsions – carcinogenic	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 1.5 mg/m^3* 0.015 mg/m^3 Ca *NIC-0.05 A1		PEL TLV REL	Ca 10 mg/m^3
Phenol [108-95-2]	8.5	0.040-3.0	Inh Abs Ing Con	Irritated eyes, nose, and throat; anorexia, low weight; weakness, muscular aches and pains; dark urine; cyanosis; liver and kidney damage; skin burns; dermatitis; ochronosis; tremors, convulsions, twitching	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	5 ppm (skin) 5 ppm (skin) 5 ppm (skin)	 C15.6 ppm	PEL TLV REL	250 ppm
Polychlorinated biphenyls (PCB) Aroclor 1242 [53469-21-9] and Aroclor 1254 [11097-69-1]	ND	ND	Inh Abs Ing Con	Aroclor 1242: irritated eyes; chloracne; acne-form dermatitis; mildly toxic by ingestion; poison by subcutaneous route – carcinogenic Aroclor 1254: irritated eyes and skin; acne-form dermatitis; poison by intravenous route; moderately toxic by ingestion and intraperitoneal routes – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	Aroclor 1242: 1 mg/m^3 (skin) 1 mg/m^3 (skin) 0.001 mg/m^3 Aroclor 1254: 0.5 mg/m^3 (skin) 0.5 mg/m^3 (skin) 0.001 mg/m^3		 PEL TLV REL PEL TLV REL	 Ca (10 mg/m^3) Ca (5 mg/m^3)
2-Propanol [ISO5300]			Inh Abs Ing Con	irritating to the respiratory tract and can cause central nervous system depression; nausea and vomiting, headache, facial flushing, dizziness, lowered blood pressure, mental depression, hallucinations and distorted perceptions, difficulty breathing, respiratory depression, stupor, unconsciousness, and coma. Kidney insufficiency including oliguria (reduced urine excretion), anuria (absent urine excretion), nitrogen retention, and edema (fluid build-up in tissues) may occur.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	400 ppm 200 ppm 400 ppm	 400 ppm	PEL TLV RELs	2000 ppm (10% LEL).
Silver (metal) [7440-22-4]	NA	NA	Inh Ing Con	Blue-gray eyes, nasal septum, throat, and skin; irritated skin, ulceration; gastrointestinal disturbance	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	0.01 mg/m^3 0.1 mg/m^3 0.01 mg/m^3		PEL TLV REL	10 mg/m^3
Styrene [100-42-5]	8.40	ND	Inh Abs Ing Con	Irritated eyes, nose, and respiratory system; headache; fatigue, dizziness, confusion, malaise, drowsiness, unsteady gait; narcosis; defatting dermatitis; reproductive effects	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 20 ppm 50 ppm	 100 ppm	PEL TLV REL	700 ppm

Solvents Recovery Service of New England, Southington, CT
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Tetrahydrofuran [109-99-7]			Ing Con	moderately discomforting to the upper respiratory tract. Inhalation of vapor may aggravate a pre-existing respiratory condition. Overexposure by inhalation may result in the irritation of the mucous membrane and cause coughing, chest pains, nausea, dizziness, headache and narcosis. Exposure to high concentrations can affect the central nervous system skin contact may cause reactions which may lead to dermatitis. certain grades of tetrahydrofuran may cause liver and kidney damage.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	200 ppm 200 ppm 200 ppm	 250ppm 250ppm	PEL TLV REL	2000 ppm (10% LEL).
Tetrachloroethylene (perchloroethylene) [127-18-4]	9.32	ND	Inh Abs Ing Con	Irritation to eyes, skin, nose, throat, and respiratory system; nausea; flush face, neck; vertigo, dizziness, incoordination; headache, somnolence; skin erythema; liver damage; carcinogen	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 25 ppm	C 200 ppm, 300 ppm (5-min maximum peak in any three hours)	PEL TLV REL	150 ppm
Thallium [7440-28-0]	ND	ND	Inh Abs Ing Con	Irritated eyes and skin; nausea, vomiting, diarrhea; headache; chest pain or tightness; excessive salivation	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.1 mg/m^3 0.1 mg/m^3 0.1 mg/m^3		PEL TLV REL	15 mg/m^3
Trichloroethylene (TCE, trichloroethene) [79-01-6]	9.45	21.4	Inh Ing Con	Headache, vertigo; visual disturbance, tremors, somnolence, nausea, vomiting; irritated eyes; dermatitis; cardiac arrhythmia, paresthesia – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm 25 ppm (10-hour)	C200 ppm C100 ppm C2 ppm (60 MIN)	PEL TLV REL	Ca (1,000 ppm)
1,1,1-Trichloroethane (methyl chloroform) [71-55-6]	11.0		Inh Ing Con	Irritated eyes, skin; headache, lassitude, CNS depression, poor equilibrium, dermatitis, cardiac arrhythmia; liver damage	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	350 ppm 350 ppm	450 ppm C 350 ppm	PEL TLV REL	700ppm
Vanadium pentoxide (as dust) [1314-62-1]			Inh Ing Con	Irritated eyes, skin, throat; green toung, metallic tase; eczema; cough; fine rales, wheezing, bronchitis dyspnea (breathing difficulty)	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	 0.5 ppm	 C0.5 mg/m^3 (respirable)	PEL TLV REL	35 mg/m^3
Vinyl chloride [75-01-4]	9.99	25	Inh Con	Intoxication, weakness; abdominal pain; GI bleeding; enlarged liver; pallor; cyanosis of extremities	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 ppm 1 ppm	5 ppm	PEL TLV REL	Ca
Xylene (o-, m-, and p-isomers) [1330-20-7; 95-47-6; 108-38-3; 106-42-3]	8.56 8.56 8.44	1.1-20	Inh Abs Ing Con	Dizziness, excitement, drowsiness, incoordination, staggering gait; irritated eyes, nose, throat; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	150 ppm 150 ppm 150 ppm	PEL TLV REL	900 ppm

CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Zinc (as oxide fume) [1314-13-2]	NA	NA	Inh	Sweet metallic taste; dry throat, cough, chills, fever; tight chest, dyspnea, rales, reduced pulmonary function; headache; blurred vision; muscular cramps, low back pain; nausea, vomiting; fatigue, lassitude, malaise	Breath: Respiratory support	5 mg/m^3 5 mg/m^3 5 mg/m^3	10 mg/m^3	PEL TLV REL	50 mg/m^3

[1]IP = Ionization potential (electron volts).
[2]Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; and Con, Skin and/or eye contact.
[3]TWA = Time-weighted average. The TWA concentration for a normal workday (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[4]STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the TWA is not exceeded.
[5]PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
[5]TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value – TWA.
[5]REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.
[6]IDLH (NIOSH) = Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = None established. No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990, 1997).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
ND = Not Determined.
LEL = Lower explosive limits.
LC_{50} = Lethal concentration for 50 percent of population tested.
LD_{50} = Lethal dose for 50 percent of population tested.
NIC = Notice of intended change (ACGIH).

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Appendix D-6

Material Safety Data Sheets

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

Acetone
MSDS 300
ACE4750

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Acetone **CAS Number:** 67-64-1

Chemical Formula: C_3H_6O

Structural Chemical Formula: CH_3COCH_3

Synonyms: ACETON; ACETONE; CHEVRON ACETONE; DIMETHYL KETONE; DIMETHYLFORMALDEHYDE; DIMETHYLKETAL; EPA PESTICIDE CHEMICAL CODE 004101; KETONE PROPANE; KETONE,DIMETHYL; BETA-KETOPROPANE; METHYL KETONE; 2-PROPANONE; PROPANONE; PYROACETIC ACID; PYROACETIC ETHER

General Use: Solvent for fats, oils, waxes, resins, rubber, plastics, lacquers.
Used in manufacture of methyl isobutyl ketone, mesityl oxide, acetic acid, diacetone alcohol, isoprene. Used in solvent extraction processes.
Solvent in the manufacture of explosives and rayon. Component of adhesives, glues, cleaning solvents, lacquer thinners, nail polish, paint removers.
Storing acetylene gas (takes up about 24 times its volume of the gas).
Purifying paraffin and biomedical hardening and dehydrating tissues.
Minor food additive, permitted in USA.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
acetone	67-64-1	95-99.5

OSHA PEL
TWA: 1000 ppm; 2400 mg/m^3.

NIOSH REL
TWA: 250 ppm; 590 mg/m^3.

DFG (Germany) MAK
TWA: 500 ppm; 1200 mg/m^3.

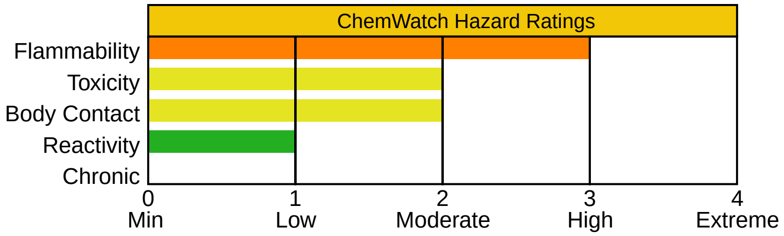
OSHA PEL Vacated 1989 Limits
TWA: 750 ppm; 1800 mg/m^3;
STEL: 1000 ppm; 2400 mg/m^3.

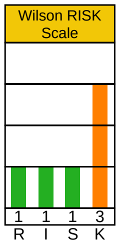
IDLH Level
2500 ppm; LEL.

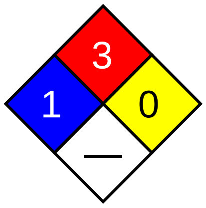
ACGIH TLV
TWA: 750 ppm; 1780 mg/m^3;
STEL: 1000 ppm; 2380 mg/m^3.

Section 3 - Hazards Identification

HMIS	
1	Health
3	Flammability
0	Reactivity







Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, highly volatile liquid; sweet odor. Irritating. Also causes: muscle weakness, mentaI confusion, coma (high concentrations). Ingestion: GI irritation, kidney and liver damage, metabolic changes, coma. Chronic: dermatitis. Highly flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact, ingestion

Target Organs: respiratory system, central nervous system (CNS), skin

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract.

Inhalation hazard is increased at higher temperatures.

Exposure to ketone vapors may produce nose, throat and mucous membrane irritation. High concentrations of vapor may produce central nervous system depression characterized by headache, vertigo, loss of coordination, narcosis and cardiorespiratory failure. Some ketones produce neurological disorders (polyneuropathy) characterized by bilateral symmetrical paresthesia and muscle weakness primarily in the legs and arms.

Symptoms of exposure may include restlessness, headache, vomiting, stupor, low blood pressure and rapid and irregular pulse, eye and throat irritation, weakness of the legs, dizziness and lightheadedness.

Inhalation of high concentrations produces dryness of the mouth and throat, dizziness, nausea, incoordinated movements, loss of coordinated speech, drowsiness, and in extreme cases, coma.

Inhalation of acetone vapors over long periods causes irritation of the respiratory tract, coughing, headache. Acetone concentrations of 52200 ppm for 1 hour produced narcosis in rats and fatalities at 126600 ppm.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration.

The vapor is discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin if exposure is prolonged and may cause drying of the skin, which may lead to dermatitis.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting and mildly toxic if swallowed but may be harmful if swallowed in quantity.

Small amounts or low dose rates are regarded as practically non-harmful.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Workers exposed to 700 ppm acetone for 3 hours/day for 7-15 years showed inflammation of the respiratory tract, stomach and duodenum, attacks of giddiness and loss of strength. Exposure to acetone may enhance liver toxicity of chlorinated solvents.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.

Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.

Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water.

Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to acetone:

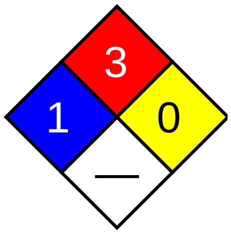
1.Symptoms of acetone exposure approximate ethanol intoxication.

2.About 20% is expired by the lungs and the rest is metabolized.

Alveolar air half-life is about 4 hours following two hour inhalation at levels near the Exposure Standard; in overdose, saturable metabolism and limited clearance, prolong the elimination half-life to 25-30 hours.

3.There are no know antidotes and treatment should involve the usual methods of decontamination followed by supportive care.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: -20 °C
Autoignition Temperature: 465 °C
LEL: 2.15% v/v
UEL: 13% v/v
Extinguishing Media: Water spray or fog; alcohol stable foam.
Dry chemical powder.
Bromochlorodifluoromethane (BCF) (where regulations permit).
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
PLEASE NOTE: 10% of acetone in water has a flash point below 20 deg. C.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Avoid breathing vapors and contact with skin and eyes.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Shut off all possible sources of ignition and increase ventilation.
Water spray or fog may be used to disperse vapor.
Stop leak if safe to do so. Contain spill with sand, earth or vermiculite.
Collect residues and place in flammable waste container.
Any electric cleaning equipment must be explosion proof.
Wash spill area with large quantities of water.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.

DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
None required when handling small quantities. OTHERWISE: If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves or Butyl rubber gloves or Neoprene rubber gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >1000 to <2500 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 2500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: use ov (black) cartridge for nuisance(<1000)

Other: Overalls. Ensure that there is ready access to eye wash unit and Ensure there is ready access to an emergency shower.

Glove Selection Index:

BUTYL/NEOPRENE	A
PE/EVAL/PE	A
PVDC/PE/PVDC	A
BUTYL	A
SARANEX-23 2-PLY	B
TEFLON	B
SARANEX-23	C
CPE	C
HYPALON	C
NITRILE+PVC	C
PVA	C
VITON/NEOPRENE	C
NEOPRENE	C
PVC	C
NATURAL+NEOPRENE	C
NATURAL RUBBER	C
NITRILE	C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless, highly volatile, highly flammable liquid with characteristic sweet odor. Mixes in alcohol, ether, most hydrocarbons and oils.

Physical State: Liquid
Vapor Pressure (kPa): 24 at 20 °C
Vapor Density (Air=1): 2.0
Formula Weight: 58.08
Specific Gravity (H_2O=1, at 4 °C): 0.79 at 20 °C
Water Solubility: Miscible
Evaporation Rate: 11 (BuAc=1) VFast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 56.2 °C (133 °F) at 760 mm Hg
Freezing/Melting Point Range: -95.35 °C (-139.63 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers, strong acids and strong alkalis.
Reacts violently with bromoform and chloroform in the presence of alkalies or in contact with alkaline surfaces.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (man) TD_{Lo}: 2857 mg/kg
Oral (rat) LD_{50}: 5800 mg/kg
Inhalation (human) TC_{Lo}: 500 ppm
Inhalation (man) TC_{Lo}: 12000 ppm/4 hr
Inhalation (man) TC_{Lo}: 10 mg/m^3/6 hr
Inhalation (rat) LC_{50}: 50100 mg/m^3/8 hr
Dermal (rabbit) LD_{50}: 20000 mg/kg

IRRITATION
Eye (human): 500 ppm - irritant
Eye (rabbit): 3.95 mg - SEVERE
Eye (rabbit): 20 mg/24 hr -moderate
Skin (rabbit): 395 mg (open) - mild
Skin (rabbit): 500 mg/24 hr - mild

See NIOSH, *RTECS* AL 3150000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on soil, it will both volatilize and leach into the ground and probably biodegrade. If released into water, it will probably biodegrade. It will also be lost due to volatilization (estimated half-life 20 hr from a model river). Bioconcentration in aquatic organisms and adsorption to sediment should not be significant. In the atmosphere, it will be lost by photolysis and reaction with photochemically produced hydroxyl radicals. Half-life estimates from these combined processes average 22 days and are shorter in summer and longer in winter. It will also be washed out by rain.

Ecotoxicity: LD_{100} Asellus aquaticus 3 ml/l (within 3 days of exposure) /Conditions of bioassay not specified; LC_{50} Mexican axolotl 20.0 mg/l/48 hr (3-4 weeks after hatching) /Conditions of bioassay not specified; TLm Mosquito fish 13,000 mg/l/24, 48, 96 hr /Conditions of bioassay not specified; LD_{100} Gammarus fossarum 10 ml/l (within 48 hr) /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 7,032 ppm/14 days /Conditions of bioassay not specified; LC_{50} Ring-necked pheasant oral greater than 40,000 ppm, in diet, age 10 days, (no mortality to 40,000 ppm); LC_{50} Salmo gairdneri (Rainbow trout) 5,540 mg/l/96 hr at 12 °C (95% confidence limit 4,740-6,330 mg/l), wt 1.0 g /static bioassay; LC_{50} Clawed toad 24.0 mg/l/48 hr (3-4 weeks after hatching) /Conditions of bioassay not specified; TLm Daphnia magna 10 mg/l/24, 48 hr /Conditions of bioassay not specified

Henry's Law Constant: 3.97×10^{-5}
BCF: negligible
Biochemical Oxygen Demand (BOD): theoretical 122%, 5 days
Octanol/Water Partition Coefficient: $\log K_{ow} = -0.24$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ACETONE
Hazard Class: 3.1
ID No.: 1090
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U002 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: ....1999-11 **Review Date:** 2000-07

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Issue Date: 2000-07

Acetylene Dichloride
MSDS 703
DIC4500

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Acetylene Dichloride **CAS Number:** 540-59-0
Chemical Formula: $C_2H_2Cl_2$
Structural Chemical Formula: ClCH=CHCl
Synonyms: ACETYLENE DICHLORIDE; CIS-ACETYLENE DICHLORIDE; TRANS-ACETYLENE DICHLORIDE; 1,2-DCE; 1,2-DICHLOR-AETHEN; 1,2-DICHLOROETHENE; 1,2-DICHLOROETHYLENE; CIS-TRANS-1,2-DICHLOROETHYLENE; DICHLORO-1,2-ETHYLENE; SYM-DICHLOROETHYLENE; TRANS-DICHLOROETHYLENE; DIOFORM; ETHENE,1,2-DICHLORO-; ETHYLENE,1,2-DICHLORO-
General Use: Solvent for organic materials, dye extraction, perfumes, lacquers, thermoplastics and organic syntheses. The trans-isomer being a "universal solvent" is more widely used than either the cis-isomer or the mixture.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
acetylene dichloride	540-59-0	>98

OSHA PEL
TWA: 200 ppm; 790 mg/m^3.

NIOSH REL
TWA: 200 ppm; 790 mg/m^3.

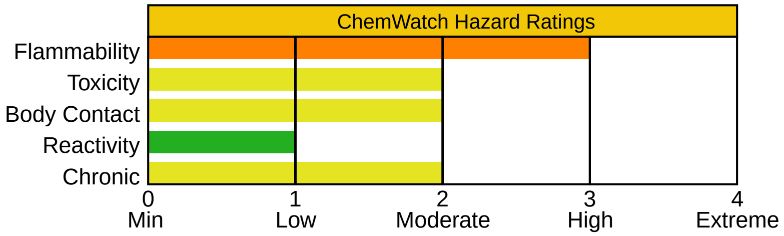
DFG (Germany) MAK
TWA: 200 ppm; 790 mg/m^3.

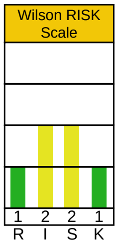
ACGIH TLV
TWA: 100 ppm; 793 mg/m^3.

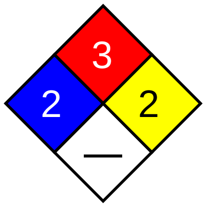
IDLH Level
1000 ppm.

Section 3 - Hazards Identification

HMIS
② Health
③ Flammability
① Reactivity







Fire Diamond

ANSI Signal Word
Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; pleasant odor. Irritating to eyes/skin/respiratory tract. Also causes: narcosis, nausea, tremor, weakness, CNS depression, epigastric cramps. Can form explosive mixtures in air. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion, skin contact, eye contact
Target Organs: central nervous system (CNS), eyes, respiratory system
Acute Effects
Inhalation: There is a single report of an industrial poisoning, a fatality caused by the inhalation of a vapor in a small enclosure.

Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.

Depression of the central nervous system is the most outstanding effect of most halogenated aliphatic hydrocarbons. Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin).

The most important effects of exposure are narcosis and irritation of the central nervous system. Liver responses may occur after repeated narcotic doses and involves fatty liver degeneration.

Vapor exposure may produce central nervous system depression or in milder exposures, nausea, vomiting, weakness, tremor and epigastric cramps.

Recovery is usually rapid. In rats, single and repeated inhalation exposures to 200 ppm acetylene dichloride and its isomers lead to temporary inhibition of mixed function oxidase system (MFO), fatty infiltration of the liver and morphological alterations to the lung. The cis isomer which is more readily taken up by liver tissue is a more potent inhibitor of rat MFO whereas at higher concentrations the trans-isomer is twice as strong a CNS depressant (rats and humans).

Eye: The vapor when concentrated has pronounced eye irritation; this gives some warning of high vapor concentrations. If eye irritation occurs seek to reduce exposure with available control measures, or evacuate area.

Exposure to the trans isomer at 2200 ppm caused burning of the eyes, vertigo, nausea.

Reversible corneal clouding has been described in exposures to acetylene dichloride

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis. The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: The liquid is discomforting to the gastrointestinal tract and toxic if swallowed.

Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: The material may accumulate in the human body and progressively cause tissue damage.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treatment should follow that practiced in carbon tetrachloride exposures.

1.Acute exposures to carbon tetrachloride present, initially, with CNS depression followed by hepatic and renal disfunction.
2.Respiratory depression and cardiac dysrhythmias are an immediate threat to life.
3.Since a major fraction of absorbed carbon tetrachloride is exhaled in first hour, good tidal volumes should be maintained in severely poisoned patients; hyperventilation may be an additional therapeutic modality.
4.Ipecac syrup, lavage, activated charcoal or catharsis may all be used in the first 4 hours.
5.Since reactive metabolites may cause hepatorenal toxicity, administration of N-acetyl-L-cysteine may reduce complications.

Experience with this therapy is limited.

Section 5 - Fire-Fighting Measures

Flash Point: 2 °C
Autoignition Temperature: 460 °C
LEL: 9.7% v/v
UEL: 12.8% v/v

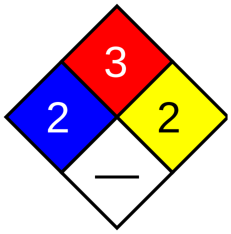
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.

Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.

Severe fire hazard when exposed to heat, flame and/or oxidizers.

Vapor forms an explosive mixture with air.



Fire Diamond

Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include hydrogen chloride and phosgene.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
DO NOT use aluminum or galvanized containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Butyl rubber gloves; Neoprene gloves.

Respiratory Protection:
Exposure Range >200 to <1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:
VITON.......................................C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless liquid with pleasant chloroform-like odor. A mixture of isomers typically comprising 60% cis-form and 40% trans-form.

Physical State: Liquid
Vapor Pressure (kPa): 36.66 at 20 °C
Vapor Density (Air=1): >1
Formula Weight: 96.94
Specific Gravity (H_2O=1, at 4 °C): 1.28
Water Solubility: 0.4% by weight

pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point Range: 47.78 °C (118 °F)
Freezing/Melting Point Range: -50 °C (-58 °F)

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid reaction with oxidizing agents.
Acetylene dichloride in contact with solid caustic alkalies or their concentrated solutions will form chloracetylene which ignites in air.
Distillation of ethanol containing 0.25% of the halocarbon with aqueous sodium hydroxide gave a product which ignited in air.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 770 mg/kg	Skin (rabbit): 100 mg/24h - mod.
Intraperitoneal (mouse) LD_{50}: 2000 mg/kg	

See NIOSH, *RTECS* KV 9360000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on soil, it should evaporate readily and leach in soil very slowly. Biodegradation should occur. If released into water, it will be lost mainly through volatilization (half life 3 hr in a model river). Biodegradation, adsorption to sediment, and bioconcentration to aquatic organisms should not be significant. In the atmosphere, cis- and trans- will be lost by reaction with photochemically produced hydroxyl radicals (half lives 8 and 3.6 days, respectively) and scavenged by rain. Because it is relatively long lived in the atmosphere, considerable dispersal from source area should occur.

Ecotoxicity: No data found.
Henry's Law Constant: 0.00408
BCF: calculated at 15
Octanol/Water Partition Coefficient: log K_{ow} = calculated at 1.86
Soil Sorption Partition Coefficient: K_{oc} = 36 to 49

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: 1,2-DICHLOROETHYLENE
Hazard Class: 3.1
ID No.: 1150
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Not listed
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Research Date: ....1999-11 **Review Date:** 2000-07

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Issue Date: 2001-06

cis-Acetylene Dichloride
MSDS: DIC4550

Section 1 - Chemical Product and Company Identification 55

Material Name: cis-Acetylene Dichloride **CAS Number:** 156-59-2
Chemical Formula: $C_2H_2Cl_2$
Structural Chemical Formula: CHCl=CHCl
Synonyms: ACETALYNE DICHLORIDE; CIS-ACETYLENE DICHLORIDE; CIS-1,2-DICHLORETHYLENE; CIS-1,2-DICHLOROETHENE; (Z)-1,2-DICHLOROETHYLENE; 1,2-CIS-DICHLOROETHYLENE; CIS-1,2-DICHLOROETHYLENE; CIS-DICHLOROETHYLENE; ETHENE,1,2-DICHLORO-,(Z)-; ETHYLENE,1,2-DICHLORO-,(Z)-
General Use: solvent for waxes, resins, fats, phenol, camphor, acetyl cellulose, organic materials and heat-sensitive substances such as caffeine; in rubber manufacture, as a refrigerant, as an additive to dye and lacquer solutions, in retarding fermentation, in organic synthesis, in medicines, in dye extraction, in chlorination reactions and in the manufacture of artificial pearls; a constituent of perfumes and thermoplastics

Section 2 - Composition / Information on Ingredients

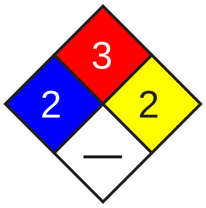
Name	CAS	%
cis-acetylene dichloride	156-59-2	>98

OSHA PEL
No data found.

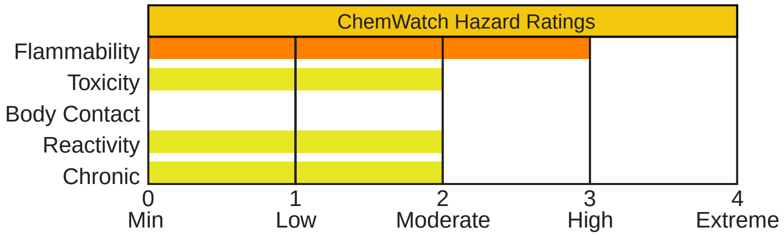
NIOSH REL
TWA: 200 ppm; 790 mg/m^3

ACGIH TLV
TWA: 200 ppm; 793 mg/m^3

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweetish odor. Irritating to eyes/skin/respiratory tract. Harmful. Other Acute Effects: narcotic effect. Flammable.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, nervous system, liver, kidneys
Primary Entry Routes: inhalation of vapor, skin/eye contact
Acute Effects

Inhalation: There is a single report of an industrial poisoning, a fatality caused by the inhalation of a vapor in a small enclosure. Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident, a single organ alone is (almost) never involved. Depression of the central nervous system is the most outstanding effect of most halogenated aliphatic hydrocarbons. Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin). The most important effects of exposure are narcosis and irritation of the central nervous system. Liver responses may occur after repeated narcotic doses and involves fatty liver degeneration. Vapor exposure may produce central nervous system depression or in milder exposures, nausea, vomiting, weakness, tremor and epigastric cramps. Recovery is usually rapid.

Eye: The vapor when concentrated has pronounced eye irritation effect; this gives some warning of high vapor concentrations. If eye irritation occurs seek to reduce exposure with available control measures, or evacuate area. Exposure to the trans isomer at 2200 ppm caused burning of the eyes, vertigo, nausea. Reversible corneal clouding has been described in exposures to acetylene dichloride.

Skin: The liquid may produce skin discomfort following prolonged contact. Defatting and/ or drying of the skin may lead to dermatitis.

Ingestion: The liquid is discomforting to the gastrointestinal tract and toxic if swallowed. Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: The material may accumulate in the human body and progressively cause tissue damage.

Section 4 - First Aid Measures

Inhalation: • If fumes or combustion products are inhaled, remove to fresh air.
- Lay patient down. Keep warm and rested.
- If breathing is shallow or has stopped, ensure clear airway and apply resuscitation, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital or doctor.

Eye Contact: • Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: • Immediately remove all contaminated clothing, including footwear (after rinsing with water).
- Wash affected areas thoroughly with water (and soap if available).
- Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treatment should follow that practiced in carbon tetrachloride exposures:
- Acute exposures to carbon tetrachloride present, initially, with CNS depression followed by hepatic and renal dysfunction.
- Respiratory depression and cardiac dysrhythmias are an immediate threat to life.
- Since a major fraction of absorbed carbon tetrachloride is exhaled in first hour, good tidal volumes should be maintained in severely poisoned patients; hyperventilation may be an additional therapeutic modality.
- Ipecac syrup, lavage, activated charcoal or catharsis may all be used in the first 4 hours.
- Since reactive metabolites may cause hepatorenal toxicity, administration of N-acetyl-L-cysteine may reduce complications. Experience with this therapy is limited.

Section 5 - Fire-Fighting Measures

Flash Point: 2.2 to 3.9 °C Closed Cup

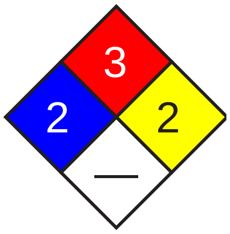
Autoignition Temperature: 460 °C

LEL: 9.7% v/v

UEL: 12.8% v/v

Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: • Liquid and vapor are highly flammable.
- Severe fire hazard when exposed to heat, flame and/or oxidizers.
- Vapor forms an explosive mixture with air.
- Severe explosion hazard, in the form of vapor, when exposed to flame or spark.
- Vapor may travel a considerable distance to source of ignition.
- Heating may cause expansion/decomposition with violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include hydrogen chloride and phosgene.



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e., nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or waterways.
- Consider evacuation (or protect in place).
- Fight fire from a safe distance, with adequate cover.

- If safe, switch off electrical equipment until vapor fire hazard removed.
- Use water delivered as a fine spray to control the fire and cool adjacent area.
- Avoid spraying water onto liquid pools.
- Do not approach containers suspected to be hot.
- Cool fire-exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: • Remove all ignition sources.
- Clean up all spills immediately.
- Avoid breathing vapors and contact with skin and eyes.
- Control personal contact by using protective equipment.
- Contain and absorb small quantities with vermiculite or other absorbent material.
- Wipe up.
- Collect residues in a flammable waste container.

Large Spills: • Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or waterways.
- No smoking, bare lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse/absorb vapor.
- Contain spill with sand, earth or vermiculite.
- Use only spark-free shovels and explosion proof equipment.
- Collect recoverable product into labeled containers for recycling.
- Absorb remaining product with sand, earth or vermiculite.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- DO NOT enter confined spaces until atmosphere has been checked.
- Avoid smoking, bare lights or ignition sources.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately.
- Follow good occupational work practices.
- Observe manufacturer's storage and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Check that containers are clearly labeled. Packaging as recommended by manufacturer. DO NOT use aluminum or galvanized containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required. If risk of overexposure exists, wear NIOSH-approved respirator. Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields or, as required, chemical goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Butyl rubber gloves. Neoprene gloves.

Respiratory Protection:

Respirator protection may be required. Consult your supervisor.

Other: • Overalls.
• Barrier cream.
• Eyewash unit.

Glove Selection Index:

VITON.......................................Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless liquid with pleasant chloroform-like odor.

Physical State: colorless liquid

Vapor Pressure (kPa): 200 mm Hg at 25 °C

Vapor Density (Air=1): 3.34

Formula Weight: 96.94

Specific Gravity (H_2O=1, at 4 °C): 1.2837 at 20 °C/4 °C

Water Solubility: 1 to 5 mg/mL at 16 °C

Boiling Point Range: 60.3 °C (141 °F) at 760 mm Hg

Freezing/Melting Point Range: -80.5 °C (-112.9 °F)

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid reaction with oxidizing agents. Acetylene dichloride in contact with solid caustic alkalies or their concentrated solutions will form chloracetylene which ignites in air. Haloalkenes are highly reactive.

Section 11 - Toxicological Information

Toxicity	Irritation
Inhalation (mouse) LC_{Lo}: 65000 mg/m^3/2 hr	Nil reported
Rat liver cell mutagen in vitro	

See NIOSH, *RTECS* KV9420000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on soil, it should evaporate and/or leach into the groundwater where very slow biodegradation should occur. If released into water, it will be lost mainly through volatilization (half life 3 hr in a model river). Biodegradation, adsorption to sediment, and bioconcentration in aquatic organisms should not be significant. In the atmosphere it will be lost by reaction with photochemically produced hydroxyl radicals (half life 8 days) and scavenged by rain. Because it is relatively long lived in the atmosphere, considerable dispersal from source areas should occur.

Ecotoxicity: LC_{50} Lepomis machrochirus (bluegill) 135,000 ug/l/96 hr in a static unmeasured bioassay

Henry's Law Constant: estimated at 0.00337

BCF: calculated at 15

Octanol/Water Partition Coefficient: log K_{ow} = 1.86

Soil Sorption Partition Coefficient: K_{oc} = 49

Section 13 - Disposal Considerations

Disposal: • Consult manufacturer for recycling options and recycle where possible.
• Follow applicable local, state, and federal regulations.
• Incinerate residue at an approved site.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: 1,2-DICHLOROETHYLENE

Hazard Class: 3.1

ID No.: 1150

Packing Group: II

Label: Flammable Liquid[3]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed

CERCLA 40 CFR 302.4: Not listed

SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.............................2000-11 **Review Date:** 2001-05

Material Safety Data Sheet Collection

Genium group inc.

1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Aldrin
ALD9000

Section 1 - Chemical Product and Company Identification

Material Name: Aldrin **CAS Number:** 309-00-2

Chemical Formula: $C_{12}H_8Cl_6$

EINECS Number: 206-215-8

ACX Number: X1002761-7

Synonyms: ALDOCIT; ALDREC; ALDREX; ALDREX 30; ALDREX 30 E.C; ALDREX 40; ALDRIN; ALDRINE; ALDRITE; ALDRON; ALDROSOL; ALGRAN; ALTOX; COMPOUND 118; 1,4:5,8-DIMETHANONAPHTHALENE,1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-,(1ALPHA,4ALPHA,4ABETA,5ALPHA,8ALPHA,8ABETA)-; 1,4:5,8-DIMETHANONAPHTHALENE,1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-,ENDO,EXO-; DRINOX; ENDO,EXO-1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4:5,8-DIMETHANONAPHTHALENE; ENT 15,949; (1R,4S,4AS,5S,8R,8AR)-1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4:5,8-DI METHANONAPHTHALENE,NOT LESS THAN 95%; (1ALPHA,4ALPHA,4A BETA,5ALPHA,8ALPHA,8A BETA)-1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4:5,8-DIMETHANONAPHTHALENE; (1R,4S,5S,8R)-1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4:5,8-DIMETHANONAPHTHALENE; 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4,5,8-DIMETHANONAPHTHALENE; 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4:5,8-DIMETHANONAPHTHALENE; 1,2,3,4,10,10-HEXACHLORO-1ALPHA,4ALPHA,4ABETA,5ALPHA,8ALPHA,8ABETA-HEXAHYDRO-1,4:5,8-DIMETHANONAPHTHALENE; 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4,5,8-DIMETHANONAPTHALENE; 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4-ENDO,EXO-5,8-DIMETHAN ONAPHTHALENE; 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4-ENDO-EXO-5,8-DIMETHANONAPHTHALENE; 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-ENDO-1,4-EXO-5,8-DIMETHANONAPHTHALENE; HEXACHLOROHEXAHYDRO-ENDO-EXO-DIMETHANONAPHTHALENE; HEXACHLOROHEXAHYDRO-ENDO-EXO-DIMETHANONAPTHALENE; 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-EXO-1,4-ENDO-5,8-DIMETHANONAPHTHALENE; HHDN; KORTOFIN; LATKA 118; OCTALENE; OCTALENE COMPOUND 118; SD 2794; SEEDRIN; SOILGRIN; TATUZINHO; TIPULA

Derivation: Produced via the Diels-Alder addition of hexachlorocyclopentadiene with excess bicycloheptadiene. Usually found dissolved in a solvent, such as petroleum distillates.

General Use: Formerly used as an insecticide. The EPA banned its commercial manufacture in August of 1974 due to its persistence in the environment and bioconcentration in the food chain as well as its toxicity to humans. The EPA still may use aldrin in termite and other treatment under certain circumstances, but it is not available to the public.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Aldrin	309-00-2	ca 20 to 95% wt

OSHA PEL
TWA: 0.25 mg/m^3; skin.

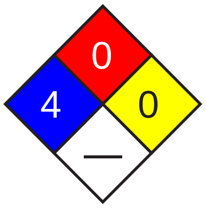
ACGIH TLV
TWA: 0.25 mg/m^3; skin.

NIOSH REL
TWA: 0.25 mg/m^3; skin.

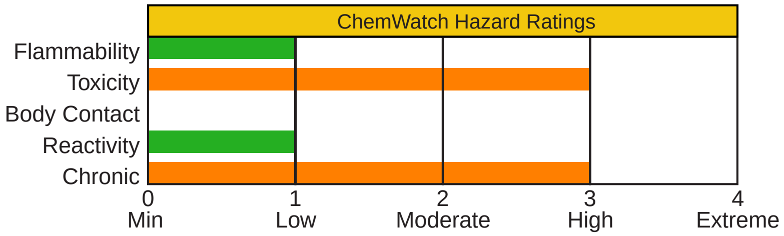
IDLH Level
25 mg/m^3.

DFG (Germany) MAK
TWA: 0.25 mg/m^3; PEAK: 10 mg/m^3; skin; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond



HMIS
4 Health
0 Flammability
0 Reactivity

ANSI Signal Word

Danger!

Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White (pure) or brown (technical grade) crystalline solid. Poison. Acute Effects: respiratory depression, CNS excitement, headache, dizziness, convulsions, kidney/liver damage. Chronic Effects: kidney/liver damage.

Potential Health Effects

Target Organs: Central nervous system, blood, liver, kidneys.

Primary Entry Routes: Inhalation, skin and eye contact.

Acute Effects

Inhalation: Difficulty breathing, headache, dizziness, nausea and vomiting, malaise, myoclonic jerks of the limbs, clonic-tonic convulsions, and occasionally, coma. Kidney damage is possible if exposure is prolonged.

Eye: Irritation may develop from exposure to the solvent (usually petroleum distillates).

Skin: Irritation may develop from exposure to the solvent (usually petroleum distillates). One case of erthematobullous (red, blistering) dermatitis has been reported, but redness is usually the extent of the irritation.

Ingestion: Hematuria (blood in the urine) and azotemia (nitrogenous compounds in the blood due to kidney insufficiency) and seizures may occur. The estimated human fatal dose = 3 to 7 g for a 150 lb adult.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Liver and convulsive disorders.

Chronic Effects: Because the metabolite of aldrin, dieldrin, is stored in the liver, chronic exposure may cause liver damage. Liver tumors have occurred in some experimental animals, but not throughout all species studied.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air, administer 100% humidified, supplemental oxygen, and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water followed quickly by repeated, thorough soap and water washes (including hair and nails). For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Support respiratory, cardiovascular, and kidney function. The toxic level in human blood = 0.0035 µg/ml. Aldrin is metabolized to dieldrin and then ultimately to 4,5-seco-aldrin-4,5-dicarboxylic acid. Exposure to aldrin in combination with endrin, heptachlor, or 1,1,1-trichloro-2,2-bis (*p*-chlorophenyl) ethane may produce synergistic toxic effects.

Special Precautions/Procedures: *Do not* give adrenergic amines which may further increase myocardial irritation and produce refractory ventricular arrythmias.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Noncombustible; however aldrin is dissolved in solvents (generally petroleum distillates) with flash points of 150 °F (65.5 °C) or more, Closed Cup

Autoignition Temperature: Noncombustible

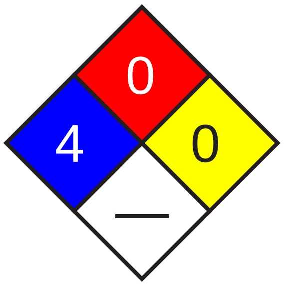
LEL: None reported.

UEL: None reported.

Flammability Classification: Noncombustible solid; solvents are generally Class IIIA and Class IIIB Combustible Liquids.

Extinguishing Media: Use carbon dioxide, dry chemical, water spray or foam.

General Fire Hazards/Hazardous Combustion Products: Carbon oxide(s), hydrogen chloride, phosgene, and chlorine gas. Container may explode in heat of fire. Aldrin may be transported in molten form (solid).



Fire Diamond

Fire-Fighting Instructions: If possible without risk, move container from fire area. Fight fire from maximum distance. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. *Aldrin is not combustible. However, it is generally found dissolved in a combustible solvent such as petroleum distillates with flash points of 150 °F (65.5 °C) or more, which would give it an NFPA Flammability rating of "1".

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against inhalation and skin/eye contact.

Small Spills: If dissolved in solvent: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers. For dry spills, carefully scoop up or vacuum (with appropriate HEPA filter) and place in suitable containers for disposal.

Large Spills: Flush spills with water to containment area for later disposal. *Do not* release into sewers or waterways. Damp mop any residue.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use only with adequate ventilation to control airborne hazards and wear appropriate PPE. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using aldrin, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from incompatibles (Sec. 10). Outdoor or detached storage is preferred.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where possible, enclose processes to prevent dust dispersion into the work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the central nervous system, liver, kidneys, and blood.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. At any detectable concentration, wear any SCBA with a full facepiece operated in pressure-demand or other positive-pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or othe positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove aldrin from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White (*pure*) or brown (*technical grade*).

Physical State: Solid (*pure*), liquid (*solution*)

Vapor Pressure (kPa): 6.5 x 10^{-5} mm Hg at 77 °F (25 °C)

Formula Weight: 364.93

Density: 1.54 g/mL at 68 °F (20 °C)

Boiling Point: 293 °F (145 °C) at 2 mm Hg

Freezing/Melting Point: 219 °F (104 °C), *pure*; 120 to 140 °F (49 to 60 °C), *technical*

Water Solubility: 0.003%

Other Solubilities: Soluble in aromatics, esters, ketones, paraffins, halogenated solvents, and > 600 g/L at 27 °C in acetone, benzene, and xylene.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Aldrin is stable at room temperature in closed containers under normal storage and handling conditions. It is not decomposed by alkalis or dilute acids. It is thermally stable up to 200 °C. Hazardous polymerization does not occur. Exposure to elevated temperatures and incompatibles.

Storage Incompatibilities: Reacts with concentrated acids and phenols in the presence of oxidizers to yield dieldrin. Although noncorrosive to steel, brass, Monel, copper, nickel, and aluminum, aldrin may corrode other metals.

Hazardous Decomposition Products: Thermal oxidative decomposition of dieldrin can produce carbon oxide(s), hydrogen chloride, and chlorine gas.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD$_{50}$: 39 mg/kg.
Human, oral, TD$_{Lo}$: 14 mg/kg caused tremor, excitement, nausea and vomiting.
Acute Inhalation Effects:
Rat, inhalation, LC$_{Lo}$: 5800 µg/m^3/4 hr.
Acute Skin Effects:
Rabbit, skin, LD$_{50}$: 15 mg/kg caused convulsions or effect on seizure threshold.
Other Effects:
Rat, oral: 9.1 mg/kg administered intermittently for 26 weeks caused blood changes.
Tumorgenicity, mouse, oral: 270 mg/kg administered intermittently for 80 weeks resulted in liver tumors.
Genetic Effects - Rat, liver cell: 300 µmol/L caused DNA damage.
Rat oral: 109 mg/kg administered continuously for 2 years caused changes in liver weight.
Mouse, oral: 25 mg/kg administered on the 9th day of pregnacy caused specific developmental abnormalities of the musculoskeletal system, eyes, and ears.

See *RTECS* IO2000000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Under most conditions, aldrin is gradually converted to dieldrin. If released to soil, aldrin will volatilize slowly or decompose into dieldrin. It is classified as being mildly persistent with a half-life of 20 to 100 days. 26% may persist after 1 year and 5% after 3 years. Residues appear to remain longer in clay than sandy soils. In water, it is expected to volatilize. Bioconcentration is expected to be high. The bioconcentration factor (BCF) is 4571 (molluscs), 1071 (fish), and 12,260 (algae). If released to the atmosphere, aldrin is expected to react with photochemically-produced hydroxyl radicals with an estimated half-life of 35.46 minutes. It may also be adsorbed to particulate matter in the atmosphere. Slow photolysis can occur but is not expected to be significant.

Ecotoxicity: *Phasianus colchicus* (Pheasant), LD$_{50}$ = 16.8 mg/kg; *Salmo gairdneri* (rainbow trout), LD$_{50}$ = 2.6 µg/L/96 hr; *Pimephales promelas* (fathead minnow), LC$_{50}$ = 8.2 µg/L/96 hr.

Henry's Law Constant: 4.96 x 10^{-4} atm/m^3/mole

Octanol/Water Partition Coefficient: log K$_{ow}$ = 3.01

Section 13 - Disposal Considerations

Disposal: Aldrin is a potential candidate for rotary kiln and fluidized bed incineration. Carbon absorption can remove up to 90% and reverse osmosis has been shown to remove up to 95% of aldrin from the wastestream. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Organochlorine pesticides, solid, toxic
ID: UN2761
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7, IP1
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** A **Other:** 40

Shipping Name and Description: Organochlorine pesticides, solid, toxic
ID: UN2761
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Shipping Name and Description: Organochlorine pesticides, solid, toxic
ID: UN2761
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging: **Exceptions:** 153 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed P004
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1 lb (0.454 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 1 lb
  - **TPQ:** 500/10000 lb
- **TSCA:** Not listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Aluminum Powder Uncoated
ALU1560

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Aluminum Powder Uncoated **CAS Number:** 7429-90-5
Chemical Formula: Al
Structural Chemical Formula: Al
EINECS Number: 231-072-3
ACX Number: X1000207-0
Synonyms: ALUMINUM POWDER UNCOATED
General Use: Component of incendiary and self heating devices - thermite process.
Coarse powdered aluminum is used in fireworks, pyrotechnics.
Used in the testing of gold and mercury.
When handling, DO NOT eat, drink or smoke.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
aluminum powder uncoated	7429-90-5	>99

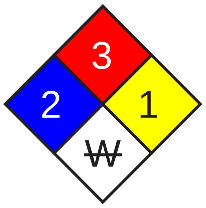
OSHA PEL
TWA: 15 mg/m^3 (total), 5 mg/m^3 (respirable).

NIOSH REL
TWA: 10 mg/m^3 (total); TWA: 5 mg/m^3 (resp).

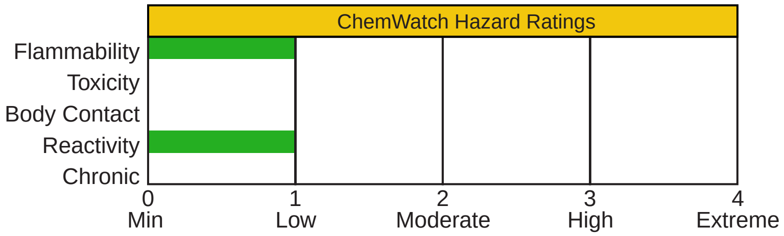
DFG (Germany) MAK
TWA: 1.5 mg/m^3; measured as resirable fraction of the aerosol.

ACGIH TLV
TWA: 10 mg/m^3.

Section 3 - Hazards Identification



Fire Diamond



HMIS
① Health
② Flammability
① Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Silvery-white, metallic powder; odorless. Irritating. Other Acute Effects: dyspnea, cough, lethargy, anorexia, increased respiration. Chronic Effects: pulmonary fibrosis, asthma, emphysema, dyspnea, cough, lung disease. Explosive. Flammable. Water reactive.

Potential Health Effects

Target Organs: respiratory system, eyes, skin
Primary Entry Routes: inhalation, ingestion
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract.
Eye: Particulate/dust is discomforting and may be abrasive to the eyes.
Skin: The dust is mildly discomforting to the skin.
Dust should be quickly removed as the fine powder prevents transpiration which may produce toxic effects if large skin areas are covered.
Ingestion: The solid/dust is discomforting if swallowed.
Considered an unlikely route of entry in commercial/industrial environments.
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic inhalation of very fine pyrotechnic-grade powder may cause lung scarring (pulmonary fibrosis).
Reports connect soluble aluminum and premature senility (Alzheimer's).

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water.
Consider drinking water to remove dust from throat.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Wash affected areas thoroughly with water (and soap if available). Seek medical attention in event of irritation.

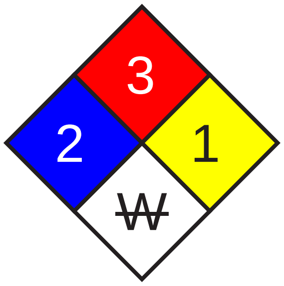
Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Combustible Solid

Autoignition Temperature: 760 °C

Extinguishing Media: Dry chemical powder or dry sand. DO NOT use halogenated fire extinguishing agents. DO NOT use water or halogens on dust fires. Dry sand, talc or sodium chloride. Class D Fire Extinguisher. DO NOT use carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Moderate fire and explosion hazard, in the form of dust, when exposed to heat or flame. Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result. Finely divided aluminum can readily burn or explode if ignited. Contact with water liberates highly flammable hydrogen gas. Molten aluminum reacts violently with water and can ignite and burn.

Fire Incompatibility: Avoid contamination with water, alkalies, acids and oxidizing agents. Can cause explosion on contact with powerful oxidizers. Aluminum powder may also react with rust, certain metal oxides (e.g., copper, iron and lead), and nitrates (eg., fertilizers). Aluminum fines can be a hazard with chlorinated hydrocarbons.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard. Clear area of personnel and move upwind. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Clean up all spills immediately.

Large Spills: Clear area of personnel and move upwind. Contact fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. No smoking, bare lights or ignition sources. Increase ventilation. Stop leak if safe to do so. Absorb or cover spill with sand, earth, inert material or vermiculite. Use only spark-free shovels and explosion proof equipment. Reclaim solvent for recycling at an approved site. Collect recoverable product into labeled containers for recycling. Collect residues and seal in labeled drums for disposal. After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing. If contamination of drains or waterways occurs, advise emergency services. Place collected powder in closed, pressure vented, DRY, metal containers.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Keep dry.
Avoid generating and breathing dust.

Avoid contact with skin and eyes.
Avoid smoking, bare lights, heat or ignition sources. Use spark-free tools when handling.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use.
Avoid physical damage to containers.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
For large scale or continuous use: spark-free, grounded ventilation system venting directly to the outside and separate from usual ventilation systems. Provide dust collectors with explosion vents.
Wash hands with soap and water after handling.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Cotton gloves or rubber gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >5 to 50 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to 500 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >500 to 5000 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >5000 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)

Other: None required when handling small quantities. OTHERWISE: Eyewash unit.
Ensure there is ready access to a safety shower.
For large scale or continuous use: Use tight-weave non-static clothing (no metallic fasteners, cuffs or pockets); & non-sparking safety footwear.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Silvery-white finely divided metallic solid. Odorless. Soluble in hydrochloric and sulfuric acids and strong alkalis, producing highly flammable and explosive hydrogen gas.

Physical State: Divided solid
Vapor Pressure (kPa): Negligible
Vapor Density (Air=1): Not applicable
Formula Weight: 26.98
Specific Gravity (H_2O=1, at 4 °C): 2.7
Evaporation Rate: Non-volatile

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 2327 °C (4221 °F)
Freezing/Melting Point: 660 °C (1220 °F)
Volatile Component (% Vol): Nil
Water Solubility: Insoluble

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Storage in unsealed containers. General reactivity reduced by protective oxide layer. Moisture sensitive.
Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from strong acids, strong alkalis, metal oxides, chlorinated solvents oxidizing agents and alcohols.

Section 11 - Toxicological Information

No relevant toxicological data found at time of research.

See *RTECS* BD 0330000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Material from spill may be contaminated with water resulting in generation of highly flammable hydrogen gas with pressurizing of closed containers. Hold spill material in vented containers only and plan for prompt disposal.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Decontaminate empty containers.
Recycle containers if possible, or dispose of in an authorized landfill.
Wetted powder sludge which is not completely covered with water may be flammable.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Aluminum powder, uncoated
ID: UN1396
Hazard Class: 4.3 - Dangerous when wet material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 4.3 - Dangerous When Wet
Special Provisions: A19, A20, IB7, IP2
Packaging: **Exceptions:** 151 **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 15 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** A **Other:** 39

Shipping Name and Description: Aluminum powder, uncoated
ID: UN1396
Hazard Class: 4.3 - Dangerous when wet material
Packing Group: III - Minor Danger
Symbols:
Label Codes: 4.3 - Dangerous When Wet
Special Provisions: A19, A20, IB8, IP4
Packaging: **Exceptions:** 151 **Non-bulk:** 213 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification 61

Material Name: Antimony **CAS Number:** 7440-36-0
Chemical Formula: Sb
Structural Chemical Formula: Sb
EINECS Number: 231-146-5
ACX Number: X1002157-3
Synonyms: ANTIMONY; ANTIMONY BLACK; ANTIMONY METAL; ANTIMONY POWDER; ANTIMONY,REGULUS; ANTYMON; C.I. 77050; REGULUS OF ANTIMONY; STIBIUM
General Use: Manufacture of alloys, such as Britannia or Babbitt metal, hard lead, white metal, type, bullets and bearing metal; in fireworks; thermoelectric piles, blackening iron, coating metals etc.

Section 2 - Composition / Information on Ingredients

Name	**CAS**	**%**
antimony	7440-36-0	>99

OSHA PEL
TWA: 0.5 mg/m^3.

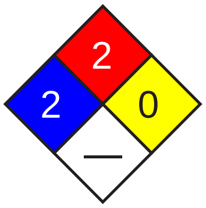
ACGIH TLV
TWA: 0.5 mg/m^3.

NIOSH REL
TWA: 0.5 mg/m^3.

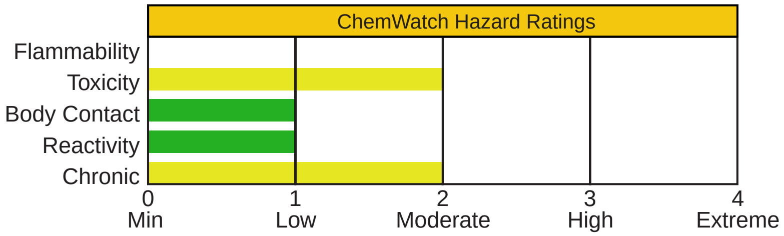
IDLH Level
50 mg/m^3 (as Sb).

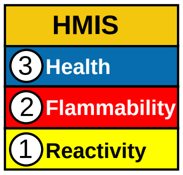
DFG (Germany) MAK
TWA: 0.5 mg/m^3; PEAK: 1 mg/m^3; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!


Explosive


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Lustrous, dark gray powder. Irritating to eyes/skin/respiratory tract. Other Acute Effects: violent vomiting, low BP, shallow breathing. Chronic Effects: dizziness, dry throat, sleeplessness, anorexia, dermatitis. Flammable. Explosive in air.

Potential Health Effects

Target Organs: skin, eyes, mucous membranes, respiratory system, cardiovascular system
Primary Entry Routes: inhalation (dust and fume), ingestion
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Inhalation of antimony and its compounds may produce respiratory and gastrointestinal tract discomfort with sore throat, shallow respiration, dizziness, weight loss, gingivitis, anemia, eosinophilia and enzyme inhibition. Pulmonary congestion and edema may also occur. Death due to circulatory failure has been described, with pathology showing acute congestion of the heart, liver and kidneys.
Eye: The dust may produce eye discomfort causing transient smarting, blinking.
Skin: The material may be mildly discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.
Open cuts, abraded or irritated skin should not be exposed to this material.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.
Acute ingestion may cause violent vomiting, diarrhea, slow pulse and low blood pressure, shallow breathing and death.
Antimony poisoning closely parallels arsenic poisoning although vomiting is probably more prominent as absorption from the gastrointestinal tract is generally lower. Temporary changes in heart rhythm occurs amongst humans while poisoned animals exhibit severe heart damage.
Trivalent compounds are generally more lethal than pentavalent derivatives.
The insoluble salts however are less likely to produce significant toxic effects.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems. The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.
Repeated or prolonged exposure to antimony and its compounds may produce stomatitis, dry throat, metallic taste, gingivitis, septal and laryngeal perforation, laryngitis, headache, dyspnea, indigestion, nausea, vomiting, diarrhea, anorexia, anemia, weight loss, pain and chest tightness, sleeplessness, muscular pain and weakness, dizziness, pharyngitis, bronchitis and pneumonitis. Degenerative changes of the liver and kidney may occur. Chronic exposure to antimony compounds may result in itchiness, papules and pustules around sweat and sebaceous glands, but rarely around the face, and dermatitis. Smelter workers often show skin rashes on the forearms and thighs resembling chicken pox pustules. Workers exposed to inorganic antimony compounds show a benign pneumoconiosis and obstructive lung disease - these are probably non-specific. Woman appear to more susceptible to systemic effects following exposure. Antimony crosses the placenta, is present in amniotic fluids, and is excreted in breast milk.
There are suggestions that exposure may produce an increased incidence of spontaneous late abortions, premature births, and gynecological problems among female antimony smelter workers. An excess of deaths from lung cancer has been reported in smelter workers with more than 7 years exposure to relatively high levels of dust and fume.
Animal studies demonstrate that the dust may produce pathological changes in cardiac muscle and may produce an interstitial pneumonitis and endogenous pneumonia. One animal study has also suggested that inhalation of the dust by rats induced a significantly increased incidence of carcinogenic tumors of the lungs and thorax.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water.
Consider drinking water to remove dust from throat.
Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Quickly but gently, wipe material off skin with a dry, clean cloth.
Immediately remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.
In case of burns: Quickly immerse affected area in cold running water for 10 to 15 minutes.
Bandage lightly with a sterile dressing. Treat for shock if required.
Lay patient down. Keep warm and rested. Transport to hospital or doctor.

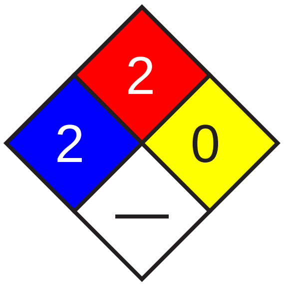
Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians:
1.Chelation with British Anti-Lewisite (BAL) for serious antimony exposures should be employed.
2.Dialyse as needed. The role of exchange diffusion is not clear.
3.Be sure to monitor for dysrhythmias.
* Provide preplacement and periodic medical examinations for those regularly exposed to antimony, with emphasis directed to skin and mucous membranes and the pulmonary, cardiac and reproductive systems. Provide suitable training for those working with antimony. Keep records.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Noncombustible Solid

Autoignition Temperature: 420 °C (cloud)

LEL: Not applicable

UEL: Not applicable

Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.

These are the only suitable means for extinguishing metal dust fires.

Do NOT use water.

General Fire Hazards/Hazardous Combustion Products: Bulk metal is combustible at high temperatures.

Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result. [A.W.R.A. Technical Note 7].

When ignited it burns with a brilliant flame , giving off dense white fumes of Sb_2O_3. Particle size and dispersion in air determine reactivity.

Heating or contact with acids, produces highly toxic fumes of stibine (SbH_3).

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: POLLUTANT -contain spillage. Environmental hazard - contain spillage.

Clean up all spills immediately.

Wear protective clothing, impervious gloves and safety glasses.

Avoid breathing vapors and contact with skin and eyes.

Remove all ignition sources.

Use dry clean-up procedures and avoid generating dust.

Collect recoverable product into labeled containers for recycling.

Collect residues and seal in labeled drums for disposal.

Large Spills: POLLUTANT -contain spillage.

Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

Shut off all possible sources of ignition and increase ventilation.

Stop leak if safe to do so.

Use dry clean-up procedures and avoid generating dust.

Collect recoverable product into labeled containers for recycling.

Collect residues and seal in labeled drums for disposal.

Wash spill area with large quantities of water.

After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Use good occupational work practices.

Avoid contact with skin and eyes.

Avoid generating and breathing dust.

Use in a well-ventilated area.

Wear protective clothing when risk of exposure occurs.

Avoid contact with incompatible materials.

Avoid all ignition sources.

Avoid sources of heat.

Avoid physical damage to containers.

Keep containers securely sealed when not in use.

When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.

Recommended Storage Methods: Glass container; plastic container.
Plastic drum.
Polyethylene or polypropylene container.
Metal can.
Metal drum.
Check that containers are clearly labeled.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Metal dusts must be collected at the source of generation as they are potentially explosive.
1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.
2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0. 5 meter/sec.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses. Chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Impervious gloves; plastic gloves.
Rubber gloves.

Respiratory Protection:
Exposure Range >0.5 to 5 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >5 to <50 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range 50 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)

Other: Overalls. P.V.C. apron. Barrier cream. Skin cleansing cream. Eye wash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Silver-white, lustrous, hard, brittle metal, or dark grey, lustrous powder. The bulk metal slowly tarnishes in moist air. Mohs hardness: 3-3.5

Physical State: Divided solid
Vapor Pressure (kPa): 0.13 at 886 °C
Vapor Density (Air=1): Not applicable
Formula Weight: 121.75
Specific Gravity (H_2O=1, at 4 °C): 6.68 at 25 °C
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 1635 °C (2975 °F)
Freezing/Melting Point: 630 °C (1166 °F)
Volatile Component (% Vol): Not applicable
Water Solubility: Insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of heat source and ignition source.
Presence of extreme humidity.
Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Contact with acids produces toxic fumes. Avoid reaction with oxidizing agents, such as nitrate salts, halogens, nitric acid, perchloric acids, chlorine trifluoride, potassium permanganate.
Avoid reaction with aqua regia and hot, concentrated sulfuric acid.
Nascent hydrogen can react with antimony or its alloys with magnesium or zinc to form stibine, a colorless, highly toxic gas with a disagreeable odor.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 7000 mg/kg

Irritation
Nil reported

See *RTECS* CC 4025000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options.
Bury residue in an authorized landfill.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Antimony powder
ID: UN2871
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging: **Exceptions:** 153 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Arsenic **CAS Number:** 7440-38-2
Chemical Formula: As
Structural Chemical Formula: As_4
EINECS Number: 231-148-6
ACX Number: X1002785-7
Synonyms: ARSEN; ARSENIA; ARSENIC; ARSENIC-75; ARSENIC BLACK; ARSENICALS; COLLOIDAL ARSENIC; GRAY ARSENIC; GREY ARSENIC; METALLIC ARSENIC
General Use: In metallurgy for hardening copper, lead alloys. In the manufacture of certain types of glass.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Arsenic		>98

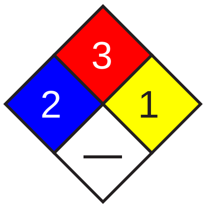
OSHA PEL
TWA: 0.01 mg/m^3.

NIOSH REL
Ceiling: 0.002 mg/m^3; 15-minute.

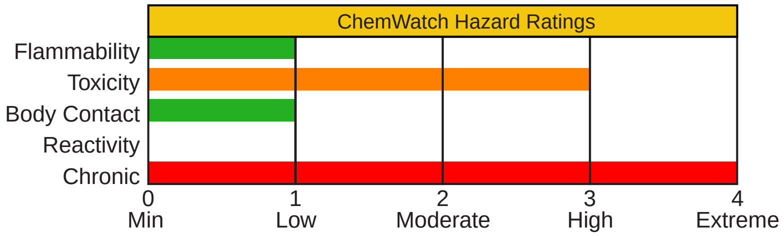
ACGIH TLV
TWA: 0.01 mg/m^3.

IDLH Level
5 mg/m^3 (as As).

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
2 Flammability
2 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Brittle, crystalline, silvery-black metal. Irritating to eyes/skin/respiratory tract. Also causes: damage to blood-forming organs, nervous and cardiovascular systems. Cancer hazard. Generally found as a powder which is flammable.

Potential Health Effects

Target Organs: liver, kidneys, skin, lungs, lymphatic system
Primary Entry Routes: inhalation, ingestion of dust and fumes, skin absorption
Acute Effects
Inhalation: The dust is toxic and discomforting to the upper respiratory tract and lungs.
Acute inhalation exposure can cause cough, chest pain, shortness of breath, dizziness, headache, pulmonary edema and extreme general weakness.
Prolonged or repeated exposure can cause perforation of the nasal septum.
High exposures can cause poor appetite, nausea, vomiting and muscle cramps. Heart effects with abnormal EKG can also occur with very high exposures.
Eye: The dust may produce eye discomfort causing smarting, pain and redness.
Skin: The material is moderately discomforting to the skin and may be harmful.
Exposure may result in abnormal redness (caused by capillary congestion), burning, itching, swelling, skin eruptions and dermatitis.
Toxic effects may result from skin absorption.
Repeated skin contact can cause thickened skin and/or patchy areas of darkening and loss of pigment. Some persons develop white lines on the nails.

Ingestion: The solid/dust is discomforting to the gastrointestinal tract and is toxic and may be fatal if swallowed.
Symptoms of acute poisoning by ingestion, which develop within 4 hours include epigastric pain, vomiting and watery diarrhea. Blood may appear in vomitus and stools. If amount ingested is sufficiently high, shock may develop, followed by death within 24 hours.
Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A1, Confirmed human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Symptoms of chronic poisoning by inhalation include weight loss, nausea and diarrhea alternating with constipation, pigmentation and eruption of the skin, loss of hair, peripheral neuritis, blood disorders (anemia), striations on fingernails and toenails.
Long-term exposure can cause an ulcer or hole in the `bone' dividing the inner nose. Hoarseness and sore eyes also occur.
High or repeated exposure can cause nerve damage with `pins and needles', burning, numbness, and later weakness of arms and legs. Repeated exposure can also damage the liver, causing narrowing of the blood vessels, or interfere with the bone marrow's ability to make red blood cells.
Many cases of skin cancer have been reported among people exposed to arsenic through medical treatment with inorganic trivalent arsenic compounds. In some instances skin cancers have occurred in combination with other cancers, such as liver angiosarcoma, intestinal and urinary bladder carcinomas and meningioma. Epidemiological studies of cancer after medical treatment have shown an excess of skin cancers but no clear association with other cancers has been shown. An association between environmental exposure to arsenic through drinking water and skin cancer has been observed and confirmed. Epidemiological studies in areas where drinking water contained 0.35-1.14 mg/l arsenic elevated risks for cancers of the bladder, kidney, skin, liver, lung and colon in both men and women.
Occupational exposure to inorganic arsenic, especially in mining and copper smelting, has consistently been associated with an increased risk of cancer. An almost tenfold increase in the incidence of lung cancer was found in workers most heavily exposed to arsenic and relatively clear dose-response relationships have been obtained with regard to cumulative exposure. Other smelter worker populations have been shown to have consistent increases in lung cancer incidence, as well as increases of about 20% in the incidence of gastrointestinal cancer and of 30% for renal cancer and hematolymphatic malignancies.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and wash continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Quickly but gently, wipe material off skin with a dry, clean cloth.
Immediately remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center.
If swallowed, and if more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short term repeated exposures to arsenic, soluble compounds:
Treat as per arsenic poisoning.

1. Acute skin lesions such as contact dermatitis usually do not require other treatment than removal from exposure.
2. If more severe symptoms of the respiratory system, the skin or the gastrointestinal tract occur, British Anti-Lewisite (BAL, dimercaprol) may be given. Prompt administration in such cases is vital; to obtain maximum benefit such treatment should be administered within 4 hours of poisoning.
3. In addition, general treatment such as prevention of further absorption from the gastrointestinal tract are mandatory.
4. General supportive therapy such as maintenance of respiration and circulation, maintenance of water and electrolyte balance and control of nervous system effects, as well as elimination of absorbed poison through dialysis and exchange transfusion, may be used if feasible.
5. Dimercaprol is given by deep intramuscular injection as a 5% solution in peanut oil (or a 10% solution with benzyl-benzoate in vegetable oil). It is usually given in a dose of 3 mg/kg, 4-hourly, for the first two days, or twice daily for up to seven days.
6. BAL Therapy is effective for hematological manifestations of chronic arsenic poisoning but not for neurological symptoms. Watch for side effects (e.g. urticaria, burning sensation in the lips, mouth and throat, fever, conjunctivitis etc).
7. Some relief results from administration of diphenhydramine (Benadryl) (1.5 mg/kg intramuscularly or by mouth every 6 hour).

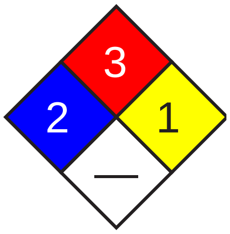
BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Inorganic arsenic metabolites in urine	50 ug/g creatinine	End of workweek	B

B: Background levels occur in specimens collected from subjects NOT exposed
Consult specific documentation.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Noncombustible solid
Extinguishing Media: Use fire fighting procedures suitable for surrounding area.
General Fire Hazards/Hazardous Combustion Products: Solid which exhibits difficult combustion or is difficult to ignite.
Avoid generating dust, particularly clouds of dust in a confined or unventilated space. Dust may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion.
Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport. Build-up of electrostatic charge may be prevented by bonding and grounding.
Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.
Decomposes on heating and produces toxic fumes of arsenic oxides (AsO_x).
Fire Incompatibility: Avoid contact with acids, oxidizing agents, halogens.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Wear protective clothing, impervious gloves and safety glasses. Increase ventilation.
Use a vacuum or a wet method to reduce dust during clean-up. DO NOT dry sweep.
Place in suitable containers for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
Large Spills: POLLUTANT -contain spillage. Clear area of personnel and move upwind.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If contamination of drains or waterways occurs, advise emergency services.
Shut off all possible sources of ignition and increase ventilation.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Use dry clean up procedures and avoid generating dust.
Collect recoverable product into labeled containers for recycling. Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use good occupational work practice.
Avoid contact with skin and eyes.
Avoid generating and breathing dust.
Use in a well-ventilated area.
Wear protective clothing when risk of exposure occurs.

Avoid sources of heat. Avoid contact with incompatible materials. Avoid physical damage to containers.
Keep containers securely sealed when not in use.
When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.

Recommended Storage Methods: Glass container. Plastic drum. Polyethylene or polypropylene container. Steel drum. Metal drum.
Check that containers are clearly labeled.

Storage Requirements: Observe manufacturer's storing and handling recommendations.
Store in a cool, dry place. Store in a well-ventilated area. Store away from sources of heat or ignition/bare lights.
Avoid storage at temperatures higher than 60 °C. Store away from incompatible materials. Store away from foodstuff containers.
Protect containers against physical damage.
Keep containers securely sealed.
Check regularly for spills and leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required.
Use ventilated helmet or air-line hood to provide clean air at the breathing zone.
If risk of overexposure exists, wear NIOSH approved respirator. Correct fit is essential to obtain adequate protection.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses. Chemical goggles.
Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Impervious, gauntlet length gloves; Rubber gloves. Neoprene gloves.
Rubber boots.

Respiratory Protection:
Exposure Range >0.01 to 0.1 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >0.1 to 1 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >1 to <5 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 5 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)

Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.
* Preplacement and periodic medical examinations are essential for workers exposed to arsenic. Preplacement physical examinations should give particular attention to allergic and chronic skin lesions, eye disease, psoriasis, chronic eczematous dermatitis, hyperpigmentation of the skin, keratosis and warts, baseline weight, baseline blood and hemoglobin counts, baseline urinary arsenic determinations.
Annual physical examinations should give attention to general health, weight, skin condition, and any evidence of excessive exposure or absorption of arsenic.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Grey, shiny, brittle, metallic-looking rhombohedral crystals. Can be heated to burn in air with a bluish flame, giving off an odor of garlic and dense white fumes of arsenic trioxide. Loses its luster on exposure to air. Converted by nitric acid or hot sulfuric acid into arsenous or arsenic acid.
Brinell hardness: 147
Mohs' scale: 3.5

Physical State: Divided solid
Vapor Pressure (kPa): Not applicable
Vapor Density (Air=1): Not applicable
Formula Weight: 74.92
Specific Gravity (H_2O=1, at 4 °C): 5.73
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: Sublimes
Freezing/Melting Point: 817 °C (1502.6 °F) at 28 atm
Volatile Component (% Vol): Not applicable
Water Solubility: Insoluble

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Contact with acids liberates toxic gases. Presence of heat source and ignition source.
Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from oxidizing agents, halogens.
Contact with acids produces toxic fumes.

Section 11 - Toxicological Information

Toxicity

Oral (man) TD_{Lo}: 7857 mg/kg/55 years
Oral (rat) LD_{50}: 763 mg/kg
Tumorigenic - Carcinogenic by RTECS criteria.

Irritation

Nil reported

See NIOSH, *RTECS* CG 0525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: Food chain concentration potential: Bioaccumulated by fresh water and marine aquatic organisms
BCF: bioaccumulated by aquatic organisms
Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Follow all federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ARSENIC
Hazard Class: 6.1
ID No.: 1558
Packing Group: II
Label: Poison [6]

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a), per CAA Section 112 1 lb (0.454 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Issue Date: 2000-07

Barium
MSDS 297
BAR1500

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Barium **CAS Number:** 7440-39-3
Chemical Formula: Ba
Structural Chemical Formula: Ba
Synonyms: BARIO; BARIUM; BARYUM
General Use: Occurs in barite and witherite.
Used as "getter" in vacuum tubes. Carrier for radium.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Barium	7440-39-3	100

OSHA PEL
TWA: 0.5 mg/m^3; as Ba.

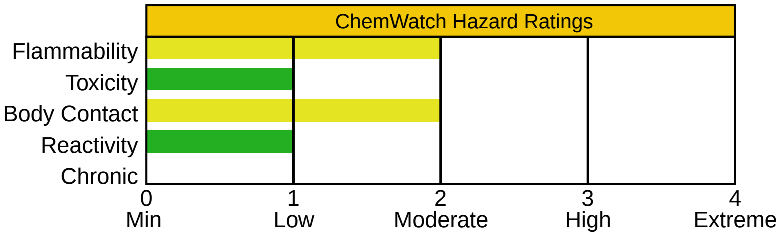
NIOSH REL
TWA: 0.5 mg/m^3; as Ba soluble.

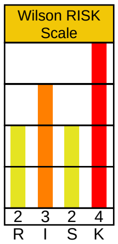
DFG (Germany) MAK
TWA: 0.5 mg/m^3; as Ba.

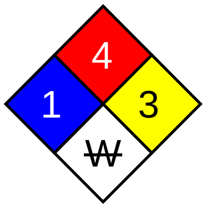
ACGIH TLV
TWA: 0.5 mg/m^3; as Ba.

Section 3 - Hazards Identification

HMIS	
2	Health
2	Flammability
4	Reactivity







Fire Diamond

ANSI Signal Word

Danger!

Explosive Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Silver/white powder. Chronic: benign pneumoconiosis (baritosis). Explosive! Pyrophoric! Reacts violently with water.

Potential Health Effects

Primary Entry Routes: inhalation of dust or fume, ingestion, skin contact, eye contact
Target Organs: skin, eyes, mucous membranes, lung, heart
Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract and may cause severe mucous membrane damage.

Barium fumes are respiratory irritants. Over-exposure to barium dusts and fume may result in rhinitis, frontal headache, wheezing, laryngeal spasm, salivation and anorexia. Long term effects include nervous disorders and adverse effects on the heart, circulatory system and musculature. Heavy exposures may result in a benign pneumoconiosis.

Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The material is moderately discomforting to the skin.

Solution of material in moisture on the skin, or perspiration, may increase irritant effects.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed.

Reaction with acid in the stomach environment will produce soluble barium compounds.

Ingestion of soluble barium compounds may result in ulceration of the mucous membranes of the gastrointestinal tract, tightness in the muscles of the face and neck, gastroenteritis, vomiting, diarrhea, muscular tremors and paralysis, anxiety, weakness, labored breathing, cardiac irregularity due to contractions of smooth striated and cardiac muscles (often violent and painful), slow irregular pulse, hypertension, convulsions and respiratory failure.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems. The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

Section 4 - First Aid Measures

Inhalation: If dust is inhaled, remove to fresh air.
Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.
If irritation or discomfort persists seek medical attention.
If fumes or combustion products are inhaled: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and wash continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Brush off dust. Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

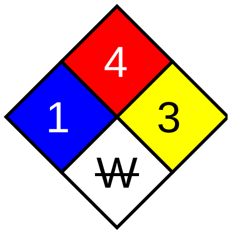
Ingestion: If swallowed, do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Long-term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

Section 5 - Fire-Fighting Measures

Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water. Contact with water liberates highly flammable gases.
Do NOT use CO_2 extinguishers.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Flammable solid. Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe to do so, remove containers from path of fire.
Fight fire from a safe distance, with adequate cover.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective neoprene gloves and chemical goggles.
Use dry clean up procedures and avoid generating dust.
Place in suitable containers for disposal.
DO NOT return unused product to containers.

Large Spills: Clear area of personnel. Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources.
Use dry clean up procedures and avoid generating dust.
DO NOT use water.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling. Collect residues and place in labeled plastic containers with vented lids.
DO NOT put the wetted material into a container.
After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Material from spill may be contaminated with water resulting in generation of highly flammable hydrogen gas with pressurizing of closed containers. Hold spill material in vented containers only and plan for prompt disposal.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practice. Observe manufacturer's storing and handling recommendations. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Avoid smoking, bare lights, heat or ignition sources.
Use spark-free tools when handling.
Avoid contact with incompatible materials.
Handle and open container with care.
WARNING: Contact with water generates heat.
DO NOT return unused product to containers.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Heavy gauge metal packages/heavy gauge metal drums.

Storage Requirements: Air-sensitive.
Observe manufacturer's storing and handling recommendations. Keep dry.
Store in original containers. Store away from sources of heat or ignition / bare lights. Store in a cool, dry and well-ventilated area. Store away from incompatible materials.
No smoking, bare lights, heat or ignition sources.
Protect containers against physical damage.
Keep containers securely sealed. Check regularly for spills and leaks.
CARE: Packing of high density product in light weight metal or plastic packages may result in container collapse with product release.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Metal dusts must be collected at the source of generation as they are potentially explosive.
1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.
2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

If exposure to workplace dust is not controlled, respiratory protection is required; wear NIOSH-approved dust respirator. Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

Eyes: Chemical goggles. DO NOT wear contact lenses.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVC gloves. Rubber gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >0.5 to 5 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >5 to <50 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range 50 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)
Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Silvery- to yellowish-white malleable, lustrous metal.

Physical State: Divided solid
Vapor Density (Air=1): Not applicable
Formula Weight: 137.34
Specific Gravity (H_2O=1, at 4 °C): 3.6
Water Solubility: Decomposes
Evaporation Rate: Not applicable

pH: Not applicable
Boiling Point Range: 1640 °C (2984 °F)
Freezing/Melting Point Range: 725 °C (1337 °F)
Volatile Component (% Vol): 0

Section 10 - Stability and Reactivity

Stability/Polymerization: Reacts with ammonia, halogens, oxygen and most acids. Is pyrophoric at room temperatures when in powder form. Easily oxidized - kept under petroleum or other oxygen-free liquid to exclude air.
Presence of water. Presence of heat source and ignition source. Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.
Reacts slowly with water. CAUTION contamination with moisture will liberate explosive hydrogen gas, causing pressure build up in sealed containers.
Reacts violently with acids and chlorinated solvents.

Section 11 - Toxicological Information

No significant acute toxicological data identified in literature search.

See NIOSH, *RTECS* CQ 8370000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options.
Recycle if possible, otherwise dispose in a chemically secure landfill.
Follow applicable federal, state, and local regulations.
Puncture containers to prevent reuse.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: BARIUM
BARIUM (non-pyrophoric)
Hazard Class: 4.3
ID No.: 1400
Packing Group: II
Label: Dang. when Wet [4]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: ....1999-11 **Review Date:** 2000-07

Material Safety Data Sheet Collection
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Issue Date: 2006-06

Benz[a]anthracene
BEN2040

Section 1 - Chemical Product and Company Identification

Material Name: Benz[a]anthracene **CAS Number:** 56-55-3
Chemical Formula: $C_{18}H_{12}$
EINECS Number: 200-280-6
ACX Number: X1002793-9
Synonyms: B(A)A; BA; BAA; 1,2-BENZ(A)ANTHRACENE; 1,2-BENZANTHRACENE; BENZ(A)ANTHRACENE; BENZANTHRACENE; BENZ[A]ANTHRACENE; 1,2-BENZANTHRAZEN; 1,2-BENZANTHRENE; BENZANTHRENE; 1,2-BENZOANTHRACENE; BENZO(A)ANTHRACENE; BENZOANTHRACENE; 2,3-BENZOPHENANTHRENE; BENZO(A)PHENANTHRENE; BENZO(B)PHENANTHRENE; 2,3-BENZPHENANTHRENE; NAPHTHANTHRACENE; TETRAPHENE
General Use: research chemistry

Section 2 - Composition / Information on Ingredients

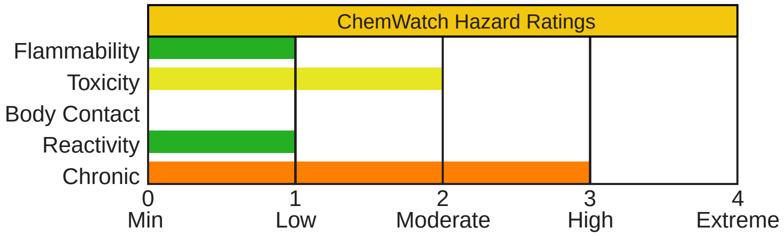
Name	CAS	%
benz[a]anthracene	56-55-3	>98

OSHA PEL

NIOSH REL

ACGIH TLV
Exposure by all routes should be carefully controlled to levels as low as possible.

Section 3 - Hazards Identification



ANSI Signal Word
Danger!

Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless plates. May cause irritation. Poison. Other Acute Effects: may be fatal if inhaled, swallowed, or absorbed through skin. Chronic Effects: may cause heritable genetic damage; may alter genetic material. Carcinogen. Will burn.

Potential Health Effects

Target Organs: No data found.
Primary Entry Routes: accidental skin and eye contact, inhalation of generated dusts
Acute Effects
Inhalation: The dust is harmful and discomforting to the upper respiratory tract. Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Eye: The dust may be discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/ or other transient eye damage/ ulceration.
Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material. Toxic effects may result from skin absorption.

Ingestion: The solid/dust is discomforting to the gastrointestinal tract and harmful if swallowed. Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Chronic Effects: Cited in many publications and by a number of regulatory authorities as a suspected human carcinogen. Subcutaneous injection produces sarcomas (soft tissue growths) in rats and mice. When administered by gavage benz[a]anthracene induced papillomas to the forestomach in mice and hamsters and mammary tumors in female rats.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: • If dust is inhaled, remove to fresh air.
- Encourage patient to blow nose to ensure clear breathing passages.
- Rinse mouth with water. Consider drinking water to remove dust from throat.
- Seek medical attention if irritation or discomfort persist.
- If fumes or combustion products are inhaled, remove to fresh air.
- Lay patient down. Keep warm and rested.
- Other measures are usually unnecessary.

Eye Contact: • Immediately hold the eyes open and flush with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Seek medical attention if pain persists or recurs.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: • Immediately remove all contaminated clothing, including footwear (after rinsing with water).
- Wash affected areas thoroughly with water (and soap if available).
- Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. If more than 15 minutes from a hospital:
- INDUCE vomiting with IPECAC SYRUP, or fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. NOTE: Wear a protective glove when inducing vomiting by mechanical means.
- SEEK MEDICAL ATTENTION WITHOUT DELAY.
- In the meantime, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
- If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided.
- If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Not available; probably combustible

Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
- Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, e.g., flame or spark, will cause fire or explosion.
- Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
- Build-up of electrostatic charge may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e., nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves for fire only.
- Prevent, by any means available, spillage from entering drains or waterways.
- Use fire fighting procedures suitable for surrounding fire.
- Do not approach containers suspected to be hot.
- Cool fire-exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

- Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: • Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Wear protective clothing, gloves, safety glasses and dust respirator.
- Use dry clean up procedures and avoid generating dust.
- Vacuum up or sweep up.
- Place in clean drum then flush area with water.

Large Spills: • Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or waterways.
- No smoking, bare lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse/absorb vapor.
- Contain or absorb spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
- If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of overexposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- DO NOT enter confined spaces until atmosphere has been checked.
- Do not allow material to contact humans, exposed food or food utensils.
- Avoid smoking, bare lights or ignition sources.
- When handling, DO NOT eat, drink or smoke.
- Avoid contact with incompatible materials.
- Keep containers securely sealed when not in used.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Working clothes should be laundered separately. Launder contaminated clothing before reuse.
- Follow good occupational work practices.
- Observe manufacturer's storage/handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Glass container. Plastic container. Metal can. Metal drum. Check that all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required. If risk of overexposure exists, wear NIOSH-approved respirator. Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields or chemical goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, e.g. PVC. Wear safety footwear.

Other: • Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Light yellow to tan crystalline powder.
Physical State: colorless plates
Vapor Pressure (kPa): 5 x10^{-9} torr at 20 °C
Formula Weight: 228.29
Evaporation Rate: Half life 89 hours
Boiling Point: Sublimes at 435 °C (815 °F)
Freezing/Melting Point: 162 °C (323.6 °F)
Volatile Component (% Vol): Negligible
Water Solubility: 0.014 mg/L in Water at 25 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Toxicity
Intravenous (rat) LD_{50}: > 200 mg/kg

Irritation
Nil reported

See *RTECS* CV9275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When released into water it will rapidly become adsorbed to sediment or particulate matter in the water column, and bioconcentrate into aquatic organisms. In the unadsorbed state, it will degrade by photolysis in a matter of hours to days. Its slow desorption from sediment and particulate matter will maintain a low concentration in the water. Because it is strongly adsorbed to soil it will remain in the upper few centimeters of soil and not leach into groundwater. It will very slowly biodegrade when colonies of microorganisms are acclimated but this is too slow a process (half-life ca 1 year to be significant). In the atmosphere it will be transported long distances and will probably be subject to photolysis and photooxidation although there is little documentation about the rate of these processes in the literature.
Ecotoxicity: Algae: Anabaena flos-aquae 2w EC_{50} growth +0.014 mg/l NOEC growth +0.003 mg/l
BCF: daphnia 4.0
Octanol/Water Partition Coefficient: log K_{ow} = 5.61
Soil Sorption Partition Coefficient: K_{oc} = sediments 55 to 1.87 x10^{6}

Section 13 - Disposal Considerations

Disposal: • Recycle wherever possible or consult manufacturer for recycling options.
• Follow applicable local, state, and federal regulations.
• Bury residue in an authorized landfill.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging: **Exceptions:** 153 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U018 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Benzo(a)pyrene
BEN5560

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

Material Name: Benzo(a)pyrene **CAS Number:** 50-32-8
Chemical Formula: $C_{20}H_{12}$
EINECS Number: 200-028-5
ACX Number: X1002798-4
Synonyms: B(A)P; BAP; BENZO(D,E,F)CHRYSENE; 3,4-BENZOPIRENE; 1,2-BENZOPYRENE; 3,4-BENZOPYRENE; 6,7-BENZOPYRENE; BENZO(A)PYRENE; 3,4-BENZPYREN; 3,4-BENZ(A)PYRENE; 3,4-BENZPYRENE; BENZ(A)PYRENE; BENZ[A]PYRENE; 3,4-BENZYLPYRENE; 3,4-BENZYPYRENE; 3,4-BP; BP; COAL TAR PITCH VOLATILES: BENZO(A)PYRENE
Derivation: Synthesized from pyrene and succinic anhydride.
General Use: Benzo(a)pyrene is no longer used or produced commercially in the US. In its pure form, benzo(a)pyrene may be used as a research laboratory reagent. It also occurs in combustion products of coal, oil, petroleum, wood and other biological matter; in motor vehicle and other gasoline and diesel engine exhaust; in charcoal-broiled foods; in cigarette smoke and general soot and smoke of industrial, municipal, and domestic origin. It occurs naturally in crude oils, shale oils, coal tars, gases and fly ash from active volcanoes and forest fires.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Benzo(a)pyrene	50-32-8	ca 100% wt

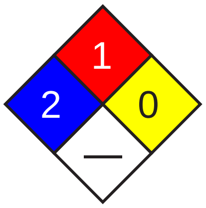
Except in laboratories, benzo(a)pyrene is usually mixed with other coal tar pitch chemicals. Consider exposure limits for coal tar pitch volatiles as a guideline. However, because benzo(a)pyrene is considered a probable carcinogen to humans, it is recommended that exposures to carcinogens be limited to the lowest feasible concentration.

OSHA PEL
TWA: 0.2 mg/m^3.

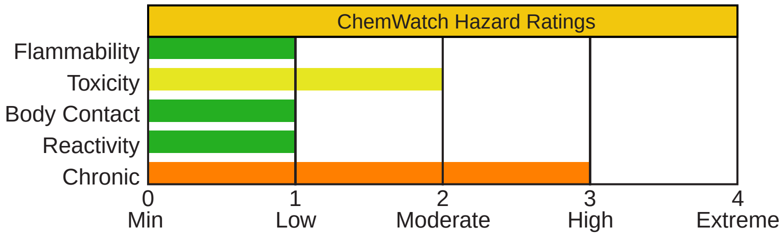
NIOSH REL

ACGIH TLV
Exposure by all routes should be carefully controlled to levels as low as possible.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
① Flammability
⓪ Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Pale yellow, crystalline solid or powder. Irritating to skin, eyes, respiratory tract. Chronic Effects: carcinogen, mutagen. Handle with extreme caution!

Potential Health Effects

Target Organs: Respiratory system, bladder, kidneys, skin.
Primary Entry Routes: Inhalation, ingestion.

Acute Effects

Inhalation: Respiratory tract irritation. Pregnant women may be especially susceptible to exposure effects of benzo(a)pyrene; exposure may damage the fetus. In general, polyaromatic hydrocarbons such as benzo(a)pyrene tend to localize primarily in body fat and fatty tissues (for ex. breasts) and are excreted in breast milk. Benzo(a)pyrene may also affect the male reproductive system (testes and sperm).

Eye: Irritation and/or burns on contact.

Skin: Irritation with burning sensation, rash, and redness; dermatitis on prolonged exposure. Sunlight enhances effects (photosensitization).

Ingestion: None reported.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: Respiratory system, bladder, kidney, and skin disorders.

Chronic Effects: Inhalation: Cough and bronchitis. Eye: Photosensitivity and irritation. Skin: Skin changes such as thickening, darkening, pimples, loss of color, reddish areas, thinning of the skin, and warts. Sunlight enhances effects (photosensitization). Other: Gastrointestinal (GI) effects include leukoplakia (a pre-cancerous condition characterized by thickened white patches of epithelium on mucous membranes, especially of the mouth). Cancer of the lung, skin, kidneys, bladder, or GI tract is also possible. Smoking in combination with exposure to benzo(a)pyrene increases the chances of developing lung cancer. Persons with a high degree of inducibility of the enzyme aryl hydrocarbon hydroxylase may be a high risk population.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of tepid water for at least 15 min. Consult an ophthalmologist if irritation or pain persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water (less than 15 min). Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. Inducing vomiting is not necessary since benzo(a)pyrene has a low acute toxicity and therefore, is generally an unnecessary procedure. Consider activated charcoal/cathartic.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Monitor CBC and arterial blood gases, conduct liver, renal, and pulmonary function tests (if respiratory tract irritation is present), and urinalysis. Biological monitoring techniques testing for metabolites in blood or urine, or DNA adducts in blood or tissues are useful for epidemiological studies that determine if exposure has occurred. Because neither normal nor toxic levels have been established, those techniques may not be useful for evaluating individual patients.

Special Precautions/Procedures: Emergency personnel should protect against exposure.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: None reported. Benzo(a)pyrene may burn, but does *not* readily ignite.

Autoignition Temperature: None reported.

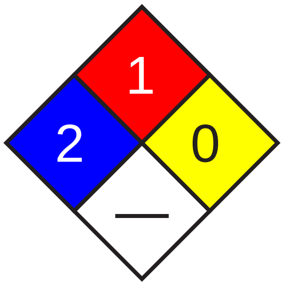
LEL: None reported.

UEL: None reported.

Extinguishing Media: For small fires, use dry chemical, sand, water spray, or foam. For large fires, use water spray, fog, or foam.

General Fire Hazards/Hazardous Combustion Products: Carbon monoxide and carbon dioxide.

Fire-Fighting Instructions: Isolate hazard and deny entry. If feasible and without undue risk, move containers from fire hazard area. Otherwise, cool fire-exposed containers with water spray until well after fire is extinguished. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel of large spills, remove heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and skin or eye contact. Clean up spills promptly.

Small Spills: Carefully scoop up spilled material and place into appropriate containers for disposal. For liquid spills, take up with a noncombustible, inert absorbent and place into appropriate containers for disposal.

Large Spills: For large spills, dike far ahead of liquid spill or contain dry spill for later disposal. Do not release into sewers or waterways. *Do not* dry sweep! Use a vacuum with a HEPA filter or a wet method to reduce dust. After cleanup is complete, thoroughly decontaminate all surfaces. *Do not* reuse contaminated cleaning materials.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Handle with extreme caution and take all necessary measures to avoid exposure to benzo(a)pyrene because it is a carcinogen and mutagen. Follow good personal hygiene procedures and thoroughly wash hands with soap and water after handling. Use safety pipettes for all pipetting.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed and properly labeled containers in a cool, well-ventilated area.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use a Class I, Type B, biological safety hood when working with benzo(a)pyrene in a laboratory. Decrease the rate of air extraction, so that benzo(a)pyrene can be handled without powder being blown around the hood. Keep glove boxes under negative pressure. Use vertical laminar-flow, 100% exhaust, biological safety cabinets for containment of in vitro procedures. The exhaust air flow should be sufficient to provide an inward air flow at the face opening of the cabinet. Ensure contaminated air sheaths that are under positive pressure are leak-tight. Never use horizontal laminar-flow hoods or safety cabinets where filtered air is blown across the working area towards the operator. Test cabinets before work begins to ensure they are functioning properly. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical examinations with emphasis on the oral cavity, bladder, kidneys, skin, and respiratory tract. Conduct urinalysis including specific gravity, albumin, glucose, and microscopic examination of centrifuged sediment for red blood cells. Also, include 14" x 17" chest roentgenogram, FVC + FEV1, and CBC to detect any leukemia or aplastic anemia. It is recommended that this exam be repeated on an annual basis and semiannual basis for employees 45 yr of age or older or with 10 or more years of exposure to coal tar pitch volatiles. Train workers about the hazards of benzo(a)pyrene and the necessary protective measures to prevent exposure. Periodically inspect lab atmospheres, surfaces such as walls, floors, and benches, and interior of fume hoods and air ducts for contamination. Post appropriate signs and labels on doors leading into areas where benzo(a)pyrene is used.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. In animal laboratories, wear protective suits (disposable, one-piece and close-fitting at ankles and wrists), gloves, hair covering, and overshoes. In chemical laboratories, wear gloves and gowns. Wear protective eyeglasses or chemical safety, gas-proof goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. The following respirator recommendations are for coal tar pitch volatiles. For any unknown concentration, wear any SCBA with a full facepiece and operated in a pressure- demand or other positive pressure mode, or any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive pressure mode. For escape, wear any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister having a high-efficiency particulate filter, or any appropriate escape-type SCBA. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Shower and change clothes after exposure or at the end of the workshift. Separate contaminated work clothes from street clothes. Launder before reuse. Remove benzo(a)pyrene from your shoes and clean personal protective equipment. Use procedures to ensure laundry personnel are not exposed. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Pale yellow monoclinic needles with a faint, aromatic odor.

Physical State: Solid

Vapor Pressure (kPa): >1 mm Hg at 68 °F (20 °C)

Formula Weight: 252.30

Specific Gravity (H_2O=1, at 4 °C): 1.351

Boiling Point: >680 °F (>360 °C); 590 °F (310 °C) at 10 mm Hg

Freezing/Melting Point: 354 °F (179 °C)

Water Solubility: Insoluble; 0.0038 mg (+/- 0.00031 mg) in 1 L at 77 °F (25 °C)

Other Solubilities: Ether, benzene, toluene, xylene, concentrated hydrosulfuric acid; sparingly soluble in alcohol, methanol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Benzo(a)pyrene is stable at room temperature in closed containers under normal storage and handling conditions. It undergoes photo-oxidation when exposed to sunlight or light in organic solvents and is also oxidized by chromic acid and ozone. Hazardous polymerization cannot occur. Avoid heat and ignition sources and incompatibles.

Storage Incompatibilities: Strong oxidizers (chlorine, bromine, fluorine) and oxidizing chemicals (chlorates, perchlorates, permanganates, and nitrates).

Hazardous Decomposition Products: Thermal oxidative decomposition of benzo(a)pyrene can produce carbon monoxide and carbon dioxide.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral: 15 mg/kg produced gastrointestinal and musculoskeletal tumors.

Irritation Effects:

Mouse: 14 µg caused mild irritation.

Other Effects:

Rat, oral: 40 mg/kg on the 14th day of pregnancy caused changes in the extra embryonic structures.

Rat, oral: 2 g/kg administered 28 days prior to mating and 1-22 days of pregnancy produced a stillbirth.

Tumorgenicity, mouse, oral: 75 mg/kg administered to the female during the 12- 14 day of pregnancy produced biochemical and metabolic effects on the newborn.

Mouse, inhalation: 200 ng/m^3/6 hr administered intermittently over 13 weeks produced tumors of the lungs.

Human, HeLa cell: 1500 nmol/L caused DNA inhibition.

Human, lung cell: 1 µmol/L caused DNA damage.

Human, liver cell: 100 nmol/L caused DNA damage.

Rabbit, skin: 17 mg/kg administered intermittently over 57 weeks produced tumors of the skin and appendages.

See *RTECS* DJ3675000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to water, benzo(a)pyrene adsorbs very strongly to particulate matter and sediments, bioconcentrates in aquatic organisms which cannot metabolize it, but does not hydrolyze. Direct photolysis at the water surface, evaporation, or biodegradation may be important, but adsorption may significantly retard these processes. Adsorption to particulates may also retard direct photolysis when benzo(a)pyrene is released to air. Benzo(a)pyrene may be removed from air by reaction with nitrogen dioxide (half-life, 7 days) or ozone (half-life, 37 min), or photochemically produced hydroxyl radicals (estimated half-life, 21.49 hr). It will adsorb very strongly to the soil. Although it is not expected to appreciably leach to the groundwater, groundwater samples indicate that it can be transported there. It is not expected to significantly evaporate or hydrolyze from soils and surfaces. However, it may be subject to appreciable biodegradation in soils. It will adsorb very strongly to the soil. Although it is not expected to appreciably leach to the groundwater, groundwater samples indicate that it can be transported there. It is not expected to significantly evaporate or hydrolyze from soils and surfaces. However, it may be subject to appreciable biodegradation in soils.

Ecotoxicity: Oysters, BCF (bioconcentration factor): 3000; rainbow trout, BCF: 920; *Daphnia pulex*, BCF: 13,000.

BCF: Some marine organisms such as phytoplankton, certain zooplankton, scallops (*Placopecten sp*), snails (*Litternia littorea*), and mussels (*Mytilus edulis*) lack a metabolic detoxification enzyme system to metabolize benzo(a)pyrene and therefore, tend to accumulate benzo(a)pyrene. Humic acid in solution may decrease bioconcentration.

Octanol/Water Partition Coefficient: log K_{ow} = 6.04

Section 13 - Disposal Considerations

Disposal: Small quantities: 10 mL of a solution containing 0.3 mol/L of potassium permanganate and 3 mol/L of sulfuric acid will degrade 5 mg of benzo(a)pyrene. Also, can treat with sodium dichromate in strong sulfuric acid (1-2 days). Benzo(a)pyrene is also a good candidate for fluidized bed incineration at a temperature range of 842 to 1796 °F (450 to 980 °C) or rotary kiln incineration at 820 to 1600°C. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U022 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per RCRA Section 3001, per CWA Section 307(a) 1 lb (0.454 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Benzo[%i/i%]fluoranthene
BEN4520

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

Material Name: Benzo[%i/**i%]fluoranthene** **CAS Number:** 205-99-2
Chemical Formula: $C_{20}H_{12}$
EINECS Number: 205-911-9
ACX Number: X1004486-7
Synonyms: B B F; B E F; B (B) F; B(B)F; B(E)F; BBF; BEF; 3,4-BENZ(E)ACEPHENANTHRYLENE; BENZ(E)ACEPHENANTHRYLENE; 2,3-BENZFLUORANTHENE; 3,4-BENZFLUORANTHENE; BENZO(B) FLUORANTHENE; BENZO[%I/**I%]FLUORANTHENE; 2,3-BENZOFLUORANTHENE; 3,4-BENZOFLUORANTHENE; BENZO(B)FLUORANTHENE; BENZO(E)FLUORANTHENE; BENZO[B]FLUORANTHENE; 2,3-BENZOFLUORANTHRENE**
Derivation: No manufacturing information available; found in coal tar, coke oven emissions, cigarette smoke and automobile exhaust. There is no commercial production of this compound in the U.S.
General Use: Used as a research chemical.

Section 2 - Composition / Information on Ingredients

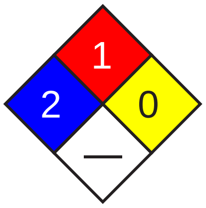
Name	CAS	%
Benzo[%i/**i%]fluoranthene**	**205-99-2**	**ca 100% wt**

(Note that, except when in the form of a laboratory research chemical, benzo[%i/i%]fluoranthene is typically found in mixtures with other PAHs (polycyclic aromatic hydrocarbons), such as coal tar pitch).

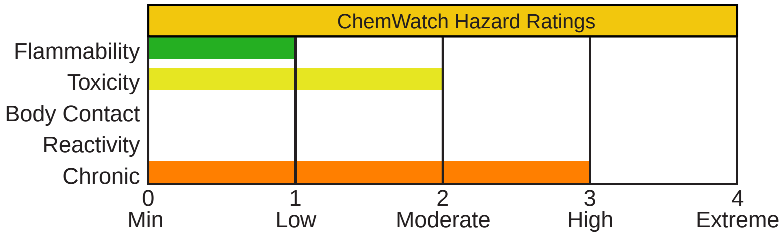
OSHA PEL **NIOSH REL**

ACGIH TLV
Exposure by all routes should be carefully controlled to levels as low as possible.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② **Health**
① **Flammability**
⓪ **Reactivity**

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless needles. May be irritating to eyes/skin/respiratory tract. Possible human carcinogen and mutagen.

Potential Health Effects

Target Organs: Eyes, skin, respiratory system, gastrointestinal (GI) system, blood, liver, kidneys
Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption
Acute Effects
Inhalation: Irritation may result from inhalation of benzo[%i/**i%]fluoranthene dust or fumes.**
Eye: Contact may result in irritation.
Skin: Contact may cause irritation.
Ingestion: None reported.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Although there is no direct epidemiological evidence linking benzo[%i/**i%]fluoranthene with cancer, it is frequently a component of mixtures associated with human cancer. Epidemiological studies demonstrate increased incidence of cancer (skin, lung, urinary tract, GI system) with exposure to mixed PAHs and substances that contain them. Coal tar pitch volatiles are reported to cause an excess of bronchitis. In animal studies, benzo[%i/i%]fluoranthene has been found to be tumorigenic and mutagenic.**

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain and/or irritation develop.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat overexposure symptomatically and supportively. Medical surveillance may be necessary for high exposures (skin, mouth, GI, respiratory system). Animal testing suggests a synergism (combined effect greater than sum of parts) of mutagenicity between benzo[%i/**i%]fluoranthene and other PAHs.**

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Probable combustible solid

Autoignition Temperature: None reported.

LEL: None reported.

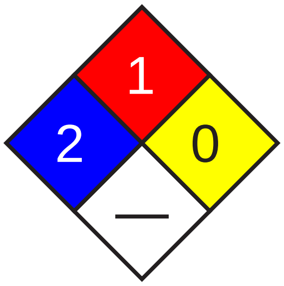
UEL: None reported.

Flammability Classification: Probable combustible solid

Extinguishing Media: Use water spray; carbon dioxide, dry chemical powder or appropriate foam.

General Fire Hazards/Hazardous Combustion Products: Heating benzo[%i/**i%]fluoranthene to decomposition can produce carbon monoxide (CO) and carbon dioxide (CO_2).**

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate area and deny entry. Remove sources of ignition, and provide maximum ventilation.

Small Spills: Vacuum or carefully scoop up material and deposit in sealed containers. Absorb liquid containing benzo[%i/**i%]fluoranthene with vermiculite, earth, sand or similar material.**

Large Spills: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Stay upwind and have cleanup personnel protect against inhalation and contact.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid dust inhalation, and skin and eye contact. Avoid sunlight exposure of contaminated skin. Use only with ventilation sufficient to reduce airborne concentrations as low as possible. Wear protective gloves, goggles, and clothing (see Sec. 8). Keep away from heat and ignition sources.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Periodically inspect stored materials.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Work with benzo[%i/**i%]fluoranthene only under an exhaust hood. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.**

Administrative Controls: Have employees with potential for exposure submit to preplacement and periodic medical examinations with emphasis on oral cavity (including sputum cytology), respiratory tract, skin (chronic disorders, lesions), blood (complete count), bladder and kidneys (urinalysis: specific gravity, albumin, glucose, microscopic examination of sediment; urinary cytology). Repeat medical exam on an annual basis, or on a semi-annual basis for employees 45 years or older or with 10 or more years of exposure to pitch volatiles. Periodically inspect lab atmospheres, and surfaces such as walls, floors, and benches and interior of fume hoods and air ducts for contamination. Post appropriate signs and labels on doors leading to areas where benzo[%i/**i%]fluoranthene is used.**

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Wear splash-proof chemical safety goggles, and face shield (8-inch minimum), per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For any detectable concentration (of coal tar pitch volatiles) use SCBA with full facepiece operated in pressure-demand or other positive pressure mode, or supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive pressure mode; escape, air purifying full face respirator (gas mask) with a chin-style or a front- or back-mounted organic vapor canister and with a full facepiece and a fume or high-efficiency filter, or escape-type SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless needles
Physical State: Solid
Vapor Pressure (kPa): 5 x10^{-7} mm Hg at 68 °F (20 °C)
Formula Weight: 252.32
Freezing/Melting Point: 334.4 °F (168 °C)
Water Solubility: 0.0012 mg/L
Other Solubilities: 95% ethanol: <1 mg/mL at 66 °F (19 °C); acetone: 10-50 mg/mL at 66 °F (19 °C); benzene: slightly soluble; DMSO: 10-50 mg/mL at 66 °F (19 °C).

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Benzo[%i/**i%]fluoranthene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Heat, sunlight.**

Storage Incompatibilities: Include strong oxidizing agents.

Hazardous Decomposition Products: Thermal oxidative decomposition of benzo[%i/**i%]fluoranthene will produce carbon monoxide (CO) and carbon dioxide (CO$_2$).**

Section 11 - Toxicological Information

Other Effects:

Tumorgenicity, mouse, skin: 88 ng/kg/120 weeks intermittently produced toxic effects: tumorigenic - carcinogenic by RTECS criteria; skin and appendages - tumors; tumorigenic - tumors at site of application.

Hamster, lung cells: 100 µg/L produced morphological transformation.

Mouse, skin: 4037 µg/kg/20 days intermittently produced toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors.

Rat, intraperitoneal: 100 mg/kg resulted in DNA adducts.

Mouse, skin: 72 mg/kg/60 weeks intermittently produced toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors; tumorigenic - tumors at site of application.

Rat, intraperitoneal: 100 mg/kg induced sister chromatid exchange.

Rat, implant: 5 mg/kg produced toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; lungs, thorax, or respiration - tumors; tumorigenic - tumors at site of application.

Human, lymphocyte cells: 55 µg/L produced mutation.

See *RTECS* CU1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Benzo[%i/**i%]fluoranthene has a low vapor pressure and Henry's Law Constant, and will not readily evaporate from water or soil. In surface water, it will partition from the water column to suspended sediments. Limited bioconcentration in aquatic organisms may occur (polychaete worms, BCF = 9.1); however, fish have an enzyme (microsomal oxidase) capable of rapidly metabolizing PAHs. Photolysis, photo-oxidation, and volatilization of dissolved benzo[%i/i%]fluoranthene may occur, but adsorption to suspended sediments is expected to inhibit these processes. Release to the soil may result in some biodegradation. Photolysis is not expected to be significant after release to soil. In the atmosphere it is likely to be adsorbed to particulate matter, and will be subject to wet and dry deposition. In the atmosphere, benzo[%i/i%]fluoranthene will rapidly degrade by reaction with photochemically produced hydroxyl radicals (half life 1.00 day). A high K_{oc} indicates significant sorption and low mobility in the soil column.**

Ecotoxicity: Evidence suggests that PAHs in lake bottom sediments may cause tumors in fish.
Henry's Law Constant: 1.38 $x10^{-4}$ atm-m^3/mole, estimated
Octanol/Water Partition Coefficient: log K_{ow} = 6.124
Soil Sorption Partition Coefficient: K_{oc} = 5.88, estimated

Section 13 - Disposal Considerations

Disposal: Benzo[%i/**i%]fluoranthene is a good candidate for rotary kiln incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.**

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Not listed

Section 16 - Other Information

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Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Benzo[k]fluoranthene
BEN4680

Section 1 - Chemical Product and Company Identification 61

Material Name: Benzo[k]fluoranthene **CAS Number:** 207-08-9
Chemical Formula: $C_{20}H_{12}$
EINECS Number: 205-916-6
ACX Number: X1004488-1
Synonyms: B; B (K) F; B K F; 8,9-BENZFLUORANTHENE; BENZO(K) FLUORANTHENE; 11,12-BENZO(K)FLUORANTHENE; 11,12-BENZOFLUORANTHENE; 8,9-BENZOFLUORANTHENE; BENZO(K)FLUORANTHENE; BENZO[K]FLUORANTHENE; 11,12-BENZOFLURANTHENE; 2,3,1',8'-BINAPHTHYLENE; 2,3,1',8'-BINAPTHYLENE; BKF; DIBENZO(B,JK)FLUORENE
General Use: there is no commerical use of this compound

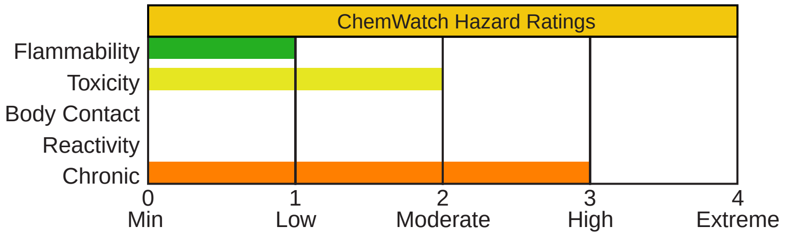
Section 2 - Composition / Information on Ingredients

Name	CAS	%
benzo[k]fluoranthene	207-08-9	>98

OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Pale yellow needles. Irritating to eyes/skin/respiratory tract. Toxic. Probable human carcinogen. Will burn.

Potential Health Effects

Target Organs: eyes, skin, respiratory system
Primary Entry Routes: skin contact/absorption, inhalation of generated dust
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract. Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/ or other transient eye damage/ ulceration.
Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.
Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The material is moderately discomforting and harmful if swallowed in large quantity.
Carcinogenicity: NTP - Listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.
Chronic Effects: When injected into pulmonary tissue of female rats benzo[k]fluoranthene induced squamous cell carcinomas. Topical administration initiated skin tumors in female mice whilst subcutaneous injection induced local sarcomas in mice of both sexes. Although there is no adequate data available to evaluate carcinogenicity of PAHs in

humans, there are a number of epidemiologic and mortality studies to show increased incidences of cancer in humans exposed to mixtures of PAHs. Lung and genitourinary cancer mortality amongst coke oven workers and skin tumors in workers exposed to creosote are examples.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: • If dust is inhaled, remove to fresh air.
- Encourage patient to blow nose to ensure clear breathing passages.
- Rinse mouth with water. Consider drinking water to remove dust from throat.
- Seek medical attention if irritation or discomfort persist.

Eye Contact: • Immediately hold the eyes open and flush with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Seek medical attention if pain persists or recurs.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: • Immediately remove all contaminated clothing, including footwear (after rinsing with water).
- Wash affected areas thoroughly with water (and soap if available).
- Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. If more than 15 minutes from a hospital:
- INDUCE vomiting with IPECAC SYRUP, or fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. NOTE: Wear a protective glove when inducing vomiting by mechanical means.
- SEEK MEDICAL ATTENTION WITHOUT DELAY.
- In the meantime, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
- If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided.
- If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Not available; probably combustible

Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
- Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, e.g., flame or spark, will cause fire or explosion.
- Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
- Build-up of electrostatic charge may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting. Combustion products include carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.

Fire-Fighting Instructions: • Use water delivered as a fine spray to control fire and cool adjacent area.
- Do not approach containers suspected to be hot.
- Cool fire-exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: • Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Wear impervious gloves and safety glasses.
- Use dry clean up procedures and avoid generating dust.
- Vacuum up or sweep up.
- Place spilled material in clean, dry, sealable, labeled container.

Large Spills: • Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or waterways.

- Stop leak if safe to do so.
- Contain spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Neutralize/decontaminate residue.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
- If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- DO NOT enter confined spaces until atmosphere has been checked.
- Avoid smoking, bare lights or ignition sources.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately.
- Follow good occupational work practices.
- Observe manufacturer's storage and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can. Metal drum. Check that all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions. If risk of overexposure exists, wear NIOSH-approved respirator. Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses, safety glasses with side shields, or chemical goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear general protective gloves, e.g. light weight rubber gloves.

Other: Overalls; impervious protective clothing. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Yellow powder.

Physical State: pale yellow needles

Vapor Pressure (kPa): 0.0000000000959 mm Hg at 25 °C

Vapor Density (Air=1): > 1

Formula Weight: 252.32

Boiling Point: 480 °C (896 °F) at 760 mm Hg

Freezing/Melting Point: 217 °C (422.6 °F)

Water Solubility: Insoluble in Water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Tumors at site of application.

NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

See *RTECS* DF6350000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Its presence in distant places indicates that it is reasonably stable in the atmosphere and capable of long distant transport. Atmospheric losses are caused by gravitational settling and rainout. On land it is strongly adsorbed to soil and remains in the upper soil layers and should not leach into groundwater. Biodegradation may occur but will be very slow (half-life ca 2 years with acclimated microorganisms). It will get into surface water from dust and precipitation in addition to runoff and effluents. In the water it will sorb to sediment and particulate matter in the water column. It would be expected to bioconcentrate in fish and seafood.
Ecotoxicity: No data found.
Henry's Law Constant: estimated at 4.2 x10^{8}
BCF: fish 4.97
Octanol/Water Partition Coefficient: log K_{ow} = 6.84
Soil Sorption Partition Coefficient: K_{oc} = nearly 1 x10^{6}

Section 13 - Disposal Considerations

Disposal: • Consult manufacturer for recycling options and recycle where possible.
• Follow applicable local, state, and federal regulations.
• Incinerate residue at an approved site.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging: **Exceptions:** 153 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed

CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Not listed

Section 16 - Other Information

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Material Safety Data Sheet Collection
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1171 RiverFront Center
Amsterdam, NY 12010
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Benzene
BEN2200

Issue Date: 2004-07

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Benzene **CAS Number:** 71-43-2
Chemical Formula: C_6H_6
Structural Chemical Formula: C_6H_6
EINECS Number: 200-753-7
ACX Number: X1001488-9
Synonyms: Benzene; BENZENE; (6)ANNULENE; BENZEEN; BENZEN; BENZIN; BENZINE; BENZOL; BENZOL 90; BENZOLE; BENZOLENE; BENZOLO; BICARBURET OF HYDROGEN; CARBON OIL; COAL NAPHTHA; CYCLOHEXATRIENE; EPA PESTICIDE CHEMICAL CODE 008801; FENZEN; MINERAL NAPHTHA; MOTOR BENZOL; NITRATION BENZENE; PHENE; PHENYL HYDRIDE; POLYSTREAM; PYROBENZOL; PYROBENZOLE
General Use: Manufacture of chemicals including styrene, dyes, and many other organic chemicals. Has been used in artificial leather, linoleum, oil cloth, airplane dopes, lacquers; as solvent for waxes, resins, oils etc.
May also be a minor component of gasoline, petrol.
Exposure should be minimized by use in closed systems.
Handling procedures and control measures should be evaluated for exposure before commencement of use in plant operations.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
benzene	71-43-2	99.9

OSHA PEL
TWA: 1 ppm; STEL: 5 ppm.

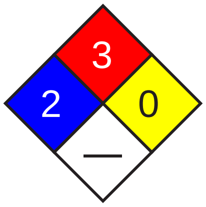
NIOSH REL
TWA: 0.1 ppm; STEL: 1 ppm.

DFG (Germany) MAK
Skin.

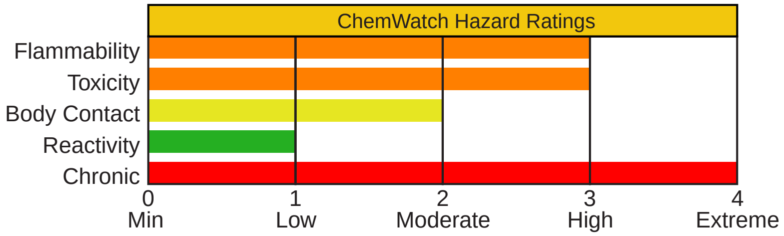
ACGIH TLV
TWA: 0.5 ppm; STEL: 2.5 ppm; skin.

IDLH Level
500 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Toxic. Also causes: headache, dizziness, drowsiness. Absorbed through the skin. Chronic: dermatitis, leukemia, bone marrow damage. Carcinogen. Reproductive effects. Flammable.

Potential Health Effects

Target Organs: blood, central nervous system (CNS), bone marrow, eyes, upper respiratory system, skin
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and lungs and may be harmful if inhaled.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

Inhalation hazard is increased at higher temperatures.

The symptoms of acute exposure to high vapor concentrations include confusion, dizziness, tightening of the leg muscles and pressure over the forehead followed by a period of excitement. If exposure continues the casualty quickly becomes stupefied and lapses into a coma with narcosis.

Effects of inhalation may include nausea, vomiting headache, dizziness, drowsiness, weakness, sometimes preceded by brief periods of exhilaration, or euphoria, irritability, malaise, confusion, ataxia, staggering, weak and rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips and tinnitus. Severe exposures may produce blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis and coma characterized by motor restlessness, tremors and hyperreflexia (occasionally preceded by convulsions). Polyneuritis and persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia and agitation may also occur. Two-three weeks after the exposure, nervous irritability, breathlessness and unsteady gait may still persist; cardiac distress and an unusual dicoloration of the skin may be evident for up to four weeks.

Hemotoxicity is not normally a feature of acute exposures although anemia, thrombocytopenia, petechial hemorrhage, and spontaneous internal bleeding have been reported. Fatal exposures may result from asphyxia, central nervous system depression, cardiac and respiratory failure and circulatory collapse; sudden ventricular fibrillation may also be fatal.

Death may be sudden or may be delayed for 24 hours. Central nervous system, respiratory or hemorrhagic complications may occur up to five days after the exposure and may be lethal; pathological findings include respiratory inflammation with edema, and lung hemorrhage, renal congestion, cerebral edema and extensive petechial hemorrhage in the brain, pleurae, pericardium, urinary tract, mucous membrane and skin.

Exposure to toxic levels has also produced chromosome damage.

Eye: The liquid is highly discomforting to the eyes, may be harmful following absorption and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is moderately discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.

Toxic effects may result from skin absorption.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Liquid is an irritant and may cause burning and blistering of skin on prolonged exposure.

Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes.

Benzene is a myelotoxicant known to suppress bone-marrow cell proliferation and to induce hematologic disorders in humans and animals.

Signs of benzene-induced aplastic anemia include suppression off leukocytes (leukopenia), red cells (anemia), platelets (thromocytopenia) or all three cell types (pancytopenia). Classic symptoms include weakness, purpura, and hemorrhage. The most significant toxic effect is insidious and often irreversible injury to the blood forming tissue. Leukemia may develop.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.

2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.

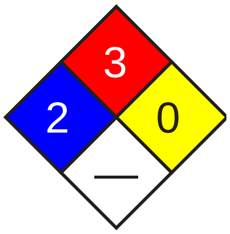
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.

4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.

5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.
Consider complete blood count. Evaluate history of exposure.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: -11 °C Closed Cup

Autoignition Temperature: 562 °C

LEL: 1.3% v/v

UEL: 7.1% v/v

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Pollutant - contain spillage. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.

Use only spark-free shovels and explosion proof equipment.

Collect recoverable product into labeled containers for recycling.

Absorb remaining product with sand, earth or vermiculite.

Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.

Wear protective clothing when risk of exposure occurs.

Use in a well-ventilated area. Prevent concentration in hollows and sumps.

DO NOT enter confined spaces until atmosphere has been checked.

Avoid smoking, bare lights, heat or ignition sources.

When handling, DO NOT eat, drink or smoke.

Vapor may ignite on pumping or pouring due to static electricity.

DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.

Avoid contact with incompatible materials.

Keep containers securely sealed. Avoid physical damage to containers.

Always wash hands with soap and water after handling.

Work clothes should be laundered separately.

Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.

Check all containers are clearly labeled and free from leaks.

Storage Requirements: Store in original containers in approved flame-proof area.

No smoking, bare lights, heat or ignition sources.

DO NOT store in pits, depressions, basements or areas where vapors may be trapped. Keep containers securely sealed.

Store away from incompatible materials in a cool, dry well ventilated area.

Protect containers against physical damage and check regularly for leaks.

Observe manufacturer's storing and handling recommendations.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.

If risk of overexposure exists, wear NIOSH-approved respirator.

Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.

Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Nitrile gloves; Neoprene gloves.

Safety footwear.

Do NOT use this product to clean the skin.

Respiratory Protection:

Exposure Range >1 to 10 ppm: Air Purifying, Negative Pressure, Half Mask

Exposure Range >10 to 100 ppm: Air Purifying, Negative Pressure, Full Face

Exposure Range >100 to 1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face

Exposure Range >1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

Cartridge Color: black

Note: must change cartridge at beginning of each shift

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
TEFLON	Best selection
VITON	Best selection
VITON/NEOPRENE	Best selection
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion

BUTYL	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion
BUTYL/NEOPRENE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, highly flammable liquid; floats on water. Characteristic aromatic odor. Highly volatile. Mixes with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone and oils.

Physical State: Liquid
Vapor Pressure (kPa): 9.95 at 20 °C
Vapor Density (Air=1): 2.77
Formula Weight: 78.12
Specific Gravity (H_2O=1, at 4 °C): 0.879 at 20 °C
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 80.1 °C (176 °F)
Freezing/Melting Point: 5.5 °C (41.9 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.18 g/100 g of water at 25 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Toxicity

Oral (man) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 930 mg/kg
Inhalation (rat) LC_{50}: 10000 ppm/7h
Inhalation (human) LC_{Lo}: 2000 ppm/5m
Inhalation (man) TC_{Lo}: 150 ppm/1y - I
Inhalation (human) TC_{Lo}: 100 ppm
Reproductive effector in rats

Irritation

Skin (rabbit): 20 mg/24 hr - mod
Eye (rabbit): 2 mg/24 hr - SEVERE

See NIOSH, *RTECS* CY 1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be subject to rapid volatilization near the surface and that which does not evaporate will be highly to very highly mobile in the soil and may leach to groundwater. It may be subject to biodegradation based on reported biodegradation of 24% and 47% of the initial 20 ppm in a base-rich para-brownish soil in 1 and 10 weeks, respectively. It may be subject to biodegradation in shallow, aerobic groundwaters, but probably not under anaerobic conditions. If released to water, it will be subject to rapid volatilization; the half-life for evaporation in a wind-wave tank with a moderate wind speed of 7.09 m/sec was 5.23 hours; the estimated half-life for volatilization from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec is estimated to be 2.7 hours at 20 °C. It will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms or hydrolyze. It may be subject to biodegradation based on a reported biodegradation half-life of 16 days in an aerobic river die-away test. In a marine ecosystem biodegradation occurred in 2 days after an acclimation period of 2 days and 2 weeks in the summer and spring, respectively, whereas no degradation occurred in winter. According to one experiment, it has a half-life of 17 days due to photodegradation which could contribute to removal in situations of cold water, poor nutrients, or other conditions less conductive to microbial degradation. If released to the atmosphere, it will exist predominantly in the vapor phase. Gas-phase will not be subject to direct photolysis but it will react with photochemically produced hydroxyl radicals with a half-life of 13.4 days calculated using an experimental rate constant for the reaction. The reaction time in polluted atmospheres which contain nitrogen oxides or sulfur dioxide is accelerated with the half-life being reported as 4-6 hours. Products of photooxidation include phenol, nitrophenols, nitrobenzene, formic acid, and peroxyacetyl nitrate. It is fairly soluble in water and is removed from the atmosphere in rain.

Ecotoxicity: LC_{50} Clawed toad (3-4 wk after hatching) 190 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 5.8 to 10.9 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 63 ppm/14 days /Conditions of bioassay not specified; LC_{50} Salmo trutta (brown trout yearlings) 12 mg/l/1 hr (static bioassay); LD_{50} Lepomis macrochirus (bluegill sunfish) 20 mg/l/24 to 48 hr /Conditions of bioassay not specified; LC_{100} Tetrahymena pyriformis (ciliate) 12.8 mmole/l/24 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae) stage 1, 108 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 20 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 5.3×10^{-3}

BCF: eels 3.5

Biochemical Oxygen Demand (BOD): 1.2 lb/lb, 10 days

Octanol/Water Partition Coefficient: log $K_{ow} = 2.13$

Soil Sorption Partition Coefficient: K_{oc} = woodburn silt loam 31 to 143

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: BENZENE
Hazard Class: 3.1
ID No.: 1114
Packing Group: II
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U019 Toxic Waste, Ignitable Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a), per CAA Section 112 10 lb (4.535 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection

Genium group inc.

1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Benzoic Acid
BEN4920

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Benzoic Acid **CAS Number:** 65-85-0

Chemical Formula: $C_7H_6O_2$

Structural Chemical Formula: C_6H_5COOH

EINECS Number: 200-618-2

ACX Number: X1001262-5

Synonyms: ACIDE BENZOIQUE; ACIDO BENZOICO; BENZENE CARBOXYLIC ACID; BENZENE FORMIC ACID; BENZENECARBOXYLIC ACID; BENZENEFORMIC ACID; BENZENEMETHANOIC ACID; BENZENEMETHONIC ACID; BENZOATE; BENZOESAEURE; BENZOIC ACID; CARBOXYBENZENE; DIACYCLIC ACID; DRACYLIC ACID; EPA PESTICIDE CHEMICAL CODE 009101; FLOWERS OF BENJAMIN; FLOWERS OF BENZOIN; HA 1; KYSELINA BENZOOVA; PHENYL CARBOXYLIC ACID; PHENYLCARBOXYLIC ACID; PHENYLFORMIC ACID; RETARDED BA; RETARDER BA; RETARDEX; SALVO LIQUID; SALVO POWDER; SOLVO POWDER; TENN-PLAS; TENNPLAS; UNISEPT BZA

Derivation: Occurs naturally in gum benzoin (20%) and up to 0.05% in most berries. Produced by decarboxylation of phthalic anhydride in the presence of catalysts; chlorination of toluene to yield benzotrichloride, which is further hydrolyzed to benzoic acid; by oxidation of toluene; from benzoin resin.

General Use: Used as a preservative for foods and pharmaceuticals, buffering agent, fungicide, bacteriostat, in seasoning tobacco, in flavoring agents, perfumes, and dentrifices, as a standard in analytical chemistry, and in the manufacture of alkyd resins.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Benzoic Acid	65-85-0	ca 100% wt

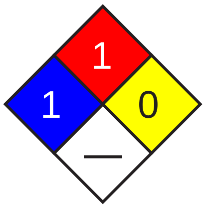
Trace Impurities: heavy metals (<=0.001%), arsenic (<=3 ppm), sulfated ash (<=0.1%), chlorinated compounds (<=0.07%)

OSHA PEL

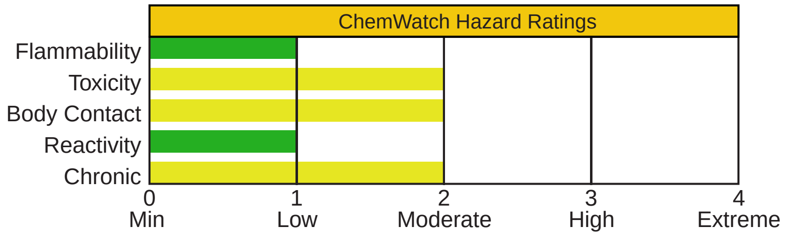
NIOSH REL

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS

2 Health

1 Flammability

0 Reactivity

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White crystals; slight aldehyde odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: possible allergic respiratory reaction. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, respiratory tract and liver and kidneys (severe exposure).

Primary Entry Routes: Inhalation, skin and eye contact.

Acute Effects

Inhalation: Respiratory tract irritation. Allergic reactions with increasing intensity upon continued exposure occur in many individuals.

Eye: Irritation.

Skin: Irritation. Redness and swelling occurs within 30 min of exposure and lasts up to 40 min after removal.

Ingestion: Benzoic acid is generally toxic only at high levels as evidenced by its use as a food preservative. Symptoms include gastrointestinal tract irritation, abdominal pain, nausea and vomiting, kidney dysfunction, elevated bilirubin levels, metabolic acidosis, and lactic acidosis. The median lethal dose is estimated at 500 mg/kg. In general, 4 to 6 g is required to produce systemic symptoms. Ingestion resulted in severe anaphylactic shock in a worker secondary to continued occupational exposure (inhalation), which caused increasingly stronger allergic reactions.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Asthma.

Chronic Effects: None reported.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting!

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Monitor electrolytes, acid-base status, and perform liver and kidney function tests. The WHO (World Health Organization) gives an acceptable daily intake of 5 mg/kg of body weight. Benzoic acid is conjugated with glycine in the liver to yield hippuric acid, which is then excreted in the urine.

See
DOT
ERG

Section 5 - Fire-Fighting Measures

Flash Point: 250 °F (121.1 °C), Closed Cup

Autoignition Temperature: 1058 °F (570 °C)

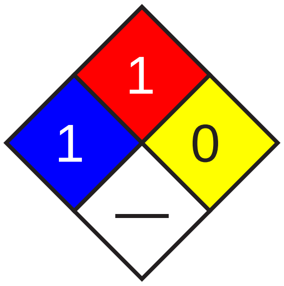
Flammability Classification: Combustible solid

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or regular foam.

General Fire Hazards/Hazardous Combustion Products: Carbon oxide(s). Dust may form explosive mixtures with air.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

See
DOT
ERG



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against inhalation and skin/eye contact.

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with appropriate filter) and place in suitable containers.

Large Spills: Flush with water to containment area for later reclamation or disposal. *Do not* release into sewers or waterways. Damp mop any residue with dilute sodium bicarbonate solution.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

See
DOT
ERG

Section 7 - Handling and Storage

Handling Precautions: Use with sufficient ventilation to prevent hazardous airborne levels. Wear appropriate PPE. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using benzoic acid, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and oxidizers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose all processes where possible to prevent dust dispersion into work areas. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove benzoic acid from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White crystals (bulk), colorless crystals (individual); slight aldehyde odor; bitter taste.

Physical State: Solid

Vapor Pressure (kPa): 1 mm Hg at 204.8 °F (96 °C)

Formula Weight: 122.12

Specific Gravity (H_2O=1, at 4 °C): 1.2659 at 59 °F (15 °C); 1.316 at 82.4 °F (28 °C)

Refractive Index: 1.539 (59 °F (15 °C)

pH: 2.8 at 77 °F (25 °C)

Boiling Point: 480.6 °F (249.2 °C)

Freezing/Melting Point: 252.3 °F (122.4 °C)

Surface Tension: 30 dyne/cm at 266 °F (130 °C)

Critical Temperature: 894 °F (479 °C)

Critical Pressure: 45 atm

Water Solubility: 1g/300 mL; solubility is enhanced by addition of citric acid or sodium acetate.

Other Solubilities: 1 g in 2.3 mL acetone, 9.4 mL benzene, 30 mL carbon disulfide, 15.2 mL carbon tetrachloride, 4.5 mL chloroform, 3 mL ethanol, 3 mL ether, 1.8 mL methanol, 23 mL oil of turpentine and 11 mL toluene.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Benzoic acid is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, ignition sources, and oxidizers.

Storage Incompatibilities: Oxidizers, alkalis, heavy metals.

Hazardous Decomposition Products: Thermal oxidative decomposition of benzoic acid can produce carbon oxide(s).

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 1700 mg/kg.
Human, oral, LD_{Lo}: 500 mg/kg.

Acute Inhalation Effects:
Rat, inhalation, LC_{50}: >26 mg/m^3/1 hr caused somnolence and tearing.

Acute Skin Effects:
Human, skin, TD_{Lo}: 6 mg/kg caused difficulty breathing and allergic dermatitis.

Irritation Effects:
Rabbit, eye: 100 mg caused severe irritation.

Other Effects:
Human, lymphocyte: 5 mmol/L caused DNA inhibition.
E. coli: 10 mmol/L (-S9) caused mutation.
Human, skin: 22 mg applied intermittently for 3 days caused moderate irritation.

See *RTECS* DG0875000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, benzoic acid will not adsorb to soil and is expected to leach to groundwater. Biodegradation will be rapid (half-life < 1 week). In water it will readily biodegrade (half-life = 0.2 to 3.6 days). It is not expected to volatilize or adsorb to sediment. Bioconcentration is low in algae and trout (< 10 and 14 respectively), but high in daphnia and snail (1800 and 2800, respectively). In air, benzoic acid is largely associated with aerosols and subject to gravitational settling and deposition via rain. Some may exist in the vapor phase and react with photochemically-produced hydroxyl radicals via ring addition with an estimated half-life of 2 days.
Ecotoxicity: Goldfish, lethal = 200 ppm/7 hr; sunfish, lethal = 500 ppm/1 hr.
Henry's Law Constant: 7 x 10-8 atm-m^3/mole
Octanol/Water Partition Coefficient: log K_{ow} = 1.87

Section 13 - Disposal Considerations

Disposal: Neutralize with soda ash or sodium bicarbonate. Benzoic acid can be burned in an approved incinerator equipped with an afterburner. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
  RCRA 40 CFR: Not listed
  CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 5000 lb (2268 kg)
  SARA 40 CFR 372.65: Not listed
  SARA EHS 40 CFR 355: Not listed
  TSCA: Listed

Section 16 - Other Information

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Issue Date: 2002-02

Beryllium
BER3010

Section 1 - Chemical Product and Company Identification 54

Material Name: Beryllium **CAS Number:** 7440-41-7
Chemical Formula: Be
Structural Chemical Formula: Be
Synonyms: BERYLLIUM; BERYLLIUM-9; BERYLLIUM DUST; BERYLLIUM METALLIC; BERYLLIUM,METAL POWDER; GLUCINIUM; GLUCINUM
General Use: Major use of metal is in alloys; i.e. beryllium-copper for its high strength, good thermal and electrical conductivity.
The high strength and light weight of some alloys is used in structural material in space technology; gyroscopes, inertial guidance systems.
Moderator and reflector of neutrons in nuclear reactors; source of neutrons when bombarded with alpha particles; special windows for x-ray tubes.
Additive in solid propellant rocket fuels. Computer parts.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
beryllium	7440-41-7	>99

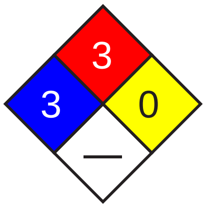
OSHA PEL
TWA: 0.002 mg/m^3; Ceiling: 0.005 mg/m^3; 30 min peak: 0.025 mg/m^3; as BE.

ACGIH TLV
TWA: 0.002 mg/m^3; STEL: 0.01 mg/m^3.

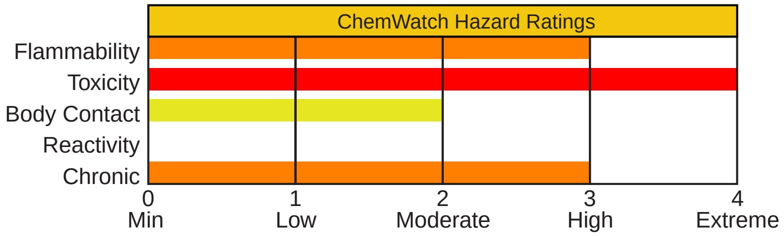
NIOSH REL
Ceiling: 0.0005 mg/m^3.

IDLH Level
4 mg/m^3; as Be.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
4	Health
3	Flammability
0	Reactivity

ANSI Signal Word

Danger!

Poison

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Gray-white powder; odorless. Poison! Causes respiratory inflammation, congestion, coughing, pulmonary edema. Heavy exposures: brain, spleen hemorrhaging, liver inflammation. Chronic: lung, heart, liver, spleen, kidney damage. May cause cancer. Flammable.

Potential Health Effects

Target Organs: lungs, mucous membranes, eyes, skin
Primary Entry Routes: inhalation
Acute Effects
Inhalation: The dust may be highly discomforting to the upper respiratory tract and may be fatal if inhaled. Beryllium absorption from the lungs into the blood takes place more readily than by ingestion but is by no means rapid. A significant part of the dose is transported to the skeletal system. Of the remainder, ionic forms (for the greater part) go to the kidney (and are excreted in the urine) whereas colloidal forms collect in the liver.

Acute pneumonitis can occur from a single high level exposure to soluble beryllium compounds and beryllium exposures in excess of 1 mg/m^3 consistently produce cases among all workers. Symptoms from an exposure may appear in a few hours and recovery may take up to 12 weeks.

Typical symptoms appear as anorexia, weight loss, weakness and varying degrees of cyanosis. Physical signs include lowered vital capacity, fine to course sibilant rales and rapid pulse.

Early pulmonary changes in guinea pigs receiving intratracheal beryllium oxide are similar to a characteristic delayed hypersensitivity.

Eye: The dust may be discomforting to the eyes.

May can cause itching, conjunctivitis and corneal burns. Sometimes an allergic eye problem develops, breaking out again with future exposure.

Skin: The material is moderately discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.

Open cuts, abraded or irritated skin should not be exposed to this material.

Beryllium is a cutaneous sensitizer and primary skin irritant that produces contact dermatitis, skin granulomas and ulcers. An affinity for proteins found in the skin may explain the allergic sensitization produced in guinea pig epidermis. The onset and pattern of the sensitization suggests that tissue reactions induced by beryllium compounds should be considered immunologic reactions of the delayed or tuberculin type.

Beryllium dermatitis in humans consists of erythematous, papular or papulo- vesicular lesions usually confined to the exposed parts of the body.

Conjunctivitis and upper respiratory tract involvement usually appear at the same time. The dermatitis appears 1 to 2-weeks after exposure to soluble salts. From patch tests a latent period of 12 to 13 days occurs before a dermal response, this being the time necessary for the development of a hypersensitive state.

Beryllium ulcer is a localized phenomenon resulting from the embedding of a particle of beryllium salt into an abrasion or crack in the skin. The ulcerated lesions may last for months unless excised.

Ingestion: The solid/dust is discomforting to the gastrointestinal tract.

Beryllium even in its most highly soluble forms is poorly absorbed from the gastrointestinal tract.

Extremely low concentrations of beryllium are effective in inhibiting a number of metabolically critical enzymes.

Further toxic action has been attributed to an affinity by beryllium for binding to the cell mitochondria and disrupting lysosomes the so-called "suicide bags of the cell".

Carcinogenicity: NTP - Class 2A, Reasonably anticipated to be a carcinogen, limited evidence of carcinogenicity from studies in humans; IARC - Group 1, Carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Chronic Effects: Chronic exposure to beryllium dusts and fumes may cause berylliosis (progressive lung damage) and systemic beryllium disease, including pneumonitis, joint pain, skin lesions, chills and fever and damage to liver, kidney, spleen, lymph nodes and heart. The onset may be marked by weakness, easy fatigue and weight loss without cough or dyspnea.

Kidney stones can occur following high or repeated exposures.

Chronic beryllium disease may appear months or years after all exposure to beryllium has ceased. Granulation tissue in the lung may appear in 3-months to 15 years, often after short exposure to low concentrations.

Unless treated the condition is often fatal. Granulumatous lesions may also develop in the abdominal lymph nodes, spleen, liver and bone marrow.

The biological half-life of beryllium is long with the material being detected more than 20-years after the last exposure.

A significant risk of chronic beryllium disease exists among workers who smelt, burn, refine, or weld the metal or its alloys, even if exposures are below the adopted respiratory standards. Disease may result from occupational exposures to alloys containing less than 2% beryllium. The disease proves to be of long duration with exacerbation and/or remission in most cases. When chills and fever develop as complications the prognosis is bad.

Some 60 individuals are known to have become ill by incidental exposure to beryllium. This exposure may have arisen as a result of living near a beryllium-producing facility (within 1 km) and/or by contact with contaminated clothing brought home by workers.

There is some evidence that beryllium causes lung and bone cancer in humans a result confirmed in animal experiments.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.

Quickly remove all contaminated clothing, including footwear.

Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Acute berylliosis produces interstitial fibrotic disease rather than the simple focal nodular lesions seen in simple pneumoconiosis. Fibrotic lesions appear out of proportion to dust-laden macrophages. In common with asbestosis and aluminosis the condition is characterized by reduced lung volumes, elasticity and diffusion. Chronic exposure causes chronic granulomatous disease similar to sarcoidosis and miliary tuberculosis.

Multi-system involvement includes lymph nodes, spleen, liver, myocardium, kidney and bones. Occasionally hypercalcemia develops. Initially non- specific symptoms appear and are followed by dyspnea and cough.

Symptoms are progressive and steroids may help to blunt the course of the disease. ACTH and cortisone therapy have been encouraging.

Aurin tricarboxylic acid effectively protects monkeys exposed to lethal quantities of beryllium - no data is available for humans to substantiate its safety or effectiveness.

Section 5 - Fire-Fighting Measures

Flash Point: Combustible solid

Autoignition Temperature: 649 °C

Extinguishing Media: Dry chemical powder, dry sand or sodium chloride.

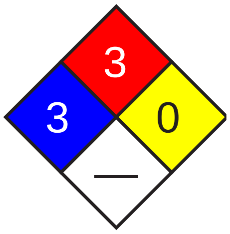
DO NOT use water.

DO NOT use carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Flammable solid.

Fine powder may ignite spontaneously in air.

Moderate fire and explosion hazard, in the form of dust, when exposed to heat or flame.



Fire Diamond

Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.

Emits highly toxic fumes on combustion.

Fire Incompatibility: Avoid reaction with oxidizers, carbon tetrachloride, trichloroethylene, lithium and phosphorus.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.

Use water delivered as a fine spray to control fire and cool adjacent area.

Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.

Avoid contact with skin and eyes.

Wear protective clothing, gloves, safety glasses and dust respirator.

Use dry clean-up procedures and avoid generating dust.

Place spilled material in clean, dry, sealable, labeled container.

Large Spills: Clear area of personnel and move upwind.

Contact fire department and tell them location and nature of hazard.

Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.

No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so.

Water spray or fog may be used to disperse/absorb vapor.

Contain or absorb spill with sand, earth or vermiculite.

Collect recoverable product into labeled containers for recycling.

Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains.

After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Keep dry.
Avoid generating and breathing dust. Avoid contact with skin and eyes.
Avoid smoking, bare lights, heat or ignition sources Use spark-free tools when handling.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use.
Avoid physical damage to containers.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
For large scale or continuous use: spark-free, grounded ventilation system venting directly to outside and separate from usual ventilation systems.
Provide dust collectors with explosion vents.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Special ventilation requirements apply for processes which result in the generation of beryllium or cadmium fume.
The use of mechanical ventilation by local exhaust systems is required as a minimum in all circumstances (including outdoor work).
Personal respirators and special glove boxes afford additional protection (In confined spaces always check that oxygen has not been depleted by excessive rusting of steel or snowflake corrosion of aluminum). Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.
Personal Protective Clothing/Equipment
Eyes: Safety glasses; safety glasses with side shields; chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.
Respiratory Protection:
Exposure Range >0.002 to 0.02 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >0.02 to 0.2 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >0.2 to 2 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >2 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)
Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.
For large scale or continuous use: tight-weave non-static clothing (no metallic fasteners, cuffs or pockets); & non sparking safety footwear.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Odorless greyish white metallic powder. Soluble in acids (except nitric) and alkalis.
Physical State: Divided solid
Vapor Pressure (kPa): Not applicable
Vapor Density (Air=1): Not applicable
Formula Weight: 9.01
Specific Gravity (H_2O=1, at 4 °C): 1.848
Water Solubility: Insoluble in cold water
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 2970 °C (5378 °F)
Freezing/Melting Point Range: 1287 °C (2348.6 °F)
Volatile Component (% Vol): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers, acids, alkalis, carbon tetrachloride, trichloroethylene, lithium and phosphorus.

Section 11 - Toxicological Information

Mutation DNA damage Human Tumorigenic - neoplastic by RTECS criteria.

See NIOSH, *RTECS* DS 1750000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: Tlm Pimephales promelas (fathead minnow) 150 ug/l/96 hr (soft water) /Conditions of bioassay not specified

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: BERYLLIUM POWDER
Hazard Class: 6.1(a)
ID No.: 1567
Packing Group: II
Label: Poison[6],Flammable Solid

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed P015
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a), per CAA Section 112 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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Issue Date: 2004-07

2-Butanol
BUT2190

Section 1 - Chemical Product and Company Identification

Material Name: 2-Butanol **CAS Number:** 78-92-2
Chemical Formula: $C_4H_{10}O$
Structural Chemical Formula: $CH_3CH_2CHOHCH_3$
EINECS Number: 201-158-5
ACX Number: X1003378-6
Synonyms: ALCOOL BUTYLIQUE SECONDAIRE; 2-BUTANOL; BUTAN-2-OL; BUTANOL-2; S-BUTANOL; SEC-BUTANOL; BUTANOL SECONDAIRE; 2-BUTYL ALCOHOL; S-BUTYL ALCOHOL; SEC-BUTYL ALCOHOL; 2-BUTYLALCOHOL; BUTYLENE HYDRATE; CCS 301; DL-2-BUTANOL; ETHYL METHYL CARBINOL; ETHYLMETHYL CARBINOL; 2-HYDROXYBUTANE; METHYL ETHYL CARBINOL; 1-METHYL PROPANOL; METHYLETHYLCARBINOL; 1-METHYL-1-PROPANOL; 1-METHYLPROPYL ALCOHOL; S.B.A; SBA; SECONDARY BUTYL ALCOHOL
Derivation: Obtained by indirect hydration of butenes with sulfuric acid.
General Use: As a dispersing agent for dyes, dehydrating agent, industrial detergent, anti-foaming agent, antioxidant, wetting agent, solvent for many natural resins; in paint removers, hydraulic brake fluid, perfume, manufacture of ethyl methyl ketone, and as flavoring in food.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
2-Butanol	78-92-2	ca 100% vol

OSHA PEL
TWA: 150 ppm; 450 mg/m^3.

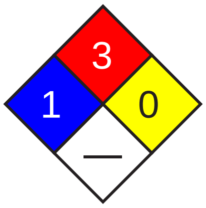
OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 305 mg/m^3.

ACGIH TLV
TWA: 100 ppm.

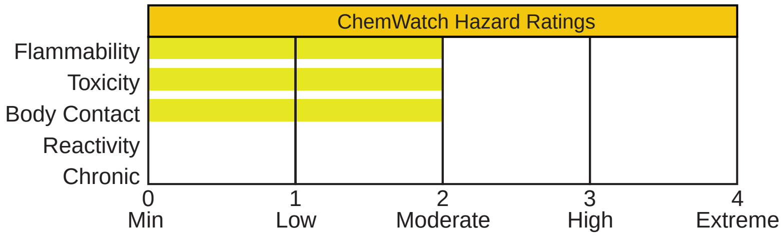
NIOSH REL
TWA: 100 ppm, 305 mg/m^3;
STEL: 150 ppm, 455 mg/m^3.

IDLH Level
2000 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
1 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

2-Butanol exists as a volatile, colorless liquid with a wine odor. It is an eye and skin irritant. High concentrations cause narcosis in animals and is expected to do the same in humans. It is a flammable liquid.

Potential Health Effects

Target Organs: Eyes, skin, central nervous system.
Primary Entry Routes: Inhalation, skin and eye contact.
Acute Effects
Inhalation: Can cause throat irritation, cough, and difficulty breathing. Varying degrees of central nervous system depression may also occur including headache, nausea and vomiting, diarrhea, muscle weakness, giddiness, ataxia, confusion, delirium, and coma.

Eye: Reportedly, regular exposure to 100 ppm did not produce irritation, however, exposure to higher concentrations may.

Skin: Mild irritation and inflammation is possible from 2-butanols defatting action. Patch tests with 2-butanol have produced sensitivity in persons who have acquired sensitivity to isopropyl alcohol.

Ingestion: Symptoms may be similar to those caused by inhalation.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Repeated and prolonged skin contact may cause drying and cracking.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Ophthalmic cortisone can be used for eye inflammation.

Section 5 - Fire-Fighting Measures

Flash Point: 75 °F (24 °C), Closed Cup

Burning Rate: 3.1 mm/min.

Autoignition Temperature: 761 °F (405 °C)

LEL: 1.7% v/v at 212 °F (100 °C)

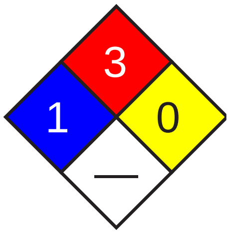
UEL: 9.8% v/v at 212 °F (100 °C)

Flammability Classification: Class 1C Flammable Liquid

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or alcohol-resistant foam.

General Fire Hazards/Hazardous Combustion Products: Carbon oxide (CO*x*) gases.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against exposure.

Small Spills: Using non-sparking tools, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal.

Large Spills: Dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways. Damp mop any residue.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Do not use near ignition sources.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using 2-butanol, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Install Class I, Group D electrical equipment. Electrically bond and ground all equipment used with and around 2-butanol. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the central nervous system and the skin.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1,000 ppm, use a powered air purifying respirator with organic vapor cartridges, any chemical cartridge respirator with a full facepiece and organic vapor cartridges providing protection against 2-butanol, any supplied-air respirator (SAR) or any SCBA. For < 2,500 ppm, use any SAR operated in continuous-flow mode. For < 5,000 ppm, use any SAR or SCBA with a full facepiece. For < 10,000 ppm, use any SAR with a full facepiece and operated in pressure-demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove 2-butanol from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless with a wine odor.
Physical State: Liquid
Odor Threshold: 2.5 ppm
Vapor Pressure (kPa): 10 mm Hg at 68 °F (20 °C)
Formula Weight: 74.12
Specific Gravity (H_2O=1, at 4 °C): 0.81 at 68 °F (20 °C)
Evaporation Rate: Relative Evaporation Rate: 1.3
Refractive Index: 1.3942 at 77 °F (25 °C)
Boiling Point: 201 °F (94 °C)
Freezing/Melting Point: -174.46 °F (-114.7 °C)
Viscosity: 4.21 cP at 59 °F (15 °C)
Surface Tension: 23 dyne/cm at 77 °F (25 °C)
Ionization Potential (eV): 10 eV
Critical Temperature: 509.34 °F (265.19 °C)
Water Solubility: 125 g/L at 68 °F (20 °C)
Other Solubilities: Soluble in alcohol, acetone, benzene, ether, esters, and most organic solvents.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: 2-butanol forms explosive peroxides upon standing via auto-oxidation. Hazardous polymerization does not occur. Exposure to heat, ignition sources, and incompatibles.

Storage Incompatibilities: Includes chromium trioxide and other oxidizers. Will attack some forms of plastic, rubber, and coatings.

Hazardous Decomposition Products: Thermal oxidative decomposition of 2-butanol can produce carbon oxide gases.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 6480 mg/kg.
Rabbit, oral, LD_{50}: 4893 mg/kg caused corneal damage, difficulty breathing, and an altered pulse rate.

Acute Inhalation Effects:
Rat, inhalation, LC_{Lo}: 16000 ppm/4 hr caused somnolence (general depressed activity) and changes in respiration.

Irritation Effects:
Rabbit, eye: 100 mg/24 hr caused moderate irritation.
Rabbit, skin: 500 mg/24 hr caused mild irritation.

Other Effects:
Rat, inhalation: 7000 ppm/7 hr (1 to 19 days of pregnancy) caused post-implantation mortality and specific developmental abnormalities of the musculoskeletal system.

See NIOSH, *RTECS* EO1750000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, 2-butanol will leach and some will volatilize. Based on studies, it is expected to biodegrade before reaching groundwater. In water, it is expected to biodegrade rapidly with a half-life of 5 days. The volatilization half-life in a model river is estimated to be 3.5 days at 77 °F (25 °C). In the air, 2-butanol will react with photochemically produced hydroxyl radicals with a half-life of ~ 2 days.

Ecotoxicity: Bacteria (*Pseudomonas putida*), cell multiplication inhibition: 500 mg/L; goldfish (*Carassius auratus*), LC_{50}: 4300 mg/l/24 hr

Octanol/Water Partition Coefficient: log K_{ow} = 0.81

Section 13 - Disposal Considerations

Disposal: Incinerate (permit approved facilities only). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Butanols
Hazard Class: 3
ID No.: UN1120
Packing Group: III
Label: Flammable Liquid

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

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Material Safety Data Sheet Collection

Cadmium **MSDS No. 23**

Issue Date: 1999-10

Section 1 - Chemical Product and Company Identification

Product/Chemical Name: Cadmium
Chemical Formula: Cd
CAS Number: 7440-43-9 **EINECS Number:** 231-152-8
Synonyms: colloidal cadmium
Derivation: Cadmium is collected as dust or fume from roasting zinc ores, mixed with coal or coke and sodium or zinc chloride, and sintered. The cadmium fume is collected in an electrostatic precipitator, leached, fractionally precipitated, and distilled; collected as sludge from zinc sulfate purification; prepared from direct distillation of cadmium-bearing zinc; obtained by recovery from electrolytic zinc process; may be prepared from cadmium sulfate in the laboratory.
General Use: Cadmium is used as a constituent of easily fusible alloys; soft solder and solder for aluminum; in electroplating; as a deoxidizer for nickel plating; for process engraving; electrodes for cadmium vapor lamps; photoelectric cells; photometry of ultraviolet sun-rays; in Ni-Cd storage batteries; to charge Jones reductors; as an amalgam in dentistry; power transmission wire; TV phosphors; basis of pigments used in ceramic glazing, machinery enamels, baking enamels; Weston-standard-cell control of atomic fission in nuclear reactors; reactor control rods; fungicide; photography and lithography; selenium rectifiers.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Cadmium, ca 99.5+% wt
Trace Impurities: < 10 ppm

OSHA PELs
8-hr TWA: 0.005 mg/m^3
Fume* TWA: 0.1 mg/m^3; Ceiling 0.3 mg/m^3
Dust* TWA: 0.2 mg/m^3; Ceiling 0.6 mg/m^3

ACGIH TLVs
TWA: 0.01 mg/m^3 (inhalable fraction); 0.002 mg/m^3 (respirable fraction)

NIOSH REL
Reduce to lowest feasible level (LOQ 0.1 mg/m^3)

DFG (Germany) MAK
None established

IDLH Level
9 mg/m^3

AIHA WEEL
8-hr Dust TWA: (0.002 mg/m^3)

*Applies to operations or sectors for which the cadmium standard, 1910.1027, is stayed or otherwise not in effect.

Section 3 - Hazards Identification

ANSI Signal Word: Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Cadmium is a lustrous metal solid of silver-white to bluish color without odor. It is toxic by inhalation. Cadmium is irritating to the respiratory tract and mildly irritating to the skin. Chronic health effects include kidney damage and obstructive lung disease. Cadmium dust ignites spontaneously in air. It is an experimental carcinogen and teratogen.

Wilson Risk Scale	
R	1
I	4
S	1
K	1
HMIS	
H	3*
F	4**
R	0
PPE†	

*Chronic effects
** Fine dust
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation and ingestion
Target Organs: Respiratory system, kidneys
Acute Effects
Inhalation: Initial signs/symptoms of cadmium poisoning resemble those of the flu. Inhalation of dust or fumes causes throat dryness, cough, headache, vomiting, chest pain, dyspnea (shortness of breath), central nervous system (CNS) effects, extreme restlessness and irritability, pneumonitis, possibly bronchopneumonia, pulmonary edema, and death due to respiratory failure in severe cases. Symptoms may be delayed up to 24 hours. Residual emphysema and fibrosis may result. Note: heating of cadmium may produce cadmium oxide, the inhalation of which can result in metal fume fever, characterized by fever, chills, malaise, headache, myalgias, fatigue, cough, thirst, and abdominal discomfort, with symptom onset about 3 to 10 hours after exposure. Symptoms do not usually last beyond 24 to 48 hours.
Eye: May cause irritation.
Skin: Contact may cause irritation, skin eruptions and pruritus. Significant dermal absorption rarely occurs.
Ingestion: Causes increased salivation, dry mouth, choking, nausea, vomiting, abdominal pain and cramping, blurred vision, anemia, kidney dysfunction, diarrhea, gastroenteritis, and substernal pain.
Carcinogenicity: IARC - Group 1, Carcinogenic to humans; NIOSH - listed as carcinogen; NTP - Class 2A, Reasonably anticipated to be a carcinogen; OSHA - listed as a carcinogen; EPA - Class B1, Probable human carcinogen based on epidemiologic studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only; ACGIH - A2, Suspected human carcinogen.

Medical Conditions Aggravated by Long-Term Exposure: Kidney disorders, respiratory disorders.

Chronic Effects: Include chronic obstructive lung disease such as emphysema, kidney damage (renal tubular disorder and proteinuria (low molecular weight)), bone demineralization, microfractures and osteomalacia, respiratory cancer, gastrointestinal symptoms, anosmia (loss of sense of smell), rhinitis and discoloration of the teeth. It is implicated as the causative agent in Itai-Itai disease in Japan.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation persist.

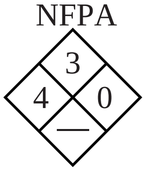
Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Consider a chest X-ray after acute exposure.

Section 5 - Fire-Fighting Measures



Flash Point: Data not found.

Autoignition Temperature: 482 ˚F (250 ˚C) (layer cadmium metal dust)

LEL: Data not found.

UEL: Data not found.

OSHA Flammability Classification: Flammable

Extinguishing Media: Extinguish with carbon dioxide, dolomite, dry powder, graphite, soda ash, sodium chloride, dry chemical, or sand.

Unusual Fire or Explosion Hazards: The finely divided material is pyrophoric. The more finely divided the powder the greater the fire/explosion hazard.

Hazardous Combustion Products: When heated to decomposition, toxic fumes of cadmium are emitted.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Cleanup personnel should protect against exposure (Sec. 8). Prevent entry into water, sewers, basements or confined areas.

Small Spills: If in solid form, *do not* sweep! Absorb or cover with dry earth, sand or other noncombustible material. Carefully scoop up or vacuum (with a HEPA filter).

Large Spills: *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120 and 1910.1027).

Section 7 - Handling and Storage

Handling Precautions: Wear personal protective clothing and equipment to prevent dust inhalation and any contact with skin or eyes (Sec. 8). Wash thoroughly after handling cadmium.

Storage Requirements: Store in tightly closed containers in a cool, well-ventilated area away from heat, light, ignition sources, incompatibles, and air. Cadmium slowly oxidizes in air to form cadmium oxide.

Regulatory Requirements: Areas where cadmium is used or stored must be labeled according to 29 CFR 1910.1027.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid dust dispersion into the work area.

Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below exposure limits (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on kidney functions (including urine screening for micro-globulins), lungs and blood. Follow written procedures set forth by OSHA in 29 CFR 1910.1027.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select respirator based on exposure range as follows. Exposure range >0.005 to 0.05 mg/m^3 use air purifying respirator, negative-pressure, half-mask; >0.05 to 0.5 mg/m^3 use air purifying respirator, negative-pressure, full-face; >0.5 to 5 mg/m^3/use supplied-air respirator, constant flow/pressure-demand, full-face; >5 mg/m^3/use a SCBA, pressure-demand, full-face. Use a magenta cartridge (P100). For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, cartridge change schedules, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent any skin contact. Butyl rubber, chlorinated polyethylene, and polyvinyl chloride are recommended materials. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not protective eye devices. Appropriate eye protection must be worn instead of, or in conjunction with, contact lenses.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid; lustrous metal or granular powder
Color: Silver-white, blue-tinged
Odor: Odorless
Vapor Pressure: 1 mm Hg at 741 ˚F (394 ˚C)
Formula Weight: 112.41
Density: 8.642 at 77 °F (25 °C)
Water Solubility: Insoluble
Other Solubilities: Dissolved by acids; ammonium nitrate solution
Boiling Point: 1409 ˚F (765 ˚C)
Melting Point: 609.8 ˚F (321 ˚C)
Refractive Index: 1.8 at 578 nm and 20 °C/D
Ionization Potential (eV): 8.99367

Section 10 - Stability and Reactivity

Stability: Cadmium is stable at room temperature in closed containers under normal storage and handling conditions. It slowly oxidizes in air to form cadmium oxide. Finely divided material is pyrophoric, i.e., it may ignite or explode spontaneously in air.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include acids (reacts readily with dilute nitric acid, slowly with hydrochloric acid); explodes on contact with hydrazoic acid; violent or explosive reaction when heated with ammonium nitrate; tellurium; zinc; ammonia; sulfur; selenium; nitryl fluoride; oxidizing agents; metals.

Conditions to Avoid: Avoid creation of dust clouds, contact with chemical incompatibles, heat, and sources of ignition.

Hazardous Decomposition Products: Thermal oxidative decomposition of cadmium can produce toxic fumes of cadmium and cadmium oxide.

Section 11 - Toxicological Information

Toxicity Data:*

Acute Dermal Effects:
Rabbit, subcutaneous, LD_{Lo}: 6 mg/kg

Acute Inhalation Effects:
Human, inhalation, LC_{Lo}: 39 mg/m^3/20 minutes produced cardiac changes; respiratory depression.
Rat, inhalation, LC_{50}: 25 mg/m^3/30 minutes produced dyspnea.

Acute Oral Effects:
Rat, oral, LD_{50}: 2330 mg/kg
Mouse, oral, LD_{50}: 890 mg/kg

Multiple Dose Toxicity Data:
Human, inhalation, TC_{Lo}: 88 µg/m^3/8.6 years produced proteinuria.
Rat, oral, 546 mg/kg administered for 26 weeks continuously produced toxic effects: changes in serum composition; transminases; weight loss or decreased weight gain.
Rat, oral, 1512 mg/kg administered for 48 weeks continuously produced toxic effects: changes to liver, kidneys, ureter and bladder.

Tumorigenic Effects:
Woman, inhalation, 129 µg/m^3/20 years, continuous produced toxic effects: carcinogenic by RTECS criteria; Lung, thorax or respiration - tumors.
Rat, subcutaneous, 3372 µg/kg produced toxic effects: carcinogenic by RTECS criteria, tumors at site of application.

Genetic Effects:
Mouse, micronucleus test, cell type - embryo: 6 µmol/L induced mutation.
Hamster, cytogenic analysis, cell type - ovary: 1 µmol/L induced mutation.

Reproductive Effects:
Rat, female, oral, 23 mg/kg administered on gestational days 1 - 22 produced specific developmental abnormalities - blood and lymphatic system (including spleen and marrow).
Rat, female, oral, 21.5 mg/kg administered to multigenerations produced toxic effects: Effects on fertility - preimplantation mortality; Effects on newborn - germ cell effects in offspring.
Rat, male, oral, 155 mg/kg administered 13 weeks prior to mating produced toxic effects: Effects on newborn - reduced weight gain and behavioral.

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[*] See NIOSH, *RTECS* (EU9800000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Dreisena polymorpha*, zebra mussels, chronic LC_{50}: 130 mcg/L; *Rivulus marmoratus*, mangrove fish, LC_{50} in fresh water: 2.96 mg/L; Steelhead trout, LC_{50}: 0.0009 ppm for 96 hours; *Daphnia magna*, 0.1 ppm lethal.
Environmental Fate: Data not found.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable federal, state, and local regulations.
Disposal Regulatory Requirements: Dispose of according to EPA regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Cadmium compounds
Shipping Symbols: -
Hazard Class: 6.1
ID No.: UN2570
Packing Group: III
Label: Keep away from food
Special Provisions (172.102): -

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger Aircraft/Rail: 100 kg
b) Cargo Aircraft Only: 200 kg

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: -

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33); RCRA Hazardous Waste Number: D006
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per (2) CWA, Sec. 307(a)
CERCLA Final Reportable Quantity (RQ): 10 lb (4.54 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
Toxic Substances Control Act (TSCA): Listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)
OSHA Specifically Regulated Substance (29 CFR 1910.1027)

Section 16 - Other Information

References: 1, 99, 124, 136, 149, 161, 176, 164, 198, 209, 216, 222, 225, 226, 227, 230, 233, 234

Prepared By .... M. Adams, Ph.D/S Fleming, BS
Research Date 1999-3
Review Date 1999-7
Industrial Hygiene Review .... R Everett Langford, Ph.D., CIH, CSP
Medical Review .... T Thoburn, MD, MPH

Issue Date: 2006-06

Carbon Disulfide
CAR4990

Section 1 - Chemical Product and Company Identification

Material Name: Carbon Disulfide **CAS Number:** 75-15-0
Chemical Formula: CS_2
Structural Chemical Formula: S=C=S
EINECS Number: 200-843-6
ACX Number: X1001270-7
Synonyms: CARBON BISULFIDE; CARBON BISULPHIDE; CARBON DISULFIDE; CARBON DISULPHIDE; CARBON SULFIDE; CARBON SULPHIDE; CARBONE (SUFURE DE); CARBONE (SULFURE DE); CARBONIO (SOLFURO DI); DITHIOCARBONIC ANHYDRIDE; EPA PESTICIDE CHEMICAL CODE 016401; KOHLENDISULFID (SCHWEFELKOHLENSTOFF); KOOLSTOFDISULFIDE; SCHWEFELKOHLENSTOFF; SOLFURO DI CARBONIO; SULPHOCARBONIC ANHYDRIDE; SULPHURET OF CARBON; WEEVILTOX; WEGLA DWUSIARCZEK
General Use: Used in manufacture of rayon, carbon tetrachloride, xanthogenates, soil disinfectants, electronic vacuum tubes; solvent for phosphorus, sulfur, selenium, bromine, iodine, fats, resins, rubbers.
Also used as solvent in gas chromatography.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
carbon disulfide	75-15-0	>99

OSHA PEL
TWA: 20 ppm; Ceiling: 30 ppm; 100 ppm, 30-minute maximum peak.

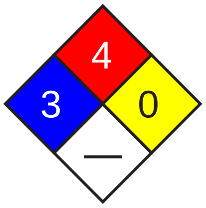
ACGIH TLV
TWA: 10 ppm; skin.

NIOSH REL
TWA: 1 ppm (3 mg/m^3); STEL: 10 ppm (30 mg/m^3); skin.

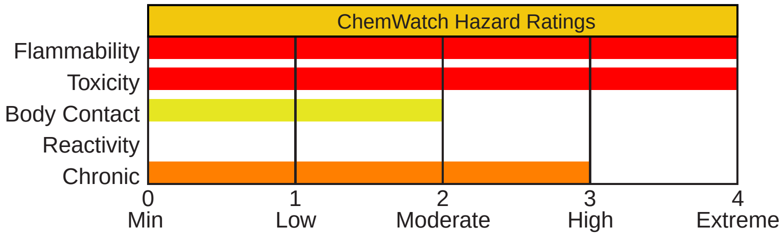
IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 5 ppm; PEAK: 10 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
4 Flammability
0 Reactivity

ANSI Signal Word
Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; chloroform-like odor. Corrosive. Other Acute Effects: cardiac/CNS damage, headache, dizziness, convulsions. Chronic Effects: pyschosis, liver damage, eye effects, peripheral neuropathies, gastric disturbances, reproductive effects. Highly flammable.

Potential Health Effects

Target Organs: skin, central nervous system (CNS), peripheral nervous system, cardiovascular system, eyes, liver, kidneys
Primary Entry Routes: inhalation, skin contact/absorption
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract and lungs and may be harmful if inhaled. The material may accentuate any pre-existing skin condition.

Acute inhalation produces rapid onset of both local irritation and central nervous system symptoms ranging from pharyngitis, nausea, vomiting, dizziness, fatigue, headache, mood changes, lethargy and blurred vision, to agitation, uncontrollable anger, suicidal tendencies, delirium, hallucinations, convulsions, coma and death.

Eye: The liquid is extremely discomforting to the eyes and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

Skin: The liquid is extremely discomforting to the skin and is capable of causing allergic skin reactions.

Toxic effects may result from skin absorption.

Concentrated solutions of carbon disulfide may cause skin pain, erythema, and exfoliation. Several minutes of contact may cause blistering with second and third degree burns. May be directly toxic to the cutaneous nerves. Skin sensitization may occur.

Ingestion: The liquid is highly discomforting to the gastrointestinal tract and may be fatal if swallowed in large quantity.

Ingestion of small amounts may result in numbness of the lips, nausea, vomiting, dyspnea, dizziness, spasmodic tremor, hyperactive tendon reflexes, hyperesthesia, cardiac arrhythmias, hallucinations, prostration, peripheral vascular collapse, hypothermia, cyanosis, mydriasis, convulsions, coma, and death within a few hours from respiratory paralysis. Non-fatal exposures may produce delayed effects including motor agitation, disorientation, pyschic disturbances, narcosis, delirium, areflexia, mydriasis, and permanent damage to the central and peripheral nervous systems.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Long-term exposure has caused serious damage to the central nervous system (degeneration of the peripheral nerves).

Concentrations as low as 20 ppm may produce neurological damage - women are apparently more susceptible to the neurological effects of carbon disulfide. Neurological effects may include headache, apprehension, lethargy, sleepiness, hearing and position sense loss, paresthesias, muscle pain, tremors, ataxia, staggering gait, weakness, loss of lower extremity reflexes, and paralysis. Visual disturbances include decreased visual acuity, impaired recognition of red and green, nystagmus, diplopia, disturbed pupillary reaction to light - optic nerve atrophy may also occur.

A decrease in corneal reflex may be an early indication of chronic intoxication.

Psychiatric symptoms may include loss of memory, nightmares leading to loss of sleep, mental deterioration, acoustic and visual hallucinations, rapid mood changes ranging from irritability to manic-depressive pyschoses, suicidal tendencies. Disturbances to the libido and impotence (with effects on sperm) have also been recorded. Menstrual and ovarian function disorders and an increased risk of spontaneous abortion may also occur.

Liver damage may be indicated by palpable, tender liver and minor derangement of liver function. Chronic renal dysfunction may occur at concentrations not sufficiently great to produce neurological damage.

Gastric or duodenal ulcers may also be produced as a result of chronic exposure.

Coronary heart disease has been significantly linked to exposure to carbon disulfide. A series of studies performed in Finland showed a significant excess mortality from cardiovascular heart disease in workers exposed to carbon disulfide for at least 5 years to concentrations estimate to range from 20-40 ppm in the 1950s and 10-30 ppm in the 1960s. Most workers however had been exposed repeatedly to far higher concentrations at various times.

Nutritional factors may account for variations in response shown amongst workers. Experimental rabbit diets reinforced with a high mineral mixture, especially copper and zinc, permitted daily exposures at 1100 ppm CS_2 without the observed effects seen in controls (body weight loss, serum lipoprotein and total cholesterol increase, adrenal hypertrophy and pathological changes in the brain and spinal cord).

A daily 4-hour exposure at concentrations exceeding 150 ppm produces chronic intoxication after a few months; 100-150 ppm is thought to produce chronic poisoning after a year or more whilst 50-100 ppm produce sporadic cases of mild intoxication.

Personnel with pre-existing central nervous system, gastrointestinal tract, liver, kidneys, skin and blood diseases may be potentially more susceptible to symptom of exposure and should be excluded from exposure.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: 1. Carbon disulfide intoxication results in severe debilitating CNS symptoms (irritability, mania, hallucinations, tremors, memory loss).

2. Chronic industrial exposures may cause neuropsychiatric changes, peripheral neuropathies and accelerated atherogenic changes.

3. Peak blood concentrations appear 2 hours after inhalation. Plasma elimination half-life is about 1 hour. Metabolic products seen in urine include thiourea, 2-mercapto-2-thiazolin-5-one and 2-thiazolidine-4- carboxylic acid (TTCA). The iodine-azide test identifies these.

4. Initial management of severe inhalation poisoning requires careful attention to airway, breathing and circulation. Treatment involves symptomatic care.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

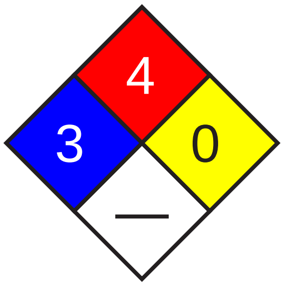
Determinant	Index	Sampling Time	Comments
2-thiothiazolidine 4-carboxylic acid	5 mg/gm creatinine.	End of shift	

NOTE: Preplacement and periodic medical examinations should be concerned especially with skin, eyes, central and peripheral nervous system, cardio-vascular disease, as well as liver and kidney function. Electrocardiograms should be taken.

Section 5 - Fire-Fighting Measures

Flash Point: 30 °C Closed Cup
Autoignition Temperature: 90 °C
LEL: 1.3% v/v
UEL: 50% v/v

See DOT ERG



Fire Diamond

Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.
Note: Water may be ineffective except as a blanket. Foam is ineffective.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include sulfur oxides (SO_x).
WARNING: Vapors may be ignited by contact with an ordinary light bulb, a warm steam pipe or a hot exhaust pipe.

Fire Incompatibility: WARNING: May decompose violently or explosively on contact with other substances.
This substance is one of the relatively few compounds which are described as "endothermic" i.e. heat is absorbed into the compound, rather than released from it, during its formation.
The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation.
Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds.
Explosively reactive with azides or organic amines.
Reacts with zinc with incandescence.
Avoid contact with chemically active metals (sodium, potassium, aluminum, magnesium) and strong oxidizers.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Cool fire-exposed containers with water spray from a protected location.
Do not approach containers suspected to be hot.
Avoid spraying water onto liquid pools.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Environmental hazard - contain spillage. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Shut off all possible sources of ignition and increase ventilation.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Allow absorbed spillage to evaporate in an open top container, away from habitation.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Shut off all possible sources of ignition and increase ventilation.
No smoking or bare lights within area.
Stop leak if safe to do so.
Use extreme caution to avoid a violent reaction.
Any electric cleaning equipment must be explosion proof.
Absorb or cover spill with sand, earth, inert material or vermiculite.
Water spray or fog may be used to disperse vapor.
Collect recoverable product into labeled containers for recycling.
Collect, using a spark-free shovel, and seal in labeled drums for disposal.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked to ensure safe working conditions are maintained.
Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes. Wear protective clothing when risk of exposure occurs. Avoid smoking, bare lights or ignition sources. Avoid generation of static electricity.
Avoid thermal shock (wait for surfaces to cool).
Use in a well-ventilated area. Local exhaust ventilation usually required.
Vapor may travel a considerable distance to source of ignition.
Use spark-free tools when handling. Ground all lines and equipment.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces where vapor may have collected.
Avoid contact with incompatible materials. Avoid physical damage to containers. Keep containers securely sealed.
Always wash hands with soap and water after handling. Work clothes should laundered separately.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Glass container.
Steel drum.
Metal can.
Store in metal drums or safety cans.
Plastic containers may only be used if approved for flammable liquids.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Impervious, gauntlet length gloves; Viton gloves.
PVA gloves.
PVC boots.
Safety footwear.

Respiratory Protection:
Exposure Range >20 to 200 ppm: Air Purifying, Negative Pressure, Half Mask

Exposure Range >200 to <500 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
VITON/CHLOROBUTYL	Best selection
VITON	Best selection
TEFLON-FEP	Best selection
NITRILE	Poor to dangerous choice for other than short-term immersion
CPE	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to yellow, mobile liquid with a strong disagreeable odor; nearly odorless when pure. Miscible with anhydrous methanol, ethanol, ether, benzene, chloroform, carbon tetrachloride, oils.

Physical State: Liquid
Odor Threshold: 0.0243 to 23.1 mg/m^3
Vapor Pressure (kPa): 40 at 20 °C
Vapor Density (Air=1): 2.67
Formula Weight: 76.14
Specific Gravity (H_2O=1, at 4 °C): 1.26 at 20 °C

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 46.5 °C (116 °F) at 760 mm Hg
Freezing/Melting Point: -111.5 °C (-168.7 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.3% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Long term storage.
Presence of heat source and ignition source.
Stable under normal storage conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: WARNING: May decompose violently or explosively on contact with other substances.
This substance is one of the relatively few compounds which are described as "endothermic" i.e. heat is absorbed into the compound, rather than released from it, during its formation.
The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation.
Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds.
Avoid reaction with oxidizing agents.
Segregate from, azides, organic amines and chemically active metals.

Section 11 - Toxicological Information

Toxicity

Oral (human) LD_{Lo}: 14 mg/kg
Oral (human) TC_{Lo}: 40 mg/m^3
Oral (rat) LD_{50}: 3188 mg/kg
Inhalation (human) LC_{Lo}: 4000 ppm/30 min
Inhalation (human) LC_{Lo}: 2000 ppm/5 min
Inhalation (rat) LC_{50}: 25000 mg/m^3/2 h
Fatty liver degeneration, paternal effects, effects on fertility, fetotoxicity, effects on newborn recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA. Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Irritation

Nil reported

See *RTECS* FF 6650000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on land, it will be primarily lost by volatilization. It may also readily leach into the ground where it may biodegrade. If released into water, it will be primarily lost due to volatilization (half-life 2.6 hr in a model river). Adsorption to sediment and bioconcentration in fish should not be significant. In the atmosphere it degrades by reacting with atomic oxygen and photochemically produced hydroxyl radicals (half-life 6-9 days). The soil may be a natural sink for the chemical by adsorbing and subsequently biodegrading it.
Ecotoxicity: TL_m Mosquitofish 162-135 mg/l/24-96 hr /Conditions of bioassay not specified
Henry's Law Constant: 1.44×10^{-2}
BCF: estimated at 7.9
Octanol/Water Partition Coefficient: log $K_{ow} = 0.852$
Soil Sorption Partition Coefficient: K_{oc} = estimated at 63

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Evaporate or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.
Ensure damaged or non-returnable drums are gas-free before disposal.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Carbon disulfide
ID: UN1131
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: I - Great Danger
Symbols:

Label Codes: 3 - Flammable Liquid, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: B16, T14, TP2, TP7, TP13
Packaging: **Exceptions:** None **Non-bulk:** 201 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:** 18, 40, 115

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed P022
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 100 lb
  - **TPQ:** 10000 lb
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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(518) 842-4111

Issue Date: 2004-07

Carbon Tetrachloride
CAR5560

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Carbon Tetrachloride **CAS Number:** 56-23-5
Chemical Formula: CCl_4
Structural Chemical Formula: CCl_4
EINECS Number: 200-262-8
ACX Number: X1000019-0
Synonyms: BENZINOFORM; CARBON CHLORIDE; CARBON TET; CARBON TETRACHLORIDE; CARBONA; CHLORID UHLICITY; CZTEROCHLOREK WEGLA; ENT 27164; ENT 4,705; FASCIOLIN; FLUKOIDS; FREON 10; HALON 104; HALON 1040; METHANE TETRACHLORIDE; METHANE,TETRACHLORO-; NECATORINA; NECATORINE; PERCHLOROMETHANE; R 10; R 10 (REFRIGERANT); TETRACHLOORKOOLSTOF; TETRACHLOORMETAAN; TETRACHLORKOHLENSTOFF,TETRA; TETRACHLORMETHAN; TETRACHLOROCARBON; TETRACHLOROMETHANE; TETRACHLORURE DE CARBONE; TETRACLOROMETANO; TETRACLORURO DI CARBONIO; TETRAFINOL; TETRAFORM; TETRASOL; UNIVERM; VERMOESTRICID
General Use: As a fire extinguisher; for cleaning clothing; rendering benzin nonflammable; azeotropic drying agent for wet spark plugs in automobiles; as solvent for oils, lacquers, fats, varnishes, rubber waxes, and resins.
Also used for extracting oil from flowers, seeds; exterminating destructive insects; solvent; starting material in manufacture of many organic compounds; production of semiconductors.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
carbon tetrachloride	56-23-5	>99

OSHA PEL
TWA: 10 ppm; Ceiling: 25 ppm; 200 ppm, 5-minute maximum peak in any 4 hours.

OSHA PEL Vacated 1989 Limits
TWA: 2 ppm; 12.6 mg/m^3.

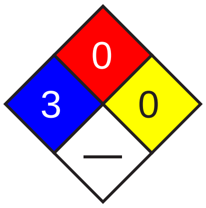
ACGIH TLV
TWA: 5 ppm; STEL: 10 ppm; skin.

NIOSH REL
STEL: 2 ppm, 12.6 mg/m^3; 60-minute.

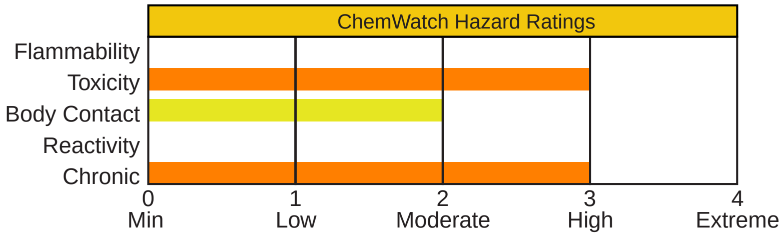
IDLH Level
200 ppm.

DFG (Germany) MAK
TWA: 0.5 ppm; PEAK: 1 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
3	Health
0	Flammability
0	Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; ethereal odor. Irritating to eyes/skin/respiratory tract. Toxic. Also causes: incoordination, confusion, liver/kidney damage. Chronic: visual disturbances, aplastic anemia, ulcers, blindness, hearing loss. Cancer/reproductive hazard.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, skin, liver, kidneys, lungs
Primary Entry Routes: inhalation, skin

Acute Effects

Inhalation: Anesthetics and narcotic effects (with dulling of senses and odor fatigue) are a consequence of exposure to chlorinated solvents.

Individual response varies widely; odor may not be considered objectionable at levels which quickly induce central nervous system effects.

High vapor concentrations may give a feeling of euphoria. This may result in reduced responses, followed by rapid onset of unconsciousness, possible respiratory arrest and death.

Exposure to less than anesthetic concentrations may cause vertigo, headache, depression, mental confusion, nausea, vomiting, diarrhea, loss of coordination, cardiac disturbances, unconsciousness, and possible death. Deaths generally occur as a result of acute liver and/or kidney necrosis. In many cases the victim is a chronic alcoholic or has a history of heavy drinking.

In an occupational setting workers exposed at 33-124 ppm were reported to be become fatigued within two hours of starting work. Workers exposed at 45-97 ppm reported headache and giddiness. Liver dysfunction also occurred. Symptoms of this dysfunction included nausea, anorexia, flatulence, vomiting, stomach ache, jaundice and an enlarged tender liver.

Acute exposures may also produce kidney damage.

Eye: The material is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis. Toxic effects may result from skin absorption.

Exposure limits with "skin" notation indicate that vapor and liquid may be absorbed through intact skin. Absorption by skin may readily exceed vapor inhalation exposure. Symptoms for skin absorption are the same as for inhalation. Contact with eyes and mucous membranes may also contribute to overall exposure and may also invalidate the exposure standard.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Contact with skin may lead to a dry, scaly, fissured dermatitis.

Ingestion: The liquid is highly discomforting to the gastrointestinal tract and may be harmful if swallowed. Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident, a single organ alone is (almost) never involved.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: The material may accumulate in the human body and progressively cause tissue damage.

Chronic exposure may cause liver, heart and kidney damage. Enlarged and tender liver, and jaundice may result from toxic hepatitis. Diminished urinary volume, red and white blood cells in urine, coma and death may be consequences of acute renal failure. Chronic exposure may also cause visual disturbances such as haze, blind spots, narrowing of visual field.

The hazard of systemic effects is increased when carbon tetrachloride is used in conjunction with ingested alcohol.

When administered by gavage, carbon tetrachloride increased the incidence of hepatomas and hepatocellular carcinoma in mice of both sexes. When administered by inhalation carbon tetrachloride induced liver carcinomas in rats. Three case reports describe liver tumors associated with cirrhosis in humans exposed to carbon tetrachloride. A mortality study of laundry and dry cleaning workers exposed to a variety of solvents suggested an excess of respiratory cancers, liver tumors and leukemia.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.

Quickly remove all contaminated clothing, including footwear.

Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center.

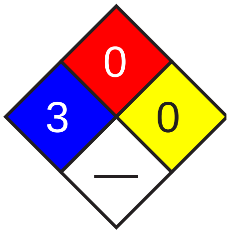
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.
Avoid giving milk or oils.
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians:

1.Acute exposures to carbon tetrachloride present, initially, with CNS depression followed by hepatic and renal disfunction.
2.Respiratory depression and cardiac dysrhythmias are an immediate threat to life.
3.Since a major fraction of absorbed carbon tetrachloride is exhaled in first hour, good tidal volumes should be maintained in severely poisoned patients; hyperventilation may be an additional therapeutic modality.
4.Ipecac syrup, lavage, activated charcoal or catharsis may all be used in the first 4 hours.
5.Since reactive metabolites may cause hepatorenal toxicity, administration of N-acetyl-L-cysteine may reduce complications.
Experience with this therapy is limited.
Preplacement and annual medical examinations are recommended for workers exposed to carbon tetrachloride.
Preplacement examinations should include an evaluation of alcohol intake, a urinalysis that includes a microscopic examination, and kidney function tests. Special attention should be given to the central nervous system, the skin and blood. Individuals with kidney, liver or central nervous system disorders or who are alcoholics should not be exposed to carbon tetrachloride.
Note: Consumption of alcohol augments the injurious effects of this substance.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Water spray or fog; foam.
Bromochlorodifluoromethane (BCF) (where regulations permit).
Dry chemical powder.
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Noncombustible. Decomposition may produce toxic fumes of phosgene, hydrogen chloride, carbon monoxide (CO), carbon dioxide (CO_2).
Fire Incompatibility: Avoid contact with alkali metals, oxidizing agents, aluminum, magnesium, dimethylformamide and fluorine. Will react with some forms of plastic, rubber and coatings.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Use fire fighting procedures suitable for surrounding area.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately.
Wear protective clothing, impervious gloves and safety glasses.
Avoid breathing vapors and contact with skin and eyes.
Remove all ignition sources.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
If contamination of drains or waterways occurs, advise emergency services.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Avoid breathing vapors and contact with skin and eyes.
Shut off all possible sources of ignition and increase ventilation.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Absorb spill with sand, earth, inert material or vermiculite.
Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Use in a well-ventilated area.
Wear personal protective equipment when handling.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Keep containers securely sealed when not in use.
Avoid physical damage to containers.
When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.

Recommended Storage Methods: Glass container. Plastic containers may only be used if approved for flammable liquids.
Mild steel can.
Stainless steel drum.
Check that containers are clearly labeled.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. NIOSH-approved respirator (supplied air type) may be required in special circumstances. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses. Chemical goggles.
Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVA gloves.
Note: Carbon tetrachloride has a pronounced degrading effect on PVC.

Respiratory Protection:
Exposure Range >10 to 50 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range >50 to <200 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 200 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties

Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:

PE/EVAL/PE	Best selection
VITON	Best selection
PVA	Best selection
TEFLON	Best selection
NITRILE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Very poisonous, colorless, clear, heavy liquid with characteristic odor. Soluble in alcohol, benzene, chloroform and ether.

Physical State: Liquid
Vapor Pressure (kPa): 12.13 at 20 °C
Vapor Density (Air=1): 5.3
Formula Weight: 153.82
Specific Gravity (H_2O=1, at 4 °C): 1.59 at 25 °C
pH: Not applicable

pH (1% Solution): Not applicable
Boiling Point: 76.54 °C (170 °F)
Freezing/Melting Point: -23 °C (-9.4 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.05% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from barium, lithium, sodium, potassium, aluminum and magnesium metals, dimethylformamide (above 65 C), fluorine, oxidizing agents. Will react with some plastics, rubber and coatings.

Section 11 - Toxicological Information

Toxicity

Oral (human) LD_{Lo}: 43 mg/kg
Oral (human) TD_{Lo}: 1800mg/kg
Oral (rat) LD_{Lo}: 2350 mg/kg
Inhalation (human) TC_{Lo}: 20 ppm
LC_{Lo}: 100 ppm
TC_{Lo}: 45 ppm/3 d
TC_{Lo}: 317 ppm/30 m
Dermal (rat) LD_{50}: 5070 mg/kg
Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Irritation

Skin (rabbit): 500 mg/24 h - mild
Eye (rabbit): 500 mg/24 h - mild
Eye (rabbit): 2200ug/30s - mild

See NIOSH, *RTECS* FG 4900000, for additional data.

Section 12 - Ecological Information

Environmental Fate: In the troposphere, it is extremely stable (residence time of 30-50 years). The primary loss process is by escape to the stratosphere where it photolyzes. As a result of its emission into the atmosphere and slow degradation, the amount in the atmosphere has been increasing. Some released to the atmosphere is expected to partition into the ocean. In water systems, evaporation appears to be the most important removal process, although biodegradation may occur under aerobic and anaerobic conditions (limited data). Releases or spills on soil should result in rapid evaporation due to high vapor pressure and leaching in soil resulting in groundwater contamination due to its low adsorption to soil. Bioconcentration is not significant

Ecotoxicity: LC_{50} Menidia beryllina 150 ppm/96 hr at 23 °C, static bioassay in fresh water, mild aeration applied after 24 hr; Toxicity Threshold (Cell Multiplication Inhibition Test) Scenedesmus quadricauda (green algae) >600 mg/l ; LC_{50} Poecilia reticulata (Guppy) 67 ppm/14 days /Conditions of bioassay not specified; EC_{50} Pimephales promelas (fathead minnow) 20.8 mg/l/96 hr (confidence limit 18.3 - 23.7 mg/l), flow-through bioassay with measured concentrations, 21.7 °C, dissolved oxygen 7.1 mg/l, hardness 49.2 mg/l calcium carbonate; Toxicity Threshold (Cell Multiplication Inhibition Test) Uronema parduczi Chatton-Lwoff (protozoa) 616 mg/l

Henry's Law Constant: 3.04×10^{-2}

BCF: low potential

Biochemical Oxygen Demand (BOD): none

Octanol/Water Partition Coefficient: $\log K_{ow} = 2.83$

Soil Sorption Partition Coefficient: K_{oc} = estimated at 71

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Decontaminate empty containers.
Return containers to drum reconditioner or recycler.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: CARBON TETRACHLORIDE
Hazard Class: 6.1(a)
ID No.: 1846
Packing Group: II
Label: Poison[6]

Additional Shipping Information: TETRACHLOROMETHANE

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U211 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

4-Chloroaniline
CHL2680

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: 4-Chloroaniline **CAS Number:** 106-47-8
Chemical Formula: C_6H_6ClN
Structural Chemical Formula: $ClC_6H_4NH_2$
EINECS Number: 203-401-0
ACX Number: X1003295-2
Synonyms: 1-AMINO-4-CHLOROBENZENE; 4-AMINO-1-CHLOROBENZENE; 4-AMINOCHLOROBENZENE; P-AMINOCHLOROBENZENE; ANILINE,4-CHLORO-; ANILINE,P-CHLORO-; BENZENAMINE,4-CHLORO-; BENZENEAMINE,4-CHLORO; P-CA; 4-CHLORANILIN; P-CHLORANILINE; 4-CHLORO-1-AMINOBENZENE; 4-CHLOROANILINE; P-CHLOROANILINE; 4-CHLOROBENZAMINE; 4-CHLOROBENZENAMINE; 4-CHLOROBENZENEAMINE; 4-CHLOROPHENYLAMINE; P-CHLOROPHENYLAMINE
Derivation: Produced by catalytic hydrogenation of chloronitrobenzene or by reduction of chloronitrobenzene with sodium bisulfide.
General Use: Used as a dye intermediate for azo dyes, and in the manufacture of pharmaceuticals and agricultural chemicals.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
4-Chloroaniline	106-47-8	ca 100% wt

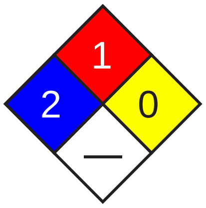
OSHA PEL

NIOSH REL

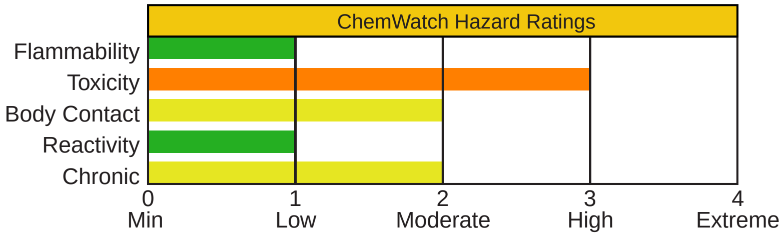
DFG (Germany) MAK
Skin.

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS

2	Health
1	Flammability
0	Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, white, or pale-yellow crystals. Severely irritating to eyes. Other Acute Effects: can be absorbed through skin in toxic amounts, toxic to central nervous system, heart/kidney/blood damage. Combustible.

Potential Health Effects

Target Organs: Central nervous system, blood, heart, kidneys.
Primary Entry Routes: Inhalation, eye contact, skin contact/absorption.
Acute Effects
Inhalation: Symptoms include severe headache, nausea and vomiting, dry throat, confusion, dizziness, incoordination, ringing in the ears, weakness, disorientation, lethargy, drowsiness, methemoglobinemia (inability of the blood to carry oxygen resulting in a lack of oxygenated blood in the kidneys), heart block, arrhythmias (irregular heart beat), kidney insufficiency, blood or free hemoglobin in urine, painful urination, and possible coma or death due to circulatory collapse.
Eye: Severely irritating.

Skin: Skin contact may change skin color to slate-gray. 4-Chloroaniline is absorbed through the skin and may produce the same symptoms as via inhalation.

Ingestion: The lips and tongue may become black. Symptoms may resemble those via inhalation. A late hemolytic (red blood cell destruction) episode may occur 6 to 8 days post ingestion.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Mutation data has been reported.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water followed quickly by a thorough soap and water wash. For reddened or blistered skin, consult a physician.

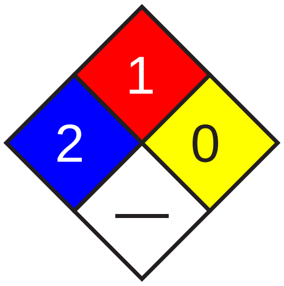
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Effects may be delayed; keep victim under observation.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: > 220 °F (> 104.4 °C), Open Cup

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Flammability Classification: Class IIIB Combustible Liquid

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam.

General Fire Hazards/Hazardous Combustion Products: Carbon oxide(s), nitrogen oxide(s) and chlorine gases.

Fire-Fighting Instructions: Move containers from fire area if possible. If impossible, apply cooling water to sides of containers until well after fire is out. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, and deny entry. Shut off all ignition sources.

Small Spills: Carefully scoop up or vacuum (with appropriate filter) and place in suitable containers. *Do not* sweep!

Large Spills: Flush with water to containment area for later disposal. *Do not* release into sewers or waterways. Damp mop any residue.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use only with adequate ventilation and appropriate PPE. *Do not* use near heat or ignition sources.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using 4-chloroaniline, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 11).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where possible, enclose processes to prevent dust dispersion into work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the kidneys, blood, and central nervous system.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove 4-chloro- aniline from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, white, or pale-yellow orthorhombic crystals.

Physical State: Solid

Odor Threshold: 1.5 mg/l

Vapor Pressure (kPa): 0.025 mm Hg at 68 °F (20 °C)

Formula Weight: 127.57

Specific Gravity (H_2O=1, at 4 °C): 1.169 at 170.6 °F (77°C); 1.427 at 66.2 °F (19 °C)

Refractive Index: 1.5546 at 188.6 °F (87 °C)

Boiling Point: 444.2 to 451.4 °F (229 to 233 °C)

Freezing/Melting Point: 157.1 °F (69.5 °C)

Water Solubility: 3.9 g/L

Other Solubilities: Soluble in alcohol, acetone, carbon disulfide, ether, and petroleum ether.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: 4-Chloroaniline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, ignition sources, and nitrous oxide.

Storage Incompatibilities: Nitrous acid.

Hazardous Decomposition Products: Thermal oxidative decomposition of 4-chloroaniline can produce carbon oxide(s), nitrogen oxide(s), hydrogen chloride, and chlorine gases.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 300 mg/kg caused convulsions or effect on seizure threshold, muscle weakness, and respiratory depression.

Acute Skin Effects:

Rabbit, skin, LD_{50}: 360 mg/kg.

Rat, skin, LD_{50}: 3200 mg/kg.

Irritation Effects:

Rabbit, eye: 250 µg/24 hr caused severe irritation.

Rabbit, skin: 500 mg/24 hr caused mild irritation.

Other Effects:

Rat, oral: 14 g/kg administered continuously for 78 weeks produced vascular and blood tumors.

Rat, oral: 3367 mg/kg administered intermittently for 13 weeks produced methemoglobin, carboxyhemoglobin, changes in red blood cell count, and changes in urine composition.

Genetic Effects - Rat, liver cell: 5 mg/L caused unscheduled DNA synthesis.

See *RTECS* BX0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, 4-chloroaniline will rapidly combine chemically with soil components and become partially mineralized by chemical and biological action (binding is stronger at lower pH's). A small percentage may volatilize from the soil surface. In water, volatilization is the primary removal mechanism with a half-life of 6.4 hr. Photooxidation, with a half-life of 0.4 hr and reactions with humic material and clay and sediment in the water column, can also occur. Bioconcentration is not significant. In the air, 4-chloroaniline will exist primarily in the vapor phase and undergo reaction with photochemically-produced hydroxyl radicals with a half-life of 4.6 hr. Some direct photolysis is also possible.
Ecotoxicity: Data not reported.
Octanol/Water Partition Coefficient: log K_{ow} = 1.83

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Chloroanilines, solid
ID: UN2018
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4, T7, TP2
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
  RCRA 40 CFR: Listed P024
  CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 1000 lb (453.5 kg)
  SARA 40 CFR 372.65: Listed
  SARA EHS 40 CFR 355: Not listed
  TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Issue Date: 2006-06

Chlorobenzene
CHL2800

Section 1 - Chemical Product and Company Identification 61

Material Name: Chlorobenzene **CAS Number:** 108-90-7
Chemical Formula: C_6H_5Cl
Structural Chemical Formula: C_6H_5Cl
EINECS Number: 203-628-5
ACX Number: X1001545-9
Synonyms: BENZENE CHLORIDE; BENZENE,CHLORO-; CHLOORBENZEEN; CHLORBENZENE; CHLORBENZOL; CHLOROBENZEN; CHLOROBENZENE; CHLOROBENZENU; CHLOROBENZOL; CLOROBENZENE; CP 27; EPA PESTICIDE CHEMICAL CODE 056504; I P CARRIER T 40; MCB; MONOCHLOORBENZEEN; MONOCHLORBENZENE; MONOCHLORBENZOL; MONOCHLOROBENZENE; MONOCLOROBENZENE; PHENYL CHLORIDE; TETROSIN SP
General Use: Used in textile processing as a fiber swelling agent and a dye carrier; as an extractant in the manufacture of diisocyanates, rubber, perfumes and pharmaceuticals; and in the manufacture of phenol, aniline and DDT. Also a tar and grease remover, a solvent for paints and a heat transfer medium.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
chlorobenzene	108-90-7	>95

OSHA PEL
TWA: 75 ppm; 350 mg/m^3.

NIOSH REL

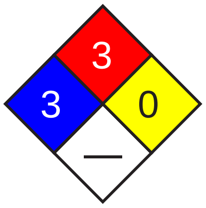
DFG (Germany) MAK
TWA: 10 ppm; PEAK: 20 ppm.

ACGIH TLV
TWA: 10 ppm.

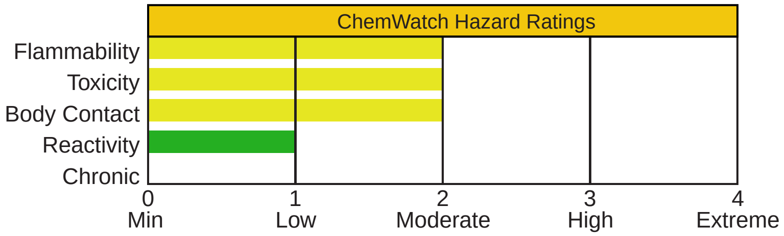
IDLH Level
1000 ppm.

EU OEL
TWA: 23 mg/m^3 (5 ppm); STEL: 70 mg/m^3 (15 ppm).

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; almond-like odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, drowsiness, cyanosis, spastic contractions of extremities, unconsciousness. Chronic Effects: skin burns; lung/liver/kidney damage. Flammable.

Potential Health Effects

Target Organs: respiratory system, eyes, skin, central nervous system (CNS), liver
Primary Entry Routes: inhalation, ingestion, eye contact, skin contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled. Headaches and upper respiratory tract and eye irritation were reported in a worker exposed to the substance contained in a glue preparation.

Inhalation of 200 ppm may produce mucous membrane irritation and coughing whilst higher concentrations produce central nervous system depression with headache, dizziness, drowsiness, somnolence, transient anesthesia, and incoherence, cyanosis from methemoglinemia, spastic contractions of the extremities, rapid respiration, weak and irregular pulse, burgundy-red urine, loss of consciousness, coma and respiratory and circulatory collapse.

Central nervous system (CNS) depression may include nonspecific discomfort, symptoms of giddiness, headache, dizziness, nausea, anesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness. Serious poisonings may result in respiratory depression and may be fatal.

The substance and/or its metabolites may bind to hemoglobin inhibiting normal uptake of oxygen. This condition, known as "methemoglobinemia", is a form of oxygen starvation (anoxia). Symptoms include cyanosis (a bluish discoloration to skin and mucous membranes) and breathing difficulties. Symptoms may not be evident until several hours after exposure. At about 15% concentration of blood methemoglobin there is observable cyanosis of the lips, nose and earlobes. Symptoms may be absent although euphoria, flushed face and headache are commonly experienced. At 25-40%, cyanosis is marked but little disability occurs other than that produced on physical exertion. At 40-60%, symptoms include weakness, dizziness, lightheadedness, increasingly severe headache, ataxia, rapid shallow respiration, drowsiness, nausea, vomiting, confusion, lethargy and stupor.

Above 60% symptoms include dyspnea, respiratory depression, tachycardia or bradycardia, and convulsions. Levels exceeding 70% may be fatal.

Narcosis may also result.

Rats exposed for 2 hours at 1200 ppm showed definite narcosis but 220-660 ppm could be tolerated without obvious clinical signs of sedation. Central nervous system depression was seen at 5850 ppm.

Eye: The vapor is discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis. Toxic effects may result from skin absorption.

Prolonged exposure may cause chemical burns.

Ingestion: The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

Ingestion may produce nausea, loss of consciousness and possibly coma.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A3, Animal carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Exposure to high levels or prolonged exposure may cause liver damage, chronic respiratory disease and changes to the kidney (urine may be burgundy red).

Workers exposed to chlorobenzene vapors from 1-2 years reported headache, dizziness, somnolence, and dyspeptic disorders. Other symptoms included acroparaesthesia, spastic contractions of the finger muscles, hypesthesia, spastic contractions of the gastocnemius muscle and vasovegetative instability.

Repeated exposure of rats, rabbits and guinea pigs to chlorobenzene at 1000 ppm, 7 hours/day, 5 days/week over 44 days resulted in lung, liver and kidney changes.

Male rats receiving high doses during chronic gavage studies showed an increase in the occurrence of neoplastic nodules of the liver.

Section 4 - First Aid Measures

See
DOT
ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

In case of burns: Quickly immerse affected area in cold running water for 10 to 15 minutes.

Bandage lightly with a sterile dressing. Treat for shock if required.

Lay patient down. Keep warm and rested. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center. DO NOT induce vomiting. Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink. Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

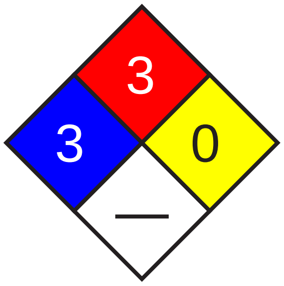
For ingestion, consider gastric lavage.

Chlorobenzene administered orally is mainly excreted in the urine with 32% appearing in the first 24 hours mostly as metabolites (4-chlorophenylmercaturic acid, chlorophenols, chlorocatechols and mandelic acid) Periodic medical examinations are recommended for occupationally exposed workers. Persons with pre-existing skin disorders or impaired liver, kidney or pulmonary function may be more susceptible to the effects of this substance.

Section 5 - Fire-Fighting Measures

Flash Point: 29.2 °C Closed Cup
Autoignition Temperature: 638 °C
LEL: 1.8% v/v
UEL: 9.6% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

See DOT ERG



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include hydrogen chloride and phosgene.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Cool fire-exposed containers with water spray from a protected location.
Do not approach cylinders suspected to be hot.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Fight fire from a safe distance, with adequate cover.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Environmental hazard - contain spillage.
Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Wash spill site with soda solution.
Large Spills: Pollutant - Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent by any means available, spillage from entering drains or watercourse.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Avoid contact with incompatible materials.
Avoid all ignition sources.
Avoid sources of heat.

Avoid physical damage to containers.
Keep containers securely sealed when not in use.
Use in a well-ventilated area.
Ground and secure containers when dispensing or pouring.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Vapor may travel a considerable distance to source of ignition.
Avoid generation of static electricity.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Glass container.
Plastic containers may only be used if approved for flammable liquids.
Metal drum.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Safety glasses.
Full face shield.
DO NOT wear contact lenses.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Impervious gloves; Viton gloves.
Neoprene gloves.
Protective footwear.
Safety footwear.

Respiratory Protection:
Exposure Range >75 to 750 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >750 to <1000 mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Exposure Range 1000 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Ensure there is ready access to a safety shower. Eyewash unit.
Impervious apron.
Overalls.
Laboratory coat.
Impervious protective clothing.
If gas concentrations are high, full-face air supplied breathing apparatus.
Barrier cream.
Skin cleansing cream.

Glove Selection Index:

VITON	Best selection
TEFLON	Best selection
PVA	Satisfactory; may degrade after 4 hours continuous immersion
NITRILE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: A clear, colorless, volatile, flammable liquid with a faint, almond- like, aromatic odor. It is a very refractive liquid (1.528); freely miscible with in alcohol, benzene, chloroform and ether. Environmental pollutant.

Physical State: Liquid
Odor Threshold: 0.98 to 280 mg/m^3
Vapor Pressure (kPa): 1.2 at 20 °C
Vapor Density (Air=1): 3.9
Formula Weight: 112.56
Specific Gravity (H_2O=1, at 4 °C): 1.11
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 132 °C (270 °F)
Freezing/Melting Point: -45.6 °C (-50.08 °F)
Volatile Component (% Vol): approx. 100
Water Solubility: 0.05% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Hazardous polymerization will not occur. Stable under normal storage conditions.

Storage Incompatibilities: Avoid reaction with oxidizing agents.
Avoid dimethyl sulfoxide and silver perchlorate (forms shock-sensitive solvated salts). Also avoid extreme humidity.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: >2290 mg/kg
Oral (rat) LD_{50}: 1100 mg/kg
Inhalation (rat) LC_{Lo}: 9000 ppm
Mammalian somatic cell mutagen

Irritation
Nil reported

See *RTECS* CZ 0175000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Once released it will decrease in concentration due to dilution and photooxidation. Releases into water and onto land will decrease in concentration due to vaporization into the atmosphere and slow biodegradation in the soil or water. It would be expected to percolate into the ground water if soil is sandy and poor in organic matter. Little bioconcentration is expected into fish and food products.

Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 19 ppm/14 days /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnow) 16.9 mg/l/96 hr (confidence limit 13.8 - 20.6 mg/l), flow-through bioassay with measured concentrations, 25.7 °C, dissolved oxygen 6.2 mg/l, hardness 43.8 mg/l calcium carbonate, alkalinity 43.4 mg/l calcium carbonate; LD_{50} Salmo gairdneri (rainbow trout) 1.8 mg/kg/24 hr /Conditions of bioassay not specified

Henry's Law Constant: calculated at 3.56×10^{-3}

BCF: fish 1 to 2

Biochemical Oxygen Demand (BOD): 0.3 lb/lb, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.18 to 2.84

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Chlorobenzene
ID: UN1134
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: III - Minor Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: B1, IB3, T2, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 203 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U037 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Chloroform
CHL4090

Section 1 - Chemical Product and Company Identification 61

Material Name: Chloroform **CAS Number:** 67-66-3
Chemical Formula: $CHCl_3$
Structural Chemical Formula: $CHCl_3$
EINECS Number: 200-663-8
ACX Number: X1000035-4
Synonyms: Chloroform; CHLOROFORM; CHLOROFORME; CLOROFORMIO; FORMYL TRICHLORIDE; FREON 20; METHANE TRICHLORIDE; METHANE,TRICHLORO-; METHENYL CHLORIDE; METHENYL TRICHLORIDE; METHYL TRICHLORIDE; R 20; R 20 (REFRIGERANT); TCM; TRICHLOORMETHAAN; TRICHLORMETHAN; TRICHLOROFORM; TRICHLOROMETHANE; TRICLOROMETANO
General Use: As a solvent for fats, oils, rubber, alkaloids, waxes, gutta-percha and resins; as a cleaning agent; in fire extinguishers to lower the freezing temperature of carbon tetrachloride; in the rubber industry; as a solvent in organic chemistry.
Medical use as anesthetic discontinued because ot toxicity.
Major use in modern industry is in the production of fluorocarbon-22, a refrigerant.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
chloroform	67-66-3	>98

OSHA PEL
Ceiling: 50 ppm, 240 mg/m^3.

ACGIH TLV
TWA: 10 ppm.

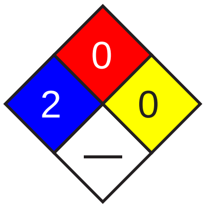
EU OEL
TWA: 10 mg/m^3.

NIOSH REL
STEL: 2 ppm (9.78 mg/m^3) (60-minute).

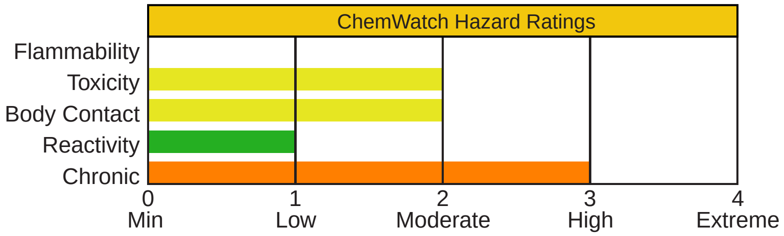
IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 0.5 ppm; PEAK: 1 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
0 Flammability
0 Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; ethereal odor. Irritating to eyes/skin/respiratory tract. Toxic. Other Acute Effects: dizziness, liver/kidney damage. Chronic Effects: CNS effects, possible cancer hazard, possible birth defects based on animal data.

Potential Health Effects

Target Organs: liver, kidneys, heart, eyes, skin
Primary Entry Routes: inhalation, ingestion, skin contact/absorption
Acute Effects
Inhalation: Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.

Depression of the central nervous system is the most outstanding effect of most halogenated aliphatic hydrocarbons. Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin).

1000-2000 ppm may cause dizziness, headache, fatigue, salivation and nausea. 4000 ppm may cause vomiting, serious disorientation and a fainting feeling. 14000-16000 ppm may cause anesthesia and rapid loss of consciousness. More than 20000 ppm may cause respiratory failure, cardiac arrhythmias and death. Fatty changes and centrilobular necrosis of the liver and fatty degenerative changes of the kidney and heart may occur.

If death does not occur immediately from respiratory arrest or ventricular fibrillation, it may occur later from liver and kidney damage.

Toxic effects are increased by consumption of alcohol.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The material may produce moderate eye irritation leading to inflammation.

Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: The material is highly discomforting to the gastrointestinal tract and may be harmful if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Other symptoms include burning of the mouth, throat, esophagus and stomach, diarrhea, abdominal and substernal pain, cold, clammy skin, cyanosis of the extremities and face, muscle cramps, mydriasis, hypotension, peripheral vasodilation, irregular respiration, respiratory failure, unconsciousness and liver damage.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Repeated exposure to 77-237 ppm has caused lassitude, dullness, urinary frequency, and gastrointestinal disturbances. Other symptoms include dry mouth, thirst, malaise, anorexia, headache, depression, confusion, weakness, blurred vision, paresthesias, loss of sense of balance, memory loss, tremors, anemia, kidney damage, and fatty degeneration of the liver.

Repeated ingestion may cause liver and kidney damage.

Chloroform is not strongly teratogenic but is embryotoxic. Several epidemiological and ecological studies indicate that there is an association between cancer of the large intestine, rectum, and/or urinary bladder and the constituents of chlorinated water.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids. Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.

Note: DO NOT INDUCE VOMITING in an unconscious person.

Avoid giving milk or oils.

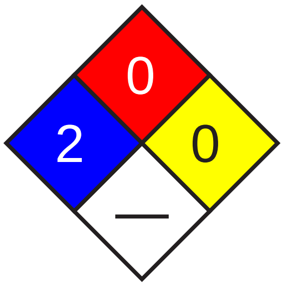
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically. Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Nonflammable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: There is no restriction on the type of extinguisher which may be used. Use fire fighting procedures suitable for surrounding area.
General Fire Hazards/Hazardous Combustion Products: Nonflammable liquid
Decomposes on heating and produces acrid and toxic fumes of phosgene, carbon dioxide (CO_2), carbon monoxide (CO), chlorine and hydrogen chloride.
Heating may cause expansion or decomposition leading to violent rupture of containers.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Product is not combustible. No special firefighting procedures required.
Use fire fighting procedures suitable for surrounding area.
If safe to do so, remove containers from path of fire.
Cool fire-exposed containers with water spray from a protected location.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Increase ventilation.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Place in suitable containers for disposal.
Allow small quantities to evaporate.
Large Spills: Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
Wear breathing apparatus plus protective gloves. Stop leak if safe to do so.
Absorb or cover spill with sand, earth, inert material or vermiculite.
Collect and seal in labeled drums for disposal.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid breathing vapors and contact with skin and eyes. Avoid contact with strong alkalis.
Avoid sources of heat.
When handling, DO NOT eat, drink or smoke.
Use in a well-ventilated area.
Keep containers securely sealed when not in use.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Recommended Storage Methods: Check that containers are clearly labeled.
Store in metal drums or safety cans.
Glass container.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses; safety glasses with side shields; chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.
Respiratory Protection:
Exposure Range >50 to <500 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

Note: poor warning properties

Other: Impervious protective clothingRubber apron.
Ensure there is ready access to a safety shower.

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
TEFLON	Best selection
VITON	Satisfactory; may degrade after 4 hours continuous immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless, very volatile liquid with characteristic heavy, "sweetish" ethereal odor and sweet taste. Viscosity is 0.56 mPa sec at 20 °C. Mixes with alcohol, benzene, ether, petroleum ether, carbon tetrachloride, carbon disulfide, and oils.

Physical State: Liquid
Odor Threshold: 250 to 1000 mg/m^3
Vapor Pressure (kPa): 21.2 at 20 °C
Vapor Density (Air=1): 4.13
Formula Weight: 119.37
Specific Gravity (H_2O=1, at 4 °C): 1.489 at 20 °C
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 61.67 °C (143 °F)
Freezing/Melting Point: -63.33 °C (-81.994 °F)
Volatile Component (% Vol): 100
Water Solubility: < 1 mg/mL at 19 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from acetone, strong alkali, nitrogen tetroxide, fluorine, metals (Al, K, Li, Mg, Na, NaK alloy), potassium tert-butoxide, methanol, sodium methoxide, disilane, amd triisopropylphosphine.
Also reacts violently with (acetone + a base), (perchloric acid + phosphorous pentoxide), (KOH + methanol) and (NaOH + methanol).
Attacks, softens and may dissolve rubber, many plastics, paints and coatings.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 800 mg/kg
Oral (human) LD_{Lo}: 140 mg/kg
Unknown route (human) LD_{Lo}: 546 mg/kg
Inhalation (human) LC_{Lo}: 25000 ppm/5 m
Inhalation (rat) LC_{Lo}: 8000 ppm/4 h
Inhalation (human) TC_{Lo}: 10 mg/m^3/1 y
Inhalation (human) TC_{Lo}: 5000 mg/m^3/7 m

Irritation
Skin (rabbit): 10 mg/24 hr (open) - mild
Skin (rabbit): 500 mg/24 hr - mild
Eye (rabbit): 148 mg
Eye (rabbit): 20 mg/24 hr - moderate

See *RTECS* FS 9100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Releases to water and land will be primarily lost by evaporation and will end up in the atmosphere. Release to the atmosphere may be transported long distances and will photodegrade with a half-life of a few months. Spills and other releases on land will also leach into the groundwater where it will reside for long periods of time. Will not be expected to bioconcentrate into the food chain but contamination of food is likely due to its use as an extractant and its presence in drinking water.

Ecotoxicity: LC_{50} Micropterus salmoides (largemouth bass) 51 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Daphnia magna (cladoceran) 28,900 ug/l/48 hr in a static bioassay; LC_{50} Salmo gairdneri (rainbow trout) 2030 ug/l soft water, 1240 ug/l hard water (40% teratogenesis), 27 day flow-through tests (20 min after fertilization to 8 days after hatching)

Henry's Law Constant: 3.67 x10^{-3}
BCF: fish < 1
Biochemical Oxygen Demand (BOD): none
Octanol/Water Partition Coefficient: log K_{ow} = 1.97
Soil Sorption Partition Coefficient: K_{oc} = soils 34

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible.
Allow absorbed spillage to evaporate in an open top container, away from habitation.
Bury residue in an authorized landfill.
Return containers to drum reconditioner or recycler.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Chloroform
ID: UN1888
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, N36, T7, TP2
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U044 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 10 lb (4.535 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 10 lb
  - **TPQ:** 10000 lb
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Issue Date: 2006-06

Chloromethane
MET2760

Section 1 - Chemical Product and Company Identification

Material Name: Chloromethane **CAS Number:** 74-87-3
Chemical Formula: CH_3Cl
Structural Chemical Formula: H_3CCl
EINECS Number: 200-817-4
ACX Number: X1003175-5
Synonyms: ARTIC; CHLOOR-METHAAN; CHLOR-METHAN; CHLOROMETHANE; CHLORURE DE METHYLE; CLOROMETANO; CLORURO DI METILE; METHANE,CHLORO-; METHYL CHLORIDE; METHYLCHLORID; METYLU CHLOREK; MONOCHLOROMETHANE; R 40
General Use: Methylating agent in the production of silicones, butyl rubber, tetramethyl lead, methyl cellulose, methylene chloride, methyl mercaptan, plastics, pesticides, pharmaceuticals, dyes, perfumes, ethers, resins, quaternary drugs, methyl ethers and commercial Grignard reagents.
Blowing agent for some polystyrene (e.g. Styrofoam) and polyurethane foams.
A potent narcotic which has been used as a local anesthetic.
Refrigerant, low temperature extraction solvent, herbicide, fluid for thermometric and thermostatic equipment.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
chloromethane	74-87-3	>98

OSHA PEL
TWA: 100 ppm; Ceiling 200 ppm; 300 ppm, 5-minute maximum peak in any 3 hours.

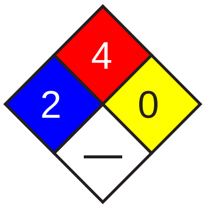
ACGIH TLV
TWA: 50 ppm; STEL: 100 ppm; skin.

NIOSH REL

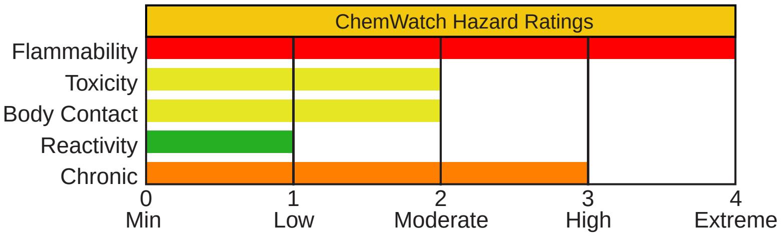
IDLH Level
2000 ppm.

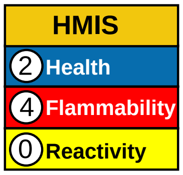
DFG (Germany) MAK
TWA: 50 ppm; PEAK: 100 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas; sweet odor. Acute Effects: staggering gait, slurred speech, dizziness, blurred vision, liver/kidney damage, displaces available oxygen. Chronic Effects: CNS effects; damage may be permanent. Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), liver, kidneys, skin
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract and lungs and may be harmful if inhaled.
Chloromethane is not a typical halogenated aliphatic hydrocarbon. it produces only slight nervous system depression.
The narcotic concentration for mice is 65000 ppm whilst that for chloroform is 440 ppm.
The brief prenarcotic phase involves inebriation with severe gastrointestinal symptoms (nausea, vomiting).

For lethal exposures the brain, lungs (pulmonary congestion and edema), kidneys and liver were reported to be markedly injured.

More than 30 deaths have been reported in the literature. The prenarcotic symptoms (headache, dizziness, confusion, marked sleepiness) and gastrointestinal disorders (nausea and vomiting) are followed by a symptom-free period of up to 2 days. Subsequent illness is characterized by neurotoxic symptoms. Personality changes originating in organic changes in the brain, tremor, tonic clonic spasms, hiccough and transient paralysis have all been observed. The eyes may also be affected. The symptoms (amblyopia, strabismus, double vision, accomodation disorders and ptosis) resemble those produced by methanol.

Apparent recovery from a seemingly minor exposure via inhalation may be followed by serious and prolonged after-effects within a few days or weeks.

These may be fatal.

Employees of a synthetic rubber plant exposed accidentally to chloromethane were disabled for 10-30 days. None suffered any permanent disability. Principal symptoms were blurred vision, dizziness and weakness. Other symptoms included gastrointestinal disturbance with prolonged vomiting, sleep disturbance, muscular incoordination, elevated body temperature and tachycardia.

When male rats inhaled 3500 ppm for 6 hours/day for 5 to 9 days, serum testosterone decreased as a result of central nervous system toxicity and degeneration of spermatic epithelium and the formation of epididymal granulomas.

Ataxia and renal damage (as evidenced by blood in the urine - hematuria) was evident, particularly in females, when mice were exposed to levels ranging from 500 to 2000 ppm chloromethane for 6 hours.

Degeneration and necrosis of proximal convoluted tubules and hepatic and cellular necrosis were found.

Exposures of 6 hours/day, 6 days/week at concentrations of 500 ppm were lethal to dogs in 4 weeks and to monkeys in 16 weeks. Signs of intoxication preceding death were convulsive seizures, periods of unconsciousness and neuromuscular disability. Repeated exposures at 300 ppm for 64 weeks did not produce adverse effects in either species.

Chloromethane is slowly excreted from the body and is metabolically converted to methanol.

Eye: The vapor is highly discomforting to the eyes, may be harmful following absorption, may cause chemical burns and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

Moderate human exposure to chloromethane has produced ocular symptoms such as mistiness, diplopia and difficulty in accommodation. These symptoms may persist for several weeks.

Skin: The liquid is discomforting to the skin.

Toxic effects may result from skin absorption.

Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Chronic and sub-acute exposures in humans may result in CNS effects such as ataxia, staggering gait, weakness, tremor, vertigo, speech difficulties and blurred vision. Significant performance decrements were found in workers chronically exposed to concentrations of 7.4 to 70 ppm.

No changes in clinical electroencephalograph were noted.

Rats and mice, chronically exposed to concentrations of 50-1000 ppm for 6 hours/day, 5 days/week for 2 years, showed renal degenerative changes (cortical tubular epithelial hypertrophy and hyperplasia with and without karyomegaly) and hepatocellular degeneration. A statistically significant increase in both malignant and non-malignant renal tumors occurred in male mice exposed at 1000 ppm. Additionally, chronic inhalation of 1000 ppm induced functional limb muscle impairment and degeneration, impairment of the internal granular layer of the cerebellum and atrophy of the spleen in both male and female mice. In teratology studies no effects were seen in rats but fetal heart-valve malformations were found in mice.

The acute and chronic toxicity of chloromethane differs greatly amongst animal species. In a human population two types of individual may react in a different fashion to chloromethane exposure. The so-called "conjugators" and "non-conjugators" metabolize the substance at markedly different rates. The effect of this difference on the susceptibility of the individual to the toxic effects has yet to be clarified.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

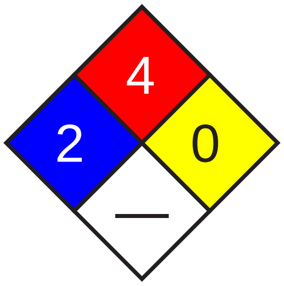
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: In case of cold burns (frost-bite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing if possible and without rubbing.
Do not apply hot water or radiant heat. Apply a clean, dry dressing.
Transport to hospital or doctor.
Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Avoid giving milk or oils.
Avoid giving alcohol.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.
Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

Section 5 - Fire-Fighting Measures

Flash Point: < 0 °C Open Cup
Autoignition Temperature: 634 °C
LEL: 8.1% v/v
UEL: 17.4% v/v
Extinguishing Media: Alcohol stable foam.
Bromochlorodifluoromethane (BCF) (where regulations permit).
Dry chemical powder.
Carbon dioxide.
Water spray or fog.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include phosgene and hydrogen chloride.
Fire Incompatibility: Reacts explosively with aluminum, magnesium, zinc or potassium, sodium or their alloys.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Do not extinguish burning gas.
If safe to do so, stop flow of gas.
If flow of gas cannot be stopped, leave gas to burn.
Use water delivered as a fine spray to control the fire and cool adjacent area.
Do not approach cylinders suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

See DOT ERG



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Avoid breathing vapor and any contact with liquid or gas. Protective equipment including respirator should be used. Do NOT enter confined spaces where gas may have accumulated. Shut of all sources of possible ignition and increase ventilation. Clear area of personnel. Stop leak only if safe to so do. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve. Keep area clear of personnel until gas has dispersed.

See DOT ERG

Large Spills: ....Clear area of all unprotected personnel and move upwind.
Contact fire department and advise them of the location and nature of hazard.
May be violently or explosively reactive.
Wear full body clothing with breathing apparatus.
Prevent by any means available, spillage from entering drains and waterways.
Consider evacuation.
Shut off all possible sources of ignition and increase ventilation.
No smoking or bare lights within area.
Use extreme caution to prevent violent reaction.
Stop leak only if safe to so do.
Water spray or fog may be used to disperse vapor.

Do NOT enter confined space where gas may have collected.
Keep area clear until gas has dispersed.
Keep area clear of personnel until gas has dispersed.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Avoid contact with incompatible materials.
Avoid smoking, bare lights or ignition sources.
Avoid sources of heat.
Avoid physical damage to containers.
Wear protective clothing and gloves when handling containers.
Use in a well-ventilated area.
Keep containers securely sealed when not in use.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Vapor may travel a considerable distance to source of ignition.
DO NOT transfer gas from one cylinder to another.
Ground all lines and equipment.
Vapor may ignite on pumping or pouring due to static electricity.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Cylinder fitted with valve protector cap.
Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Cylinder valve must be closed when not in use or when empty.
Cylinder must be properly secured either in use or in storage.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Close fitting gas tight goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVA gloves.

Respiratory Protection:
Exposure Range >100 to <2000 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 2000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properites

Other: Overalls. Eyewash unit.
Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, gas, odorless or with slight sweetish ethereal odor. Soluble in alcohol, chloroform, benzene, carbon tetrachloride, glacial acetic acid.

Physical State: Liquefied gas	**pH:** Not applicable
Odor Threshold: 21 mg/m^3	**pH (1% Solution):** Not applicable
Vapor Pressure (kPa): 492 at 20 °C	**Boiling Point:** -23.7 °C (-11 °F)
Vapor Density (Air=1): 1.74	**Freezing/Melting Point:** -97 °C (-142.6 °F)
Formula Weight: 50.49	**Volatile Component (% Vol):** 100
Specific Gravity (H_2O=1, at 4 °C): 0.92	**Water Solubility:** 303 ml/100ml at 20 °C
Evaporation Rate: Fast	

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable under normal handling conditions.
Hydrolyzes with water, forming hydrochloric acid.
Stable under normal storage conditions. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.
In the presence of catalytic amounts of aluminum chloride, powdered aluminum and chloromethane interact to form pyrophoric trimethylaluminum.
Incompatible with galvanized iron.
Incompatible with natural rubber and many neoprene compounds. Polyvinyl alcohol remains unaffected.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 1800 mg/kg
Inhalation (human) LC_{Lo}: 20000 ppm/2h
Inhalation (rat) LC_{50}: 5300 mg/m^3/4h
Human cell mutagen. Reproductive effector in rats. Specific paternal effects affecting spermatogenesis, testes etc, fetotoxicity and fetolethality, specific developmental abnormalities of the musculoskeletal and cardiovascular systems recorded. Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Irritation
Nil reported

See *RTECS* PA 6300000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released into water, it will be rapidly lost by volatilization (half-life in a typical river 2.1 hr). It will also be rapidly lost from soil by volatilization although there is a potential for it to leach into groundwater where it may very slowly biodegrade and hydrolyze (half-life may exceed a year). Once in the atmosphere it will disperse and will be lost primarily by upward dispersion. Above the tropopause, reaction with hydroxyl radicals aid in the removal and above 30 km, photodissociation, diffusion and reaction with hydroxyl radicals make roughly equal contributions to its removal.
Ecotoxicity: LC_{50} Lepomis macrochirus 550 ppm/96 hr (static bioassay in fresh water at 23 °C, mild aeration applied after 24 hr); LC_{50} Menidia beryllina 270 ppm/96 hr (static bioassay in synthetic seawater at 23 °C, mild aeration applied after 24 hr); Toxicity Threshold (Cell Multiplication Inhibition Test) Pseudomonas putida (bacteria) 500 mg/l; Toxicity Threshold (Cell Multiplication Inhibition Test) Microcystis aeruginosa (algae) 550 mg/l
Henry's Law Constant: 8.82×10^{-2}
BCF: none likely
Biochemical Oxygen Demand (BOD): none
Octanol/Water Partition Coefficient: $\log K_{ow} = 0.91$

Section 13 - Disposal Considerations

Disposal: Follow applicable federal, state, and local regulations.
Evaporate or incinerate residue at an approved site.
Return empty containers to supplier.
Ensure damaged or non-returnable cylinders are gas-free before disposal.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Methyl chloride, *or* Refrigerant gas R 40
ID: UN1063
Hazard Class: 2.1 - Flammable gas
Packing Group:
Symbols:
Label Codes: 2.1 - Flammable Gas
Special Provisions: T50
Packaging: **Exceptions:** 306 **Non-bulk:** 304 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** D **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U045 Toxic Waste, Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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(518) 842-4111

Issue Date: 2000-07

Chromium
MSDS 83
CHR4520

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Chromium **CAS Number:** 7440-47-3
Chemical Formula: Cr
Structural Chemical Formula: Cr
Synonyms: CHROM; CHROME; CHROMIUM; CHROMIUM METAL
General Use: Used in the manufacture of chrome-steel or chrome-nickel-steel alloys (stainless steel); for greatly increasing resistance and durability of metals; for chrome-plating of other metals.

Section 2 - Composition / Information on Ingredients

Name	**CAS**	**%**
chromium	7440-47-3	> 99.5

OSHA PEL
TWA: 1 mg/m^3; as Cr. Other Values: 0.1 mg/m^3; Clg Cr-VI as CrO_3.

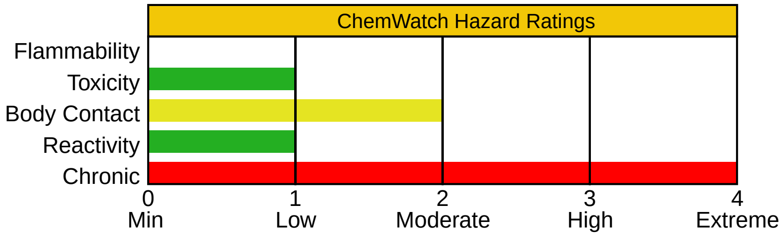
ACGIH TLV
TWA: 0.5 mg/m^3.

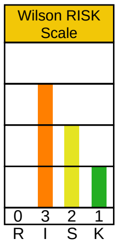
NIOSH REL
TWA: 0.5 mg/m^3; as Cr;Cr-II;Cr-III;Cr(VI)=.001.

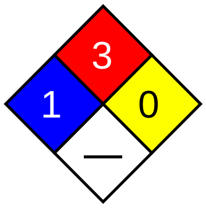
IDLH Level
250 mg/m^3; as Cr.

Section 3 - Hazards Identification

HMIS
1 Health
4 Flammability
0 Reactivity







Fire Diamond

ANSI Signal Word
Warning!


Explosive


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Steel-gray, lustrous metal powder; odorless. Irritating to eyes/skin/respiratory tract. Chronic: exposure to chromium fumes can cause fibrosis of the lungs with decreased function. Flammable. Explosive in air.

Potential Health Effects

Primary Entry Routes: inhalation, skin absorption, ingestion
Target Organs: respiratory system
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.
Chrome fume is irritating to the respiratory tract and lungs.
Toxic effects result from over-exposure.
Asthmatic conditions may result as a consequence of the sensitizing action of chrome VI compounds.
Eye: The dust may produce eye discomfort and abrasive eye inflammation.
Skin: The material may be mildly discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.
Chrome fume, as the chrome VI oxide, is corrosive to the skin and may aggravate pre-existing skin conditions such as dermatitis and eczema.
As a potential skin sensitizer, the fume may cause dermatoses to appear suddenly and without warning. Absorption of chrome VI compounds through the skin can cause systemic poisoning effecting the kidneys and liver.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

Carcinogenicity: NTP - Listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems. The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

Chromium(III) is considered an essential trace nutrient serving as a component of the "glucose tolerance factor" and a cofactor for insulin action. High concentrations of chromium are also found in RNA. Trivalent chromium is the most common form found in nature.

Chronic inhalation of trivalent chromium compounds produces irritation of the bronchus and lungs, dystrophic changes to the liver and kidney, pulmonary edema, and adverse effects on macrophages. Intratracheal administration of chromium(III) oxide, in rats, increased the incidence of sarcomas, and tumors and reticulum cell sarcomas of the lung. There is inadequate evidence of carcinogenicity of chromium(III) compounds in experimental animals and humans (IARC).

Chronic exposure to hexavalent chromium compounds reportedly produces skin, eye and respiratory tract irritation, yellowing of the eyes and skin, allergic skin and respiratory reactions, diminished sense of smell and taste, blood disorders, liver and kidney damage, digestive disorders and lung damage. There is sufficient evidence of carcinogenicity of chromium(VI) compounds in experimental animals and humans to confirm these as Class 1 carcinogens (IARC).

Exposure to chromium during chrome production and in the chrome pigment industry is associated with cancer of the respiratory tract. A slight increase in gastrointestinal cancer following exposure to chromium compounds has also been reported. The greatest risk is attributed to exposure to acid- soluble, water-insoluble hexavalent chromium which occurs in roasting and refining processes. Animal studies support the idea that the most potent carcinogenic compounds are the slightly soluble hexavalent compounds.

The cells are more active in the uptake of the hexavalent forms compared to trivalent forms and this may explain the difference in occupational effect. It is the trivalent form, however, which is metabolically active and binds with nucleic acid within the cell suggesting that chromium mutagenesis first requires biotransformation of the hexavalent form by reduction.

Hexavalent chromes produce chronic ulceration of skin surfaces (quite independent of other hypersensitivity reactions exhibited by the skin).

Water-soluble chromium(VI) compounds come close to the top of any published "hit list" of contact allergens (eczematogens) producing positive results in 4 to 10% of tested individuals. On the other hand only chromium(III) compounds can bind to high molecular weight carriers such as proteins to form a complete allergen (such as a hapten). Chromium(VI) compounds cannot.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

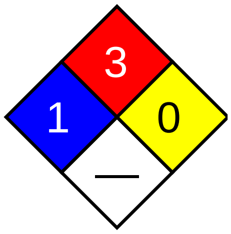
Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Noncombustible Solid

Autoignition Temperature: 580 °C (cloud)

LEL: Not applicable

UEL: Not applicable

Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.

These are the only suitable means for extinguishing metal dust fires.

Do NOT use water.

General Fire Hazards/Hazardous Combustion Products: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.

These are the only suitable means for extinguishing metal dust fires.

Do NOT use water.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.

Wear impervious gloves and safety glasses.

Remove all ignition sources.

Use dry clean-up procedures and avoid generating dust.

Vacuum up or sweep up.

Place spilled material in clean, dry, sealable, labeled container.

Large Spills: Clear area of personnel.

Contact fire department and tell them location and nature of hazard.

Control personal contact by using protective equipment.

Prevent, by any means available, spillage from entering drains or water ways.

Moderate hazard.

No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so.

Avoid generating dust.

Collect recoverable product into labeled containers for recycling.

Collect residues and seal in labeled drums for disposal.

Wash area down with large quantity of water and prevent runoff into drains.

After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.

Wear protective clothing when risk of exposure occurs.

Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.

Always wash hands with soap and water after handling.

Avoid physical damage to containers. Use good occupational work practices.

Observe manufacturer's storing and handling recommendations.

Recommended Storage Methods: Packaging as recommended by manufacturer.

Check that containers are clearly labeled.

Store in metal drums or safety cans.

Plastic container.

Metal can.

Metal drum.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Metal dusts must be collected at the source of generation as they are potentially explosive.

1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.

2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

Special ventilation requirements apply for processes which result in the generation of barium, chromium, lead, or nickel fume and in those processes which generate ozone.

The use of mechanical ventilation by local exhaust systems is required as a minimum in all circumstances (including outdoor work).

(In confined spaces always check that oxygen has not been depleted by excessive rusting of steel or snowflake corrosion of aluminum). Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVC gloves; Safety footwear.
Rubber gloves.

Respiratory Protection:
Exposure Range >1 to 10 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to <250 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 250 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)

Other: Overalls. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: A hard, brittle, lustrous, steel-grey metal which is very resistant to corrosion. Soluble in dilute sulphuric and hydrochloric acids. Welding flux grades typical sieve analysis (cumulative retention %):- 200 um 0, 150 um 10-40, 100 50-80, 75 um 80-95, 63 um 90-96, 43 um 97-100.

Physical State: Divided solid
Vapor Pressure (kPa): 0.13 at 1616 °C
Vapor Density (Air=1): 1.79
Formula Weight: 52.00
Specific Gravity (H_2O=1, at 4 °C): 7.2
Water Solubility: Insoluble in water
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 2642 °C (4788 °F)
Freezing/Melting Point Range: 1900 °C (3452 °F)
Volatile Component (% Vol): Nil
Decomposition Temperature (°C): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers, nitric oxide, potassium chlorate, sulfur dioxide, acids and strong alkalis.

Section 11 - Toxicological Information

No relevant toxicological data found at time of research.

See NIOSH, *RTECS* GB 4200000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
BCF: snails 1 x10^6
Biochemical Oxygen Demand (BOD): 62.5 lb/lb, 5 days

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options. Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: None
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.............................1999-11 **Review Date:** 2000-07

Chrysene
CHR8920

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

Material Name: Chrysene **CAS Number:** 218-01-9
Chemical Formula: $C_{18}H_{12}$
EINECS Number: 205-923-4
ACX Number: X1001743-5
Synonyms: BENZO (A) PHENANTHRENE; BENZO[A|PHENANTHRENE; 1,2-BENZOPHENANTHRENE; BENZO(A)PHENANTHRENE; 1,2-BENZPHENANTHRENE; BENZ(A)PHENANTHRENE; CHRYSENE; COAL TAR PITCH VOLATILES: CHRYSENE; 1,2,5,6-DIBENZONAPHTHALENE
Derivation: Distilled from coal tar, coal tar pitch. A small amount is produced from the distillation or pyrolysis of many fats and oils. By heating hydrogen and acetylene. Chrysene is not produced commercially in the U.S. (except as a laboratory research chemical).
General Use: Used in organic synthesis; as a research chemical. Occurs in cigarette smoke.

Section 2 - Composition / Information on Ingredients

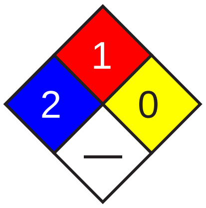
Name	CAS	%
No data found.		

OSHA PEL
TWA: 0.2 mg/m^3.

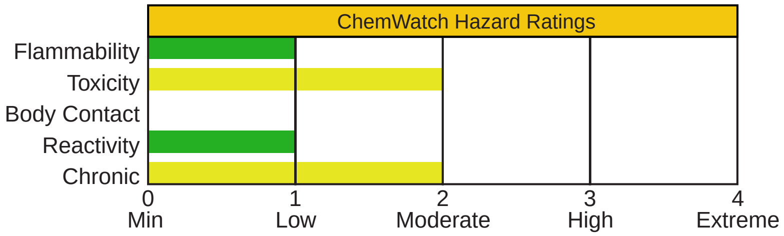
NIOSH REL

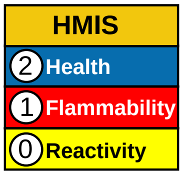
ACGIH TLV
Exposure by all routes should be carefully controlled to levels as low as possible.

Section 3 - Hazards Identification



Fire Diamond





HMIS	
2	Health
1	Flammability
0	Reactivity

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless to white crystals with reddish-blue fluorescence. May be irritating to eyes/skin/respiratory tract. Also causes: may be absorbed through skin. May be cancer-causing in humans. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, respiratory system
Primary Entry Routes: Skin absorption
Acute Effects *There is no human evidence available for the acute health effects of chrysene alone. There is, however, considerable data indicating that it is carcinogenic in humans. Based on the chemical properties of chrysene, as a polynuclear aromatic hydrocarbon, the following acute effects may occur.*
Inhalation: May cause irritation.
Eye: . May cause irritation.
Skin: May cause irritation or be absorbed.
Ingestion: None reported.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Animal data indicate that chronic exposure to chrysene and other coal tar pitch volatiles probably causes cancer. May also cause respiratory, skin, or eye irritation; cough, bronchitis, photosensitivity, "coal tar warts" (precancerous lesions enhanced by UV light exposure), erythema (skin inflammation), dermal burns, acneiform lesions, hematuria (blood in urine). May alter genetic material. Exposure to PAH's is believed to cause leukoplakia (precancerous patches on the tongue), lip and oral cavity cancers, and bladder cancer.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For high exposures, medical surveillance (skin, mouth, GI tract, respiratory system) may be necessary.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Combustible solid

Autoignition Temperature: None reported.

LEL: None reported.

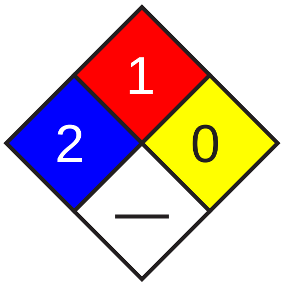
UEL: None reported.

Flammability Classification: Combustible solid

Extinguishing Media: Use water spray, carbon dioxide, dry chemical powder or appropriate foam.

General Fire Hazards/Hazardous Combustion Products: Acrid smoke and fumes, including carbon monoxide and carbon dioxide.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Tag container as defective and return to supplier. Use spark-proof tools and explosion-proof equipment.

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills: Large spills of chrysene are unlikely. *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid dust inhalation and skin and eye contact. Use only with adequate ventilation to maintain concentrations at nonhazardous levels (see Sec. 2). Wear personal protective clothing and equipment to prevent contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid dust dispersion into the work area. Ventilate at the site of chemical release. To prevent static sparks, electrically ground and bond all containers and equipment. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (see Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the skin and lungs.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Air purifying respirators may be adequate for handling small amounts of chrysene in a laboratory setting. For unlimited exposure ranges, wear a pressure-demand, full-face SCBA. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder clothing separately before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless to white rhombic plates with reddish-blue fluorescence.

Physical State: Solid

Vapor Pressure (kPa): 6.3 x10^{-7} mm Hg; 6.3 x10^{-9} mm Hg at 68 °F (20 °C)

Formula Weight: 228.28

Specific Gravity (H$_2$O=1, at 4 °C): 1.274 at 20 °C/4 °C

Refractive Index: 2610

Boiling Point: 838 °F (448 °C); sublimes easily in a vacuum

Freezing/Melting Point: 489 °F (254 °C) to 496 °F (258 °C)

Ionization Potential (eV): 7.59 +/- 0.2 eV

Water Solubility: Insoluble (0.0018 mg/kg)

Other Solubilities: Slightly soluble in 95% ethanol, acetone, carbon disulfide, ether, glacial acetic acid. Soluble in hot benzene, toluene.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Chrysene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid contact with chemical incompatibles, heat and ignition sources.

Storage Incompatibilities: Include strong oxidizers.

Hazardous Decomposition Products: Thermal oxidative decomposition of chrysene can produce acrid smoke and fumes, including carbon monoxide and carbon dioxide.

Section 11 - Toxicological Information

Acute Skin Effects:

Mouse, skin: 192 µmol/kg produced DNA adducts.

Mouse, skin, TD$_{Lo}$: 3600 µg/kg.

Other Effects:

Tumorgenicity, mouse, skin: 23 mg/kg; toxic effects: tumorigenic - neoplastic by RTECS criteria; skin and appendages - tumors.

Human, lymphocyte: 6 µmol/L produced mutation.

Mouse, intraperitoneal, LD$_{50}$: >320 mg/kg.

Tumorigenic Effects: Mouse, skin, 3600 mg/kg for 30 weeks, intermittent; toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors.

Hamster, intraperitoneal: 900 mg/24 hr induced sister chromatid exchange.

Bacteria, *S typhimurium*: 5 mg/plate (-S9) produced mutation.

See *RTECS* GC0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to water, it will adsorb very strongly to sediments and particulate matter, but will not hydrolyze or appreciably evaporate. It will bioconcentrate in species which lack microsomal oxidase. Calculated BCF: 4,230. K_{ow} indicates bioaccumulation, which could cause food-chain contamination. It will not hydrolyze or appreciably evaporate from soils or surfaces. The estimated biodegradation half-life in soil is 7 years. The estimated half-life of any gas phase in the atmosphere is 1.25 hours as a result of reaction with photochemically produced hydroxyl radicals. It will be subject to near-surface, direct photolysis with a half-life of 4.4 hours computed for exposure to sunlight at mid-day in midsummer at latitude 40°N. If released to air, it will be subject to direct photolysis, although adsorption to particulates may affect the rate of this process. If released to soil it will be expected to adsorb very strongly to the soil and will not be expected to leach appreciably to groundwater.

Ecotoxicity: *Anabaena flos-aquae* (algae), 2 weeks, EC_{35} growth: +/- 0.002 mg/L. *Daphnia magna* (crustaceans), 2 hr, LC_{50}: 1.9 mg/L. *Rana pipiens* (amphibians), 24 hr, LC_{50}: >6.7 mg/L. *Neanthes arenaceodentata* (fishes), 96 hr, LC_{50}: >1 mg/L.

Henry's Law Constant: 9.4×10^{-8}

Octanol/Water Partition Coefficient: $\log K_{ow} = 5.61$ to 5.91

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. One method is to dissolve or mix the material with a combustible solvent and burn in an incinerator equipped with an afterburner and scrubber. Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U050 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification 50/57

Material Name: Coal Tar Creosote **CAS Number:** 8001-58-9
Chemical Formula: No data found.
EINECS Number: 232-287-5
Synonyms: AWPA #1; BRICK OIL; COAL TAR CREOSOTE; COAL TAR CRESOTE; COAL TAR OIL; CREOSOTE; CREOSOTE OIL; CREOSOTE P1; CREOSOTE,FROM COAL TAR; CREOSOTUM; CRESYLIC CREOSOTE; DEAD OIL; EPA PESTICIDE CHEMICAL CODE 025004; HEAVY OIL; HODGSONS CREOSOTE; LIQUID PITCH OIL; NAPHTHALENE OIL; PRESERV-O-SOTE; SAKRESOTE 100; TAR OIL; WASH OIL
Derivation: By distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking.
General Use: Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, tap hole refractory cement, and lubricant for die molds. Used only in limited quantities as an animal and bird repellent, animal dip, and insecticide (ovicide).

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Coal tar creosote	8001-58-9	Consists of aromatic hydrocarbons,

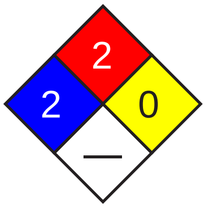
anthracene, naphthalene, and phenanthrene derivatives; some tar acids; and tar bases. Polycylic aromatic hydrocarbons make up at least 75%. * Creosote contains several carcinogenic polycyclic aromatic hydrocarbons including benz[a]anthracene, benzo[a]pyrene, and dibenz[a,h]anthracene.

OSHA PEL
No data found.

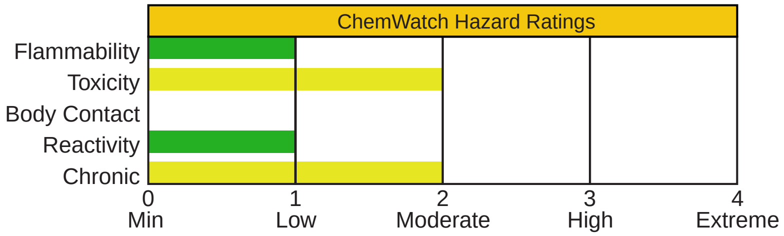
NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



Fire Diamond



HMIS
③ **Health**
② **Flammability**
⓪ **Reactivity**

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Coal tar creosote is a colorless (pure) or yellow to black (industrial) liquid with an aromatic smoky smell. It is irritating to the eyes, skin and respiratory tract and can be corrosive, causing severe burns. Coal tar creosote is a probable human carcinogen. It is a combustible liquid that is a moderate fire hazard when exposed to an ignition source.

Potential Health Effects

Target Organs: Eyes, skin, bladder, kidneys, and respiratory system
Primary Entry Routes: Inhalation, skin absorption, and skin and/or eye contact
Acute Effects *Note! Phenol and phenolic derivatives of various aromatic hydrocarbons (tar acids), present in low concentrations, are the constituents most likely to be responsible for acute toxicity.*
Inhalation: Inhalation of vapors causes moderate irritation to the nose, throat, and upper respiratory tract.
Eye: Contact with liquid causes conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. May cause loss of vision.

Skin: Contact causes irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur.

Ingestion: Causes salivation, nausea; vomiting; gastrointestinal tract irritation or bleeding; abdominal pain; rapid, thready pulse; vertigo; headaches; loss of pupillary reflexes; hypothermia; cyanosis; respiratory distress; shock and mild convulsions. Large doses may be fatal.

Carcinogenicity: NTP - Not listed; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B1, Probable human carcinogen based on epidemiologic studies; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Skin disorders.

Chronic Effects: Include dermatitis and, possibly, skin cancer or other forms of cancer. An increased risk of scrotal cancer for creosote-exposed brick makers was indicated in a worker mortality analysis. Epidemiological studies of coke oven workers reveal increased incidences of lung, bladder, prostate, pancreas, and intestinal cancer.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.

Skin Contact: *Quickly* remove contaminated clothing. Prior to washing and if readily available, use undiluted polyethylene glycol 300 to 400. Wash affected area with soap and flooding amounts of water for at least 15 min. *Do not* rub or apply pressure to the affected skin, apply any oily substance or use hot water to rinse. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Rinse the mouth several times with cold water. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not induce vomiting!* Keep victim warm and at rest.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Creosote may be detected in urine.

Special Precautions/Procedures: An exposed person should examine their skin periodically for growths, changes in warts or moles, and sores that do not heal.

Section 5 - Fire-Fighting Measures

Flash Point: 165.2 °F (74 °C), Closed Cup

Autoignition Temperature: 637 °F (336 °C)

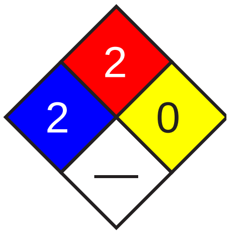
LEL: None reported.

UEL: None reported.

Flammability Classification: OSHA IIIA combustible liquid

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or regular foam. For large fires, use water spray, fog or regular foam.

General Fire Hazards/Hazardous Combustion Products: Include carbon oxides. Coal tar creosote may present a vapor explosion hazard indoors, outdoors, and in sewers. Vapors may travel to an ignition source and flash back.



Fire Diamond

Fire-Fighting Instructions: If feasible and without undue risk, remove containers from fire hazard area. Otherwise use water spray to cool fire-exposed containers until well after they are extinguished. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration as a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Fully decontaminate or properly dispose of personal protective clothing.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin and eye contact.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal.

Large Spills: Consider initial downwind evacuation for at least 300 meters (1000 feet). For large spills, dike far ahead of liquid spill for later disposal. Water spray may reduce vapor. *Do not* release into sewers or waterways. Use nonsparking tools during clean-up.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation and skin and eye contact. Use ventilation sufficient to reduce airborne exposures to nonhazardous levels (Sec. 2). Wear protective gloves, goggles, and clothing to avoid contact. Wear respiratory protection when necessary (Sec. 8). Consult your industrial hygienist. Practice good personal hygiene procedures to avoid inadvertently ingesting this material. Keep away from ignition sources.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat and ignition sources. Store coal tar creosote as close to area of use as possible to minimize transporting distance. Avoid physical damage to containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose all operations and/or ventilate at the site of release to avoid vapor dispersion into the work area. To prevent static sparks, electrically ground and bond all containers and equipment. Provide general or local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney disorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the attending physician considers appropriate. Educate workers about the health and safety hazards associated with coal tar creosote.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent any skin contact. With breakthrough times of >8 hr, butyl rubber, Teflon, and Viton are recommended materials. Frequent change of protective garments is an additional protective measure. Wear protective eyeglasses or chemical safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. (The following respirator recommendations are for coal tar pitch volatiles.) For concentrations above the NIOSH REL or at any detectable concentrations, wear a SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or 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 SCBA operated in pressure-demand or other positive-pressure mode. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air- purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless (pure) or yellow to black (industrial); aromatic smoky smell.

Physical State: Oily liquid

Specific Gravity (H_2O=1, at 4 °C): 1.07 to 1.08 at 68 °F (20 °C)

Boiling Point: 381 to 752 °F (194 to 400 °C)

Water Solubility: Slightly soluble

Other Solubilities: Soluble in alcohol; ether; glycerin; dimethyl sulfate; fixed or volatile oils; in solution of fixed alkali hydroxides.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid excessive heat and contact with chlorosulfonic acid.

Storage Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.

Hazardous Decomposition Products: Thermal oxidative decomposition of coal tar creosote can produce carbon oxides and thick, black, acrid smoke.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 725 mg/kg.
Mouse, oral, LD_{50}: 433 mg/kg.
Other Effects:
Tumorgenicity, mouse, oral: 2 g/kg administered on gestational days 5-9 produced maternal effects and fetotoxicity.
Reproductive Effects - Hamster, ovary cell: 10 mg/L induced sister chromatid exchange.
Tumorigenicity: Mouse, skin, 99 g/kg/33 weeks administered intermittently produced tumors on skin and appendages (carcinogenic by RTECS criteria).
S. typhimurium: 20 µg/plate (-S9) produced mutations.

See NIOSH, *RTECS* GF8615000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: TL50, goldfish (*Carassius auratus*), 3.51 ppm/24 hr (60:40) mixture of creosote and coal tar; TL50, rainbow trout (*Salmo gairdneri*), 3.72 ppm/24 hr (60:40) mixture of creosote and coal tar; LD_{50}, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
Octanol/Water Partition Coefficient: log K_{ow} = 1.0

Section 13 - Disposal Considerations

Disposal: Coal tar creosote is a good candidate for rotary kiln and fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Corrosive liquids, n.o.s.
Hazard Class: 8
ID No.: UN1760
Packing Group: I, II, or III*
Label: CORROSIVE

Additional Shipping Information: * See 49 CFR 173.137 to assign Packing Group.

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Cobalt
COB1000

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

Material Name: Cobalt **CAS Number:** 7440-48-4
Chemical Formula: Co
EINECS Number: 231-158-0
ACX Number: X1002885-2
Synonyms: AQUACAT; C.I. 77320; COBALT; COBALT-59; COBALT FUME; COBALT METAL DUST; COBALT METAL FUME; KOBALT; SUPER COBALT

Derivation: Recycled from superalloy, cemented carbide scrap, or spent catalyst. May be derived from ore through roasting and then thermal reduction with aluminum, electrolytic reduction of solutions, or leaching at high temperatures and pressures with ammonia or acid in an autoclave and then reducing with hydrogen.

General Use: Used as a pigment and for its magnetic properties in chemical manufacturing, electroplating, ceramics, lamp filaments, glass; as a drier in printing inks, paints and varnishes; trace element in fertilizers; catalyst; used in alloys, especially steels, for permanent and soft magnets and high speed tool steels; used in jet engines; treatment of cyanide poisoning; in the automobile industry, as a pigment in enamels and glazes; in the photographic and electrical industries; radioactive material used in medicine for diagnostic aid, biological and medical research, radiation therapy and cancer treatment; used in the cobalt bomb.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Cobalt	7440-48-4	ca 99.5 - 99.8% pure (powder)
	up to 99.99% pure (crystals)	

OSHA PEL
TWA: 0.1 mg/m^3.

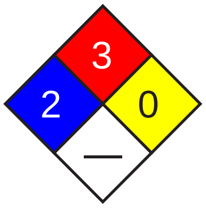
ACGIH TLV
TWA: 0.02 mg/m^3.

NIOSH REL
TWA: 0.05 mg/m^3.

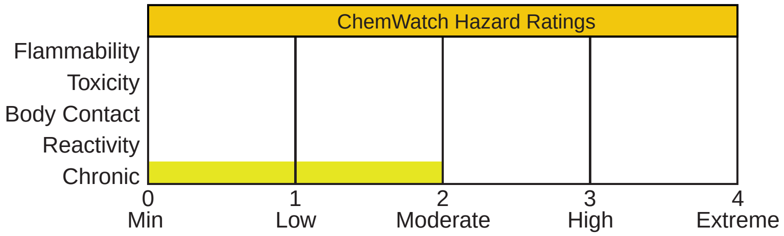
IDLH Level
20 mg/m^3 (as Co).

DFG (Germany) MAK
Danger of sensitization of the airways and the skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word

Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Gray to black powder or shiny metal; odorless. Irritating to eyes/skin/respiratory tract. Other Acute Effects: respiratory system damage, dermatitis, sensitization. Possible human carcinogen. Fine dust is pyrophoric. Forms explosive dust-air mixtures.

Potential Health Effects

Target Organs: Eyes, skin, respiratory system, kidneys, blood, cardiovascular system
Primary Entry Routes: Inhalation, skin and eye contact

Acute Effects

Inhalation: May cause irritation, allergic reaction, shortness of breath, fever, lack of appetite, cough, dyspnea (difficult breathing), wheezing, bronchitis, pulmonary edema (fluid in lungs), asthma.
Eye: Contact causes irritation, conjunctivitis (fumes).
Skin: Contact causes mild irritation, sensitization, allergic dermatitis.

Ingestion: May cause pain, nausea, vomiting, hypotension (low blood pressure), pericardial effusions (fluid in heart cavity), lung densities, nerve deafness, convulsions, thyroid enlargement.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: Persons with pre-existing respiratory or skin disorders should *not* work with cobalt. Protect patients with interstitial fibrotic lung disease, occupational reactive airway disease, or hypersensitivity from further exposure to cobalt. *Based on animal studies,* cobalt exposure may affect an unborn child if exposure occurs during pregnancy and may also have reproductive effects (see Sec. 11).

Chronic Effects: Chronic exposure to cobalt is more dangerous than isolated exposures. Chronic exposure may cause interstitial lung disease (may occur 4 to 16 years after exposure), obstructive airways syndrome (allergic reaction with wheezing, cough, shortness of breath), cardiomyopathy (heart disease), polycythemia (elevated red blood cell counts), hematuria (blood in urine), kidney, thyroid, and eye damage, weight loss, scarring of the lungs (fibrosis), chest pain and edema (fluid accumulation), possibly leading to death.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

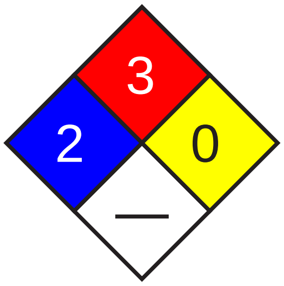
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Monitor red blood cell count, thyroid function, and arterial blood gases in patients with significant exposure.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: None reported; cobalt dust is flammable; bulk solid form is incombustible

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Extinguishing Media: *Do not* use water. Extinguish with dry chemical, sand, or carbon dioxide (CO_2).

General Fire Hazards/Hazardous Combustion Products: Cobalt oxides can be produced on heating. Fine black cobalt dust is pyrophoric in air. It may flare up after fire is out. *Dust

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Tag container as defective and return to supplier. Use spark-proof tools and explosion proof equipment. Cleanup personnel should protect against exposure.

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid dust inhalation and skin and eye contact. Use only with adequate ventilation to maintain concentrations at nonhazardous levels (see Sec. 2). Wear personal protective clothing and equipment to prevent contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material. *Do not* attempt to handle broken containers without proper protective equipment. Practice good housekeeping techniques that minimize accumulation of dust; cleaning procedures should not create dusty conditions.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid dust dispersion into the work area. Ventilate at the site of chemical release. To prevent static sparks, electrically ground and bond all containers and equipment. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (see Sec. 2). Local exhaust ventilation is preferred for it prevents contaminant dispersion into work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the skin and respiratory system.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For exposures <= 0.25 mg/m^3: any dust and mist respirator (if not present as a fume); <= 0.5 mg/m^3: any dust and mist respirator except single-use and quarter-mask respirators (if not present as a fume), or any dust, mist and fume respirator, or any supplied-air respirator; <= 1.25 mg/m^3: any supplied- air respirator operated in a continuous-flow mode, or any powered, air-purifying respirator with a dust and mist filter (if not present as a fume) or any powered, air-purifying respirator with a dust, mist and fume filter; <= 2.5 mg/m^3: any air-purifying, full-facepiece respirator with a high-efficiency particulate filter, any SCBA with a full facepiece, or any supplied-air respirator with a full facepiece; <= 20 mg/m^3: any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. Emergency or planned entry into unknown concentrations or IDLH conditions: any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or 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 SCBA operated in a pressure-demand or other positive-pressure mode. Escape: any air-purifying, full-facepiece respirator with a high- efficiency particulate filter, or any appropriate escape-type SCBA. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Shower and change clothes after exposure or at end of work shift. Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Ensure that cleaning personnel are aware of the hazards of cobalt and use cleaning procedures that do not create dusty conditions. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Gray to black powder or shiny metal; odorless.

Physical State: Solid; exists in two allotropic forms, hexagonal (alpha) and cubic (beta)

Formula Weight: 58.9332

Density: 8.92 g/cm^3 at 68 °F (20 °C)

Boiling Point: 5198 °F (2870 °C)

Freezing/Melting Point: 2719.4 °F (1493 °C)

Ionization Potential (eV): 7.8810 eV

Water Solubility: Insoluble

Other Solubilities: Soluble in dilute sulfuric acid, hydrochloric acid, nitric acid.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Cobalt is stable at room temperature in closed containers under normal storage and handling conditions. Some isotopes of cobalt undergo radioactive decay. Hazardous polymerization cannot occur. Avoid contact with chemical incompatibles, heat, and sources of ignition. *Do not* allow the powder to accumulate or form a potentially explosive dust cloud.

Storage Incompatibilities: Include acids and oxidizers. Fine black dust is pyrophoric in air. Reacts with incandescence with acetylene or nitryl fluoride. Reacts explosively with hydrazinium nitrate, ammonium nitrate + heat, and 1,3,4,7-tetramethy- lisoindole. Ignites on contact with bromine pentafluoride.

Hazardous Decomposition Products: Thermal oxidation of cobalt can produce oxides of cobalt (Co_xO_x).

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD$_{50}$: 6171 mg/kg produced toxic effects: behavioral - somnolence (general depressed activity), ataxia; gastrointestinal - hypermotility, diarrhea.

Rabbit, oral, LD$_{Lo}$: 750 mg/kg, toxic effects: behavioral - somnolence (general depressed activity).

Irritation Effects:

Rabbit, eye: unknown amount produced severe reaction with abscess involving lens, ciliary body, vitreous humor and retina.

Other Effects:

Rat, inhalation: 200 mg/m^3, 17 weeks, intermittent produced toxic effects: vascular - regional or general arteriolar or venous dilation; lung, thorax, or respiration - other changes; kidney, ureter, and bladder - changes in tubules (including acute renal failure, acute tubular necrosis).

Rat, unspecified exposure route: 0.05 mg/kg continuous, administered throughout gestation to female was embryotoxic.

Rat, intramuscular: 126 mg/kg produced toxic effects: tumorigenic - neoplastic by RTECS criteria; gastrointestinal - tumors; tumorigenic - tumors at site of application.

See *RTECS* GF8750000, for additional data.

Section 12 - Ecological Information

Environmental Fate: In water, cobalt is adsorbed greatly to hydrolysate or oxidate sediments. It may be taken into solution in small amounts through bacteriological activity. In soil, adsorption of cobalt is dependent on pH. At low pH, it is oxidized to trivalent cobalt and leaching and plant uptake are enhanced. At a pH of 6 - 7, divalent cobalt is adsorbed to soil colloids.

Ecotoxicity: Few plants accumulate cobalt at greater than 100 ppm, the level at which severe phytotoxicity would occur.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Whenever possible, recover cobalt for reuse or recycling. Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Cobalt resinate, precipitated
ID: UN1318
Hazard Class: 4.1 - Flammable solid
Packing Group: III - Minor Danger
Symbols:
Label Codes: 4.1 - Flammable Solid
Special Provisions: A1, A19, IB6
Packaging: **Exceptions:** 151 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed as Compound per CAA Section 112
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium Publishing Corp.
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Issue Date: 2000-07

Copper
MSDS 162
COP1000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Copper **CAS Number:** 7440-50-8
Chemical Formula: Cu
Structural Chemical Formula: Cu
Synonyms: ALLBRI NATURAL COPPER; ANAC 110; ARWOOD COPPER; BRONZE POWDER; C.I. 77400; C.I. PIGMENT METAL 2; CDA 101; CDA 102; CDA 110; CDA 122; CE 1110; COPPER; COPPER BRONZE; COPPER M 1; COPPER METAL DUSTS; COPPER METAL FUMES; COPPER POWDER; COPPER SLAG-AIRBORNE; COPPER SLAG-MILLED; COPPER-AIRBORNE; COPPER,METALLIC POWDER; COPPER-MILLED; CU M3; CUPRUM; E 115 (METAL); EPA PESTICIDE CHEMICAL CODE 022501; 1721 GOLD; GOLD BRONZE; KAFAR COPPER; M 1; M 3; M 4; M1 (COPPER); M2 (COPPER); M3 (COPPER); M3R; M3S; M4 (COPPER); OFHC CU; RANEY COPPER
General Use: Manufacture of bronzes, brass, other copper alloys, electrical conductors, ammunition, copper salts, works of art, catalyst, oxygen scavenger.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
copper	7440-50-8	>99

OSHA PEL
TWA: 0.1 mg/m^3; as Cu, fume.

NIOSH REL
TWA: 1 mg/m^3.

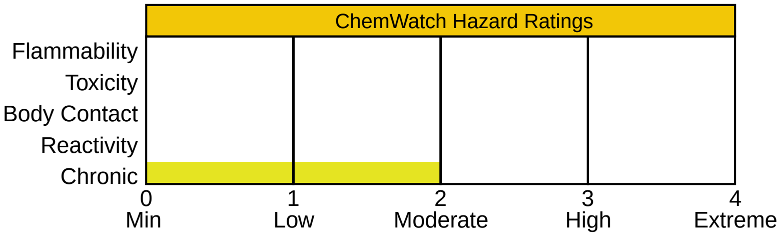
DFG (Germany) MAK
TWA: 0.1 mg/m^3.

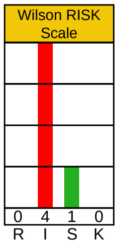
ACGIH TLV
TWA: 0.2 mg/m^3; as Cu; Inhalable.

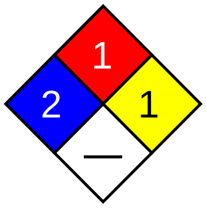
IDLH Level
100 mg/m^3; as Cu.

Section 3 - Hazards Identification

HMIS	
2	Health
0	Flammability
0	Reactivity







Fire Diamond

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Red/brown-colored powder; odorless. Irritating. Also causes: skin discoloration; ingestion: nausea, vomiting, abdominal pain, diarrhea. Inhalation of copper fume: metal fume fever. Chronic: respiratory disease, dermatitis.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion
Target Organs: respiratory system, skin, eyes, liver, kidneys
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Copper poisoning following exposure to copper dusts and fume may result in headache, cold sweat and weak pulse. Capillary, kidney, liver and brain damage are the longer term manifestations of such poisoning. Inhalation of freshly formed metal oxide particles sized below 1.5 microns and generally between 0.02 to 0.05 microns may result in "metal fume fever". Symptoms may be delayed for up to 12 hours and begin with the sudden onset of thirst, and a sweet, metallic or foul taste in the mouth.

Other symptoms include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalized feeling of malaise. Mild to severe headache, nausea, occasional vomiting, fever or chills, exaggerated mental activity, profuse sweating, diarrhea, excessive urination and prostration may also occur. Tolerance to the fumes develops rapidly, but is quickly lost. All symptoms usually subside within 24-36 hours following removal from exposure.

Nasal ulcerations with resultant nose-bleed may occur following inhalation of fine dusts.

Eye: Particulate/dust is regarded as discomforting and abrasive to the eyes.

Skin: The material may be slightly discomforting and abrasive to the skin.

Ingestion: The material may be mildly discomforting to the gastrointestinal tract if swallowed in large quantity.

Large oral doses may cause nausea, vomiting, abdominal pain, metallic taste and diarrhea. If vomiting does not occur immediately, systematic copper poisoning may occur; capillary damage, headache, cold sweat, weak pulse, kidney and liver damage may be the result of poisoning.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic exposure to copper dusts may result in runny nose, irritation of mucous membranes and atrophic changes with resultant dementia.

Pre-existing skin, kidney, liver and pulmonary disorders may be aggravated by exposure.

Chronic copper poisoning is rarely recognized in man although in one instance, at least, symptoms more commonly associated with exposures to mercury, namely infantile acrodynia (pink disease), have been described.

Tissue damage of mucous membranes may follow chronic dust exposure.

A hazardous situation is exposure of a worker with the rare hereditary condition (Wilson's disease or hereditary hepatolenticular degeneration) to copper exposure which may cause liver, kidney, CNS, bone and sight damage and is potentially lethal.

Hemolytic anemia (a result of red-blood cell damage) is common in cows and sheep poisoned by copper derivatives.

Overdosing of copper feed supplements has resulted in pigmentary cirrhosis of the liver.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.

Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.

Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Copper, magnesium, aluminum, antimony, iron, manganese, nickel (and their compounds) in welding, galvanizing or smelting operations all give rise to thermally produced particulates of smaller dimension than might be produced if the metals are divided mechanically. Where insufficient ventilation or respiratory protection is available these particulates may produce "metal fume fever" in the worker.

1.Onset occurs in 4-6 hours generally on the evening following exposure.

Tolerance develops in workers but may be lost over the weekend. (Monday Morning Fever).

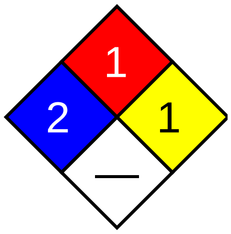
2.Pulmonary function tests may indicate reduced lung volumes, small airway obstruction and decreased carbon monoxide diffusing capacity but these abnormalities resolve after several months.

3.Although mildly elevated urinary levels of heavy metal may occur they do not correlate with clinical effects.

4.The general approach to treatment is recognition of the disease, supportive care and prevention of exposure.

5.Seriously symptomatic patients should receive chest x-rays, have arterial blood gases determined and be observed for the development of tracheobronchitis and pulmonary edema.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Noncombustible, except as a powder
Autoignition Temperature: Not applicable
Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.
General Fire Hazards/Hazardous Combustion Products: Does not burn.

Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.
Fire Incompatibility: Avoid contact with acetylene, ammonium nitrate, barium bromate, chlorate and iodate, bromates, phosphorus, potassium chlorate, potassium iodate, potassium peroxide, sodium azide, sodium chlorate and iodate, sodium peroxide, sulfur and chlorates.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Cool fire-exposed containers with water spray from a protected location.
Do not approach containers suspected to be hot.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Control personal contact by using protective equipment and dust respirator.
Prevent spillage from entering drains, sewers or waterways.
Avoid generating dust. Sweep, shovel up. Recover product wherever possible.
Put residues in labeled plastic bags or other containers for disposal.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling.
Avoid physical damage to containers. Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Glass container.
Plastic drum.
Polyethylene or polypropylene container.
Metal can.
Metal drum.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

Eyes: Safety glasses; safety glasses with side shields; chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: No special equipment needed when handling small quantities.
OTHERWISE: Wear chemical protective gloves, eg. PVC.

Respiratory Protection:
Exposure Range >0.1 to 1 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1 to 10 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >10 to 100 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >100 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)
Note: as a fume; if exposure is as a dust, respirator recommendations are different

Other: No special equipment needed when handling small quantities.
OTHERWISE: Overalls. Barrier cream. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Reddish metallic solid with high electrical conductivity. Odorless.

Physical State: Divided solid
Vapor Pressure (kPa): 0.13 at 1628 °C
Formula Weight: 63.5
Specific Gravity (H_2O=1, at 4 °C): 8.94
Water Solubility: Insoluble in water
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 2595 °C (4703 °F)
Freezing/Melting Point Range: 1083 °C (1981.4 °F)
Volatile Component (% Vol): Not applicable
Decomposition Temperature (°C): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with acetylene, ammonium nitrate, bromates, chlorates, chlorine, chlorine plus oxygen difluoride, chlorine trifluoride, ethylene oxide, fluorine, hydrazine, mononitrate, hydrozoic acid, hydrogen peroxide, hydrogen sulfide, iodates, lead azide, phosphorus, nitric acid, potassium peroxide, sodium azide, sodium peroxide, sulfur plus chlorates, and 1-bromo-2-propylene.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY	IRRITATION
Oral (human) TD_{Lo}: 0.12 mg/kg	Nil Reported

See NIOSH, *RTECS* GL 5325000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options. Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NONE
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.............................1999-11 **Review Date:** 2000-07

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Material Safety Data Sheet Collection

Genium group inc.

1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

o-Cresol
CRE4420

Section 1 - Chemical Product and Company Identification

Material Name: o-Cresol **CAS Number:** 95-48-7

Chemical Formula: C_7H_8O

Structural Chemical Formula: $CH_3C_6H_4OH$

EINECS Number: 202-423-8

ACX Number: X1004974-2

Synonyms: 2-CRESOL; O-CRESOL; ORTHO-CRESOL; O-CRESYLIC ACID; 1-HYDROXY-2-METHYLBENZENE; 2-HYDROXYTOLUENE; O-HYDROXYTOLUENE; O-KRESOL; 2-METHYL PHENOL; 2-METHYLPHENOL; O-METHYLPHENOL; O-METHYLPHENYLOL; ORTHOCRESOL; O-OXYTOLUENE; PHENOL,2-METHYL-; PHENOL,2-METHYL-(9CI); O-TOLUOL

General Use: as a disinfectant, solvent, resins, metal cleaner, food antioxidant, ore flotation, textile scouring agent, organic intermediate surfactant, cresylic acid constituent, additives to lubricating oil and insecticide; in the manufacturing of perfumes, dyes, plastic herbicides, tricresyl phosphate, salicylaldehyde and coumarin

Section 2 - Composition / Information on Ingredients

Name	CAS	%
o-cresol	95-48-7	>99

OSHA PEL
TWA: 5 ppm; 22 mg/m^3; skin.

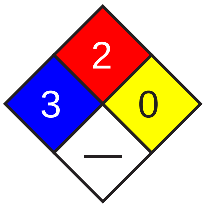
NIOSH REL
TWA: 2.3 ppm (10 mg/m^3).

DFG (Germany) MAK
Skin.

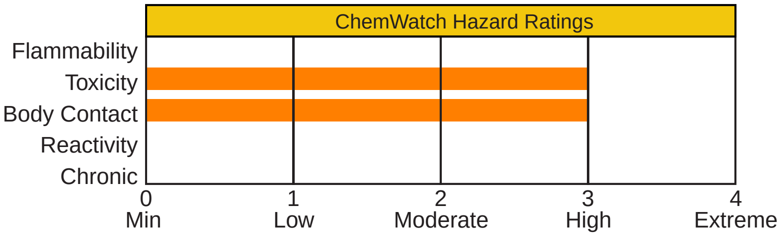
ACGIH TLV
TWA: 5 ppm; skin.

IDLH Level
250 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS

④ Health

② Flammability

⓪ Reactivity

ANSI Signal Word

Danger!

Poison

Corrosive

Explosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless to white crystalline solid; sweet tarry phenolic odor. Corrosive. Poison. Other Acute Effects: inflammation/edema/spasm of larynx/bronchi, sensation, coughing, shortness of breath, headache, nausea, CNS depression, dizziness, GI disturbances. Explosive. Combustible.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, nervous system, liver

Primary Entry Routes: skin absorption

Acute Effects

Inhalation: The vapor/mist is highly discomforting to the upper respiratory tract.

Eye: The material is highly corrosive to the eyes and is capable of causing severe damage with loss of sight. The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The material is highly corrosive to the skin, is rapidly absorbed and is capable of causing burns and ulceration. Exposure limits with "skin" notation indicate that vapor and liquid may be absorbed through intact skin. Absorption by skin may readily exceed vapor inhalation exposure. Symptoms for skin absorption are the same as for inhalation. Contact with eyes and mucous membranes may also contribute to overall exposure and may also invalidate the exposure standard. The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Ingestion: The material is highly corrosive to the gastrointestinal tract and may be fatal if swallowed. Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class C, Possible human carcinogen; MAK - Not listed.

Chronic Effects: Dilute solutions cause redness, vesiculation and burning of the skin. Chronic exposure to the skin can cause facial peripheral nerve damage, impairment of renal function and even necrosis of the liver and kidneys. Acute exposure by all routes of absorption may cause muscular weakness, gastroenteric disturbances, pancreas and spleen injury. In extreme cases it has been known to be a severe depressant of the cardiovascular system and the central nervous system, particularly the spinal cord. Symptoms of systemic absorption include: headache, nausea, shock, hypothermia, unconsciousness, respiratory failure and in some cases death.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: • If fumes or combustion products are inhaled, remove to fresh air.

- Lay patient down. Keep warm and rested.
- If breathing is shallow or has stopped, ensure clear airway and apply resuscitation, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital or doctor.

Eye Contact: • Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: • Remove contaminated clothing, swab repeatedly with glycerin, PEG (polyethylene glycol), or PEG/methylated spirit mixture or if necessary with methylated spirit alone.

- Contamination of skin with phenol and some of its derivatives may produce rapid collapse and death.
- After skin contamination, keep patient under observation for at least 24-48 hours.
- Phenol-decontaminating fluid is more effective than water in removing phenol from the skin and retarding absorption; olive oil or vegetable oil may also be used; do not use mineral oil.
- Alcohols (methylated spirit, for example) may enhance absorption and their use alone may be ill-advised; some authorities however continue to advise the use of such treatment.
- Rapid water dilution of phenol burns may increase systemic absorption by decreasing the extent of the coagulum and thus allowing greater absorption.

Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to phenols/cresols:

- Phenol is absorbed rapidly through lungs and skin. Massive skin contact may result in collapse and death
- Ingestion may result in ulceration of upper respiratory tract; perforation of esophagus and/or stomach, with attendant complications, may occur. Esophageal stricture may occur.
- An initial excitory phase may present. Convulsions may appear as long as 18 hours after ingestion. Hypotension and ventricular tachycardia that require vasopressor and antiarrhythmic therapy, respectively, can occur.
- Respiratory arrest, ventricular dysrhythmias, seizures and metabolic acidosis may complicate severe phenol exposures so the initial attention should be directed towards stabilization of breathing and circulation with ventilation, intubation, intravenous lines, fluids and cardiac monitoring as indicated.
- Vegetable oils retard absorption; do NOT use paraffin oils or alcohols. Gastric lavage, with endotracheal intubation, should be repeated until phenol odor is no longer detectable; follow with vegetable oil. A saline cathartic should then be given. ALTERNATELY: Activated charcoal (1g/kg) may be given. A cathartic should be given after oral activated charcoal.
- Severe poisoning may require slow intravenous injection of methylene blue to treat methemoglobinemia.
- Renal failure may require hemodialysis.
- Most absorbed phenol is biotransformed by the liver to ethereal and glucoronide sulfates and is eliminated almost completely after 24 hours.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Total phenol in blood	250 mg/g creatinine	End of shift	B,NS

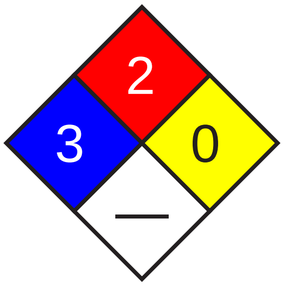
B: Background levels occur in specimens collected from subjects NOT exposed
NS: Non-specific determinant; also seen after exposure to other materials.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 81 °C Closed Cup
Autoignition Temperature: 599 °C
LEL: 1.35% v/v
Extinguishing Media: Water spray or fog. Dry chemical powder. Dry agent. Alcohol stable foam. Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: • Combustible. Vapor hazard when exposed to heat and flame.
- Emits toxic fumes and gases, including carbon monoxide(CO).

Fire Incompatibility: Avoid reaction with oxidizing agents.
Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or waterways.
- Use fire fighting procedures suitable for surrounding fire.
- Use water delivered as a fine spray to control the fire and cool adjacent area.
- Cool fire-exposed containers with water spray from a protected location.
- Do not approach containers suspected to be hot.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: • Remove all ignition sources.
- Clean up all spills immediately.
- Wear fully protective PVC clothing and breathing apparatus.
- Contain and absorb spill with sand, earth, inert material or vermiculite.
- Sweep up.
- Place in clean drum then flush area with water.

Large Spills: • Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard. Pollutant - contain spillage.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or waterways.
- If contamination of drains or waterways occurs, advise emergency services.
- Contain spill with sand, earth or vermiculite.
- Shut off all possible sources of ignition and increase ventilation.
- Stop leak if safe to do so.
- Collect recoverable product into labeled containers for recycling.
- Absorb remaining product with sand, earth or vermiculite.
- Collect, using a spark-free shovel, and seal in labeled drums for disposal.
- Wash spill area with large quantities of water.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
- If equipment is grossly contaminated, decontaminate and destroy.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Follow good occupational work practices.
- Avoid breathing vapors and contact with skin and eyes.
- Avoid all ignition sources.
- Avoid sources of heat.
- Wear personal protective equipment when handling.

- Handle and open container with care.
- When handling, DO NOT eat, drink or smoke.
- Use in a well-ventilated area.
- Keep containers securely sealed when not in use.
- Wash hands with soap and water after handling.
- Work clothes should be laundered separately: NOT at home.

Recommended Storage Methods: Check that containers are clearly labeled. Store in metal drums or safety cans. Steel drum. Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields. Chemical goggles. Full face shield. DO NOT wear contact lenses. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Rubber gloves. PVC gloves.
PVC boots.

Respiratory Protection: Respirator protection may be required. Consult your supervisor.

Other: PVC apron. PVC protective clothing. Eyewash unit. Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Solid crystals or liquid ranging from colorless to yellow but darkens with exposure to air and light. Sweet tar-like odor. Soluble in organic solvents, vegetable oils, ether, alcohol and benzene.

Physical State: colorless to white crystalline solid, liquid above 88 °F
Odor Threshold: 5 ppm
Vapor Pressure (kPa): 1 mm Hg at 38.2 °C
Vapor Density (Air=1): 3.72
Formula Weight: 108.15

Specific Gravity (H_2O=1, at 4 °C): 1.047 at 20 °C/4 °C
Boiling Point: 190.95 °C (376 °F) at 760 mm Hg
Freezing/Melting Point: 30.9 °C (87.62 °F)
Water Solubility: 1 parts in about 40 parts Water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable under normal handling and storage conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 121 mg/kg
Dermal (rabbit) LD_{50}: 890 mg/kg

Irritation
None reported

See *RTECS* GO6300000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When released to the atmosphere it will react with photochemically produced hydroxyl radicals (half-life 9.6 hr) during the day or react with nitrate radicals at night (half-life 2 min). In addition it will be scavenged by rain. When released into water, biodegradation will generally occur within days. However, in surface layers of oligotrophic waters, photolysis may be important. Its fate in soil has not been well characterized; it is mobile and will likely biodegrade, but little evidence is available.

Ecotoxicity: Aquatic toxicity: 49.1-19 ppm/24-96 hr/goldfish/TL_m/soft water; 22.2-20.8 ppm/24-96 hr/bluegill/TL_m/soft water; 18-13.4 ppm/24-96 hr/fathead minnow/TL_m/hard water; 18-50 ppm/24-96 hr/guppy/TL_m/hard water; Waterfowl toxicity: Chronic water fowl toxic limit is 25 ppm

Henry's Law Constant: 1.6 $x10^{-6}$

BCF: calculated at 18

Biochemical Oxygen Demand (BOD): 1.64 lb/lb, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 1.95

Soil Sorption Partition Coefficient: K_{oc} = brookston clay loam soil 22

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options. React the components and dispose using controlled incineration. Decontaminate empty containers. Recycle containers if possible, or dispose of in an authorized landfill. Follow applicable local, state, and federal regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Cresols, solid
ID: UN2076
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B,* 8 - Corrosive
Special Provisions: IB8, IP2, IP4, T7, TP2
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Cresols, liquid
ID: UN2076
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B,* 8 - Corrosive
Special Provisions: IB8, IP2, IP4, T7, TP2
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed U052 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 100 lb
  - **TPQ:** 1000/10000 lb
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Issue Date: 2006-06

p-Cresol
CRE5560

Section 1 - Chemical Product and Company Identification

Material Name: p-Cresol **CAS Number:** 106-44-5
Chemical Formula: C_7H_8O
Structural Chemical Formula: $CH_3C_6H_4OH$
EINECS Number: 203-398-6
ACX Number: X1001293-0
Synonyms: 4-CRESOL; P-CRESOL; PARA-CRESOL; P-CRESYLIC ACID; PARA-CRESYLIC ACID; 1-HYDROXY-4-METHYLBENZENE; 4-HYDROXYTOLUENE; P-HYDROXYTOLUENE; P-KRESOL; 4-METHYL PHENOL; 1-METHYL-4-HYDROXYBENZENE; P-METHYLHYDROXYBENZENE; 4-METHYLPHENOL; P-METHYLPHENOL; P-OXYTOLUENE; PARACRESOL; PARAMETHYL PHENOL; PHENOL,4-METHYL-; PHENOL,4-METHYL-(9CI); P-TOLUOL; P-TOLYL ALCOHOL
General Use: Used as antiseptics, insecticides and disinfectants. Incorporated in explosives, synthetic resins, petroleum, photographics, paints and is also used as an ore flotation agent. It can also be used as an intermediate for dyes, plastics and antioxidants.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
p-cresol	106-44-5	>99

OSHA PEL
TWA: 5 ppm; 22 mg/m^3; skin.

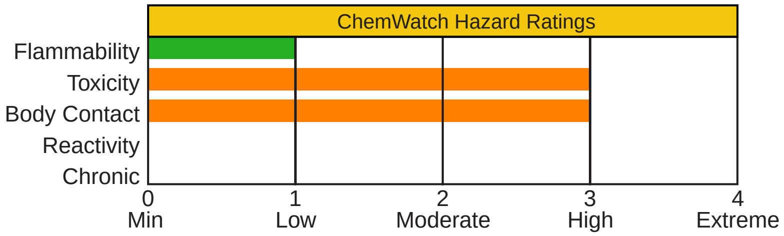
NIOSH REL
TWA: 2.3 ppm (10 mg/m^3).

DFG (Germany) MAK
Skin.

ACGIH TLV
TWA: 5 ppm; skin.

IDLH Level
250 ppm.

Section 3 - Hazards Identification



ANSI Signal Word

Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless white crystals; crystalline solid, liquid above 95 deg F; sweet, tarry odor. Corrosive. Toxic effects from skin absorption. Other Acute Effects: headache, nausea, dizziness, mental confusion, weak pulse, muscle weakness, cloudy vision, ringing in ears. Chronic Effects: high BP, kidney effects, nerve damage, excessive salivation. Combustible.

Potential Health Effects

Target Organs: Skin, eyes, respiratory tract, central nervous system, kidneys, liver
Primary Entry Routes: skin absorption
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract and lungs, may cause severe mucous membrane damage and is harmful if inhaled.
Inhalation of vapor may aggravate a pre-existing respiratory condition such as asthma, bronchitis, emphysema.
Eye: The material is corrosive to the eyes and is capable of causing severe damage with loss of sight.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Concentrated cresols instilled into the eyes of rabbits caused permanent opacification and vascularization.

Skin: The material is corrosive to the skin and it is rapidly absorbed through intact skin and may cause chemical burns if exposure is prolonged.

Bare unprotected skin should not be exposed to this material.

Toxic effects may result from skin absorption.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness and swelling, which may progress to vesiculation, scaling and thickening of the epidermis.

Histologically there may be intercellular edema of the spongy layer and intracellular edema of the epidermis.

Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Dilute solutions cause redness, vesiculation and burning of the skin. Skin absorption produces toxic effects within 30 minutes.

Acute cresol poisoning occurs from exposure by inhalation, combined with ingestion and skin absorption. Signs and symptoms may appear within 20-30 minutes including headache, stomach upset, depression, dizziness, mental confusion, irregular and rapid breathing, weak pulse, muscle weakness, cloudy vision and ringing in the ears.

The symptoms normally disappear after exposure stops. Severe exposure may produce loss of consciousness, lung damage (edema), damage to the kidney, liver, pancreas and spleen, and death. In extreme cases cresols are severe depressants of the cardiovascular system and the central nervous system, particularly the spinal cord.

Ingestion: The material is highly discomforting to the gastrointestinal tract, may cause severe mucous membrane damage and may be harmful if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Several cases of ingestion have shown cresol to be corrosive to body tissues and to cause toxic effects on the vascular system, liver, kidneys and pancreas.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class C, Possible human carcinogen; MAK - Not listed.

Chronic Effects: Chronic exposure to the skin can cause facial peripheral nerve damage, impairment of renal function and even necrosis of the liver and kidneys.

Symptoms of chronic poisoning are abundant production of saliva, vomiting, diarrhea, loss of appetite, headache, dizziness, mental disturbances and fainting. Contact dermatitis may also occur.

Workers exposed to cresol vapor for 1.5 to 3 years experienced headaches that were frequently accompanied by nausea and vomiting. Other symptoms included elevated blood pressure, signs of impaired kidney function, blood calcium imbalance and marked tremors.

Isomers of cresol are tumor promoters.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: • If fumes or combustion products are inhaled, remove to fresh air.

- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- If breathing is shallow or has stopped, ensure clear airway and apply resuscitation, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital or doctor.

Eye Contact: If this product comes in contact with the eyes:

- Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: If spilled on skin:

- Remove contaminated clothing, swab repeatedly with glycerin, PEG (polyethylene glycol), or PEG/methylated spirit mixture or if necessary with methylated spirit alone.
- Contamination of skin with phenol and some of its derivatives may produce rapid collapse and death.
- After skin contamination, keep patient under observation for at least 24-48 hours.
- Phenol-decontaminating fluid is more effective than water in removing phenol from the skin and retarding absorption; olive oil or vegetable oil may also be used; do not use mineral oil.
- Alcohols (methylated spirit, for example) may enhance absorption and their use alone may be ill-advised; some authorities however continue to advise the use of such treatment.
- Rapid water dilution of phenol burns may increase systemic absorption by decreasing the extent of the coagulum and thus allowing greater absorption.

Ingestion: Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Preplacement and annual medical examinations are recommended for workers exposed to cresol.

Preplacement examinations should include: (1) work histories evaluating preexisting disorders particularly of the lungs, liver, kidneys, pancreas, nervous and cardiovascular systems, and skin. (2) physical examination with emphasis on the lungs, liver, kidneys, pancreas, skin, and nervous and cardiovascular systems. (3) urinalysis that includes a microscopic examination. (4) additional tests such as complete blood counts, and liver and kidney function tests. Annual examinations should include the above tests, and monitor cases of skin abnormalities, such as scaling, crusting, or irritation.

For acute or short-term repeated exposures to phenols/cresols:

- Phenol is absorbed rapidly through lungs and skin. Massive skin contact may result in collapse and death.
- Ingestion may result in ulceration of upper respiratory tract; perforation of esophagus and/or stomach, with attendant complications, may occur. Esophageal stricture may occur.
- An initial excitory phase may present. Convulsions may appear as long as 18 hours after ingestion. Hypotension and ventricular tachycardia that require vasopressor and antiarrhythmic therapy, respectively, can occur.
- Respiratory arrest, ventricular dysrhythmias, seizures and metabolic acidosis may complicate severe phenol exposures so the initial attention should be directed towards stabilization of breathing and circulation with ventilation, intubation, intravenous lines, fluids and cardiac monitoring as indicated.
- Vegetable oils retard absorption; do not use paraffin oils or alcohols. Gastric lavage, with endotracheal intubation, should be repeated until phenol odor is no longer detectable; follow with vegetable oil. A saline cathartic should then be given. Alternatively: Activated charcoal (1g/kg) may be given. A cathartic should be given after oral activated charcoal.
- Severe poisoning may require slow intravenous injection of methylene blue to treat methemoglobinemia.
- Renal failure may require hemodialysis.
- Most absorbed phenol is biotransformed by the liver to ethereal and glucoronide sulfates and is eliminated almost completely after 24 hours.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
• Total phenol in blood	250 mg/g creatinine	End of shift	B, NS

B: Background levels occur in specimens collected from subjects not exposed.
NS: Non-specific determinant; also seen after exposure to other materials.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 86 °C Closed Cup
Autoignition Temperature: 559 °C
LEL: 1.1% v/v
Extinguishing Media: Water spray or fog. Alcohol stable foam. Dry chemical powder. Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: • Combustible.

- Slight fire hazard when exposed to heat or flame.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).
- May emit acrid smoke.
- Mists containing combustible materials may be explosive.
- Hot organic vapors or mist are capable of sudden spontaneous combustion when mixed with air even at temperatures below their published autoignition temperatures.
- The temperature of ignition decreases with increasing vapor volume and vapor/air contact times and is influenced by pressure change.
- Ignition may occur under elevated-temperature process conditions especially in processes performed under vacuum subjected to sudden ingress of air or in processes performed at elevated pressure, where sudden escape of vapors or mists to the atmosphere occurs.

Fire Incompatibility: Avoid reaction with strong oxidizers, strong bases, oleum, nitric acid and chlorosulfonic acid.

Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.

- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or waterways.
- Use fire fighting procedures suitable for surrounding fire.
- Do not approach containers suspected to be hot.
- Cool fire-exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Clean up all spills immediately. Environmental hazard - contain spillage. Absorbs water and carbon dioxide from the air. Avoid breathing vapors and contact with skin and eyes. Wear fully protective PVC clothing and breathing apparatus. Remove all ignition sources. Wipe up and absorb small quantities with vermiculite or other absorbent material. Trowel up/scrape up.

Large Spills:
- Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or waterways.
- Stop leak if safe to do so.
- Contain spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Neutralize/decontaminate residue.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
- If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Observe manufacturer's storage and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained. Avoid all personal contact, including inhalation. Avoid generating and breathing mist. and vapor. Wear protective clothing when risk of exposure occurs. Avoid smoking, bare lights, heat or ignition sources. Vapor may travel a considerable distance to source of ignition. Use in a well-ventilated area. Avoid contact with incompatible materials. Handle and open container with care. Do not spray directly on humans, exposed food or food utensils. When handling, do not eat, drink or smoke. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Check that containers are clearly labeled. Store in metal drums or safety cans. Steel drum.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Supplied-air type respirator may be required in special circumstances. An approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield. Do not wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Rubber gloves. Impervious gloves. Rubber boots.

Other: PVC apron.
PVC protective clothing.
Eyewash unit.
Ensure there is ready access to a safety shower.
Equipment should be kept clean and in working order.

Glove Selection Index:
PE/EVAL/PE .... Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Crystalline mass with phenol-like odor.

Physical State: colorless; white crystals; prisms or crystalline mass; crystalline solid, liquid above 95 °F

Odor Threshold: 0.2 to 0.46 ppb

Vapor Pressure (kPa): 0.04 mm Hg at 20 °C

Vapor Density (Air=1): 3.72

Formula Weight: 108.13

Specific Gravity (H_2O=1, at 4 °C): 1.0178 at 20 °C/4 °C

Evaporation Rate: 0.011 Butyl Acetate=1

pH: 5.5

Boiling Point: 201.9 °C (395 °F)

Freezing/Melting Point: 34.8 °C (94.64 °F)

Water Solubility: 2.5 g in 100 mL water at 50 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers, strong alkalis, oleum, nitric acid and chlorosulfonic acid.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 207 mg/kg
Dermal (rabbit) LD_{50}: 301 mg/kg

Irritation
Skin (rabbit): 517 mg/24 hr SEVERE
Eye (rabbit): 103 mg SEVERE

See *RTECS* GO6475000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When released to the atmosphere, it will react with photochemically produced hydroxyl radicals during the day (half-life 10 hr) and react with nitrate radicals at night (half-life 4 min). It will also be scavenged by rain. Biodegradation is expected to be the dominant loss mechanism when released into water. Volatilization, bioconcentration in fish, and adsorption to sediment will be unimportant and photolysis is only expected to be significant in surface waters of oligotrophic lakes. Experimental half-lives are only a few hours in eutrophic lakes and ponds but this may be preceded by an acclimation period ranging from hours to days. Half-lives in an oligotrophic lake, marine waters, and in water/sediment ecocores were 6, <4, and <2 days, respectively. Its fate in soil has not been extensively studied; it is mobile and will probably biodegrade.
Ecotoxicity: LC_{50}Crucian Carp 21 mg/l/24 hr /Conditions of bioassay not specified; LC_{50}Roach 17 mg/l/24 hr; LC_{100}Tetrahymena pyriformis 3.7 mmole/l/24 hr /Conditions of bioassay not specified; LC_{50}Trout embryos 4 mg/l/24 hr /Conditions of bioassay not specified
Henry's Law Constant: estimated at 9.6×10^{-7}
BCF: calculated at 18
Biochemical Oxygen Demand (BOD): 1.4 to 1.48 lb/lb, 5 days
Octanol/Water Partition Coefficient: log K_{ow} = 1.94
Soil Sorption Partition Coefficient: K_{oc} = brookston clay loam soil 49

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options. Evaporate or incinerate residue at an approved site or bury spilled material in an authorized landfill. Return empty containers to supplier or bury empty containers at an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Cresols, solid
ID: UN2076
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:

Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*, 8 - Corrosive
Special Provisions: IB8, IP2, IP4, T7, TP2
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Cresols, liquid
ID: UN2076
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:

Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*, 8 - Corrosive

Special Provisions: IB8, IP2, IP4, T7, TP2
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed U052 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

DDD
DDD5000

Section 1 - Chemical Product and Company Identification 61

Material Name: DDD **CAS Number:** 72-54-8

Chemical Formula: $C_{14}H_{10}Cl_4$

Structural Chemical Formula: $(ClC_6H_4)_2CHCHCl_2$

EINECS Number: 200-783-0

ACX Number: X1002931-9

Synonyms: BENZENE,1,1'-(2,2-DICHLOROETHYLIDENE)BIS(4-CHLORO-; 1,1-BIS(4-CHLOROPHENYL)-2,2-DICHLOROETHANE; 1,1-BIS(P-CHLOROPHENYL)-2,2-DICHLOROETHANE; 2,2-BIS(4-CHLOROPHENYL)-1,1-DICHLOROETHANE; 2,2-BIS(P-CHLOROPHENYL)-1,1-DICHLOROETHANE; 2,2-BIS(P-CHLOROPHENYL-1,1-DICHLOROETHANE; 4,4'-DDD; DDD; P,P'-DDD; 1,1-DICHLOOR-2,2-BIS(4-CHLOOR FENYL)-ETHAAN; 1,1-DICHLOR-2,2-BIS(4-CHLOR-PHENYL)-AETHAN; 1,1-DICHLOR-2,2-BIS(4-CHLORPHENYL)-AETHAN; 1,1-DICHLORO-2,2-BIS(4-CHLOROPHENYL)-ETHANE; 1,1-DICHLORO-2,2-BIS(4-CHLOROPHENYL)ETHANE; 1,1-DICHLORO-2,2-BIS(P-CHLOROPHENYL)ETHANE; 1,1-DICHLORO-2,2-BIS(PARACHLOROPHENYL)ETHANE; 1,1-DICHLORO-2,2-DI(4-CHLOROPHENYL)ETHANE; DICHLORODIPHENYL DICHLOROETHANE; P,P'-DICHLORODIPHENYLDICHLOROETHANE; P,P'-DICHLORODIPHENYL-2,2-DICHLOROETHYLENE; 1,1-DICLORO-2,2-BIS(4-CHLORO-FENIL)-ETANO; 1,1-DICLORO-2,2-BIS(4-CLORO-FENIL)-ETANO; DILENE; ENT 4,225; EPA PESTICIDE CODE 029101; ETHANE,1,1-DICHLORO-2,2-BIS(P-CHLOROPHENYL)-; ME-1700; ME-700; OMS 1078; RHOTHANE; RHOTHANE D-3; ROTHANE; P,P'-TDE; TDE; TETRACHLORODIPHENYLETHANE

Derivation: DDD is no longer produced or sold commercially in the USA. Prepared by chlorination of ethanol and subsequent condensation with chlorobenzene. DDD also occurs naturally as a degradation product of DDT.

General Use: Formerly used as a pesticide (dusts, emulsions, and wettable powders) for control of leaf rollers and other insects.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
DDD	72-54-8	ca >90% wt (*p, p*' isomer)

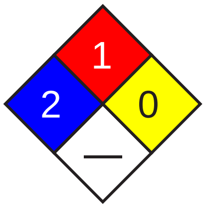
Trace Impurities: <= 10% *o, p*' isomer

OSHA PEL

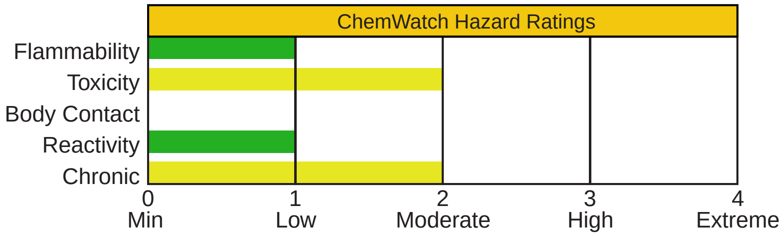
NIOSH REL

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
① Flammability
⓪ Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Odorless, colorless crystals. Irritating to eyes/skin/respiratory tract. Other Acute Effects: skin absorption with CNS and liver effects. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, respiratory tract, central nervous system, liver.

Primary Entry Routes: Inhalation, ingestion, skin absorption.

Acute Effects

Inhalation: Symptoms include irritation of the respiratory tract, nausea, vomiting, and excitement followed by lethargy (general tiredness). Exposure to DDD appears to result in less severe symptoms than exposure to its higher analogue, DDT.

Eye: Contact causes minor irritation.

Skin: Contact causes minor irritation. Absorption can cause systemic effects.

Ingestion: Ingestion causes CNS effects. The estimated fatal dose is 5 g/kg.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Liver disorders.

Chronic Effects: Repeated exposure can lead to liver damage and atrophy (deterioration) of the adrenal cortex. In general, exposure to organochlorine pesticides have been indicated in spontaneous abortions and premature delivery.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water. Consult an ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water followed by a soap and water wash. Consult a physician if pain or irritation persist.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Vomiting may be spontaneous.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: None reported. DDD is combustible, but does not ignite readily.

Autoignition Temperature: None reported.

LEL: None reported.

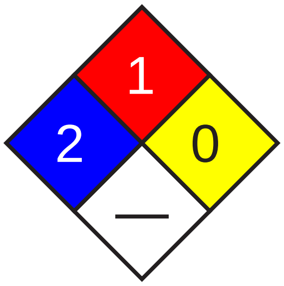
UEL: None reported.

Flammability Classification: Combustible solid

Extinguishing Media: Use dry chemical, carbon dioxide, regular foam, or water spray.

General Fire Hazards/Hazardous Combustion Products: Include chlorine and hydrogen chloride gas.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind.

Small Spills: Carefully scoop or vacuum (with appropriate filter) and place in suitable container for disposal.

Large Spills: Flush spill with water to containment area. Absorb with activated carbon. Do not release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Wear appropriate PPE to prevent inhalation, eye contact, and skin absorption. Never eat, drink, or smoke in work areas. Practice good personal hygiene after potential exposure to DDD, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from alkalis.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Since DDD is no longer produced in the USA, engineering controls are not normally applicable. However, when DDD is encountered through analysis and disposal procedures, it is important that processes are enclosed to prevent dispersion of DDD dusts or contaminated (DDD) soil through the work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of all workers potentially exposed to DDD. Emphasis should be placed on liver function.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse or plan for disposal. Remove DDD from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Odorless, colorless crystals.

Physical State: Solid

Vapor Pressure (kPa): 10.2 x 10^{-7} mm Hg at 86 °F (30 °C)

Formula Weight: 320.05

Density: 1.385 g/cm^3

Boiling Point: 379.4 °F (193 °C) at 1 mm Hg

Freezing/Melting Point: 228.2 to 230 °F (109 to 110 °C)

Water Solubility: 0.005 ppm

Other Solubilities: Soluble in organic solvents

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: DDD is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to ignition sources and alkalis.

Storage Incompatibilities: Alkalis.

Hazardous Decomposition Products: Thermal oxidative decomposition of DDD can produce chlorine gas.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 113 mg/kg.

Acute Skin Effects:

Rabbit, skin, LD_{50}: 1200 mg/kg caused primary irritation, excitement and convulsions or effect on seizure threshold, and death in 50% of test animals.

Other Effects:

Rat, oral: 54 g/kg/78 continuous weeks caused thyroid tumors.

Mouse embryo: 28,400 nmol/L caused oncogenic transformation.

See *RTECS* KI0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, DDD will absorb strongly with very little leaching to groundwater. In water, DDD will absorb strongly to sediment and bioconcentrate in aquatic animals. Hydrolysis is not appreciable; est. half-life is 570 days (pH 9) and 190 days (pH 5). Evaporation will be slow; est. half-life from a model river 1 m deep, flowing 1 m/sec with a wind velocity of 3 m/sec is 1.82 days. Biodegrades very slowly. Absorbs strongly to soil, sediment, and particulates.

Ecotoxicity: Japanese quail, LC_{50} = 3165 ppm ; mallard duck, LC_{50} = 4814 ppm; rainbow trout, LC_{50} = 70 µg/L/96 hr.

Octanol/Water Partition Coefficient: log K_{ow} = 6.02

Section 13 - Disposal Considerations

Disposal: DDD is a potential candidate for rotary kiln incineration. Activated carbon can be used to remove most DDD from wastewater (to levels < 1 mg/L). Contact a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Triple rinse containers before disposal or shipment to scrap metal facility.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Organochlorine pesticides, solid, toxic
ID: UN2761
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7, IP1
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** A **Other:** 40

Shipping Name and Description: Organochlorine pesticides, solid, toxic
ID: UN2761
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Shipping Name and Description: Organochlorine pesticides, solid, toxic
ID: UN2761
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging: **Exceptions:** 153 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U060 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1 lb (0.454 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Not listed

Section 16 - Other Information

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Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Dibenzofuran
DIB2100

Section 1 - Chemical Product and Company Identification

Material Name: Dibenzofuran **CAS Number:** 132-64-9
Chemical Formula: $C_{12}H_8O$
EINECS Number: 205-071-3
ACX Number: X1002923-7
Synonyms: (1,1'-BIPHENYL)-2,2'-DIYL OXIDE; 2,2'-BIPHENYLENE OXIDE; 2,2'-BIPHENYLYLENE OXIDE; DIBENZO(B,D)FURAN; DIBENZOFURAN; DIBENZOL(B,D)FURAN; DIPHENYLENE OXIDE
General Use: Intermediate. Heterocyclic aromatic hydrocarbon.

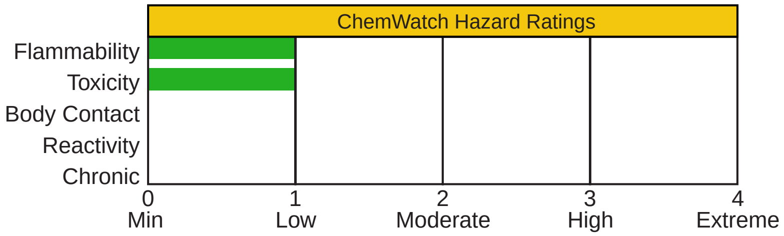
Section 2 - Composition / Information on Ingredients

Name	CAS	%
dibenzofuran	132-64-9	>98

OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, crystalline solid. May cause irritation. Also causes: may be harmful by inhalation, ingestion, or skin absorption. Will burn.

Potential Health Effects

Target Organs: No data found.
Primary Entry Routes: skin contact/absorption and inhalation of generated dust
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract.
Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to windburn), temporary impairment of vision and/ or other transient eye damage/ ulceration.
Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.
Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Chronic Effects: The so-called polycyclic aromatic hydrocarbons (PAHs) comprise a large family; some members occur in coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified, in animal studies, as amongst the most highly active carcinogens.
Administration of PAHs to Rhesus monkey on the other hand has not yet proved successful in yielding tumors and there is inadequate date to support the proposition that individual PAHs produce cancer in humans. There are however a number of epidemiology and mortality studies that show increased incidence of cancer in humans exposed to mixtures of PAHs. Evidence exists of lung and genito-urinary cancer mortality amongst coke-oven workers and skin tumors in

workers exposed to creosote. Exposures to other chemical mixtures containing PAHs such as cigarette smoke, coal tar, coal tar pitch and bitumens, have been associated with increased incidences of lung cancer in humans.

Section 4 - First Aid Measures

Inhalation: • If dust is inhaled, remove to fresh air.
- Encourage patient to blow nose to ensure clear breathing passages.
- Rinse mouth with water. Consider drinking water to remove dust from throat.
- Seek medical attention if irritation or discomfort persist.

Eye Contact: If this product comes in contact with the eyes:
- Immediately hold the eyes open and flush with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Seek medical attention if pain persists or recurs.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: If product comes in contact with the skin:
- Immediately remove all contaminated clothing, including footwear (after rinsing with water).
- Wash affected areas thoroughly with water (and soap if available).
- Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. Seek medical attention if irritation or discomfort persist.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: 130 °C

Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
- Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, i.e., flame or spark, will cause fire or explosion. Dust clouds generated by the fine grinding of the solid are a particular hazard; accumulations of fine dust may burn rapidly and fiercely if ignited
- Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
- Build-up of electrostatic charge may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting. Combustion products include carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.

Fire-Fighting Instructions: • Use water delivered as a fine spray to control fire and cool adjacent area.
- Do not approach containers suspected to be hot.
- Cool fire-exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: • Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Wear impervious gloves and safety glasses.
- Use dry clean up procedures and avoid generating dust.
- Vacuum up or sweep up.
- Place spilled material in clean, dry, sealable, labeled container.

Large Spills: • Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard.
- Control personal contact by using protective equipment and dust respirator.
- Prevent spillage from entering drains, sewers or waterways.
- Avoid generating dust.
- Sweep, shovel up. Recover product wherever possible.
- Put residues in labeled plastic bags or other containers for disposal.
- If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Limit all unnecessary personal contact.
• Wear protective clothing when risk of exposure occurs.
• Use in a well-ventilated area.
• When handling, do not eat, drink or smoke.
• Always wash hands with soap and water after handling.
• Avoid physical damage to containers.
• Observe manufacturer's storage and handling recommendations.

Recommended Storage Methods: Polyethylene or polypropylene container. Plastic carboy. Plastic drum. Polyliner drum. Packing as recommended by manufacturer. Check that all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions. If risk of overexposure exists, wear NIOSH-approved respirator. Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses; safety glasses with side shields; chemical goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear general protective gloves, e.g. light weight rubber gloves.

Other: Overalls; impervious protective clothing.
Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Tan powder.
Physical State: white, crystalline solid
Odor Threshold: 0.7752 to 1.6150 mg/m^3
Vapor Pressure (kPa): negligible
Vapor Density (Air=1): 5.8
Formula Weight: 168.19
Specific Gravity (H_2O=1, at 4 °C): 1.0886 at 99 °C/4 °C
Evaporation Rate: not applicable
pH: not applicable
pH (1% Solution): not applicable
Boiling Point: 287 °C (549 °F) at 760 mm Hg
Freezing/Melting Point: 86 °C (186.8 °F) to 87 °C (188.6 °F)
Volatile Component (% Vol): negligible
Water Solubility: < 1 mg/mL at 20 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

No significant acute toxicological data identified in literature search.

See *RTECS* HP4430000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it will exist primarily in the gas-phase where it will degrade relatively rapidly by reaction with photochemically produced hydroxyl radicals (estimated half-life of 11.3 hr in average air). A small percentage released to air will exist in the particulate phase which may be relatively persistent to atmospheric degradation. Physical removal from air can occur by both wet and dry deposition. If released to water, it may partition significantly from the water column to sediments and suspended material. Volatilization from the water column may be important; however, sorption to sediment may diminish the potential importance of volatilization. If released to soil, it is not expected to leach significantly in most soil types. Biological screening studies have shown that it is biodegraded readily by adapted microbes in the presence of sufficient oxygen. However, in various groundwaters or aquatic sediments where oxygen is limited or lacking, biodegradation may occur very slowly resulting in long periods of persistence.
Ecotoxicity: No data found.
Henry's Law Constant: estimated at 9.73×10^{-5}
BCF: fish 947
Octanol/Water Partition Coefficient: $\log K_{ow} = 4.12$
Soil Sorption Partition Coefficient: $K_{oc} = 4600$ to 6350

Section 13 - Disposal Considerations

Disposal: • Consult manufacturer for recycling options and recycle where possible.
• Follow applicable local, state, and federal regulations.
• Incinerate residue at an approved site.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: No data found.

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CAA Section 112 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection

Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Dibromochloromethane
DIB3530

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Dibromochloromethane **CAS Number:** 124-48-1
Chemical Formula: $CHBr_2Cl$
EINECS Number: 204-704-0
ACX Number: X1005119-5
Synonyms: CDBM; CHLORODIBROMOMETHANE; DIBROMOCHLOROMETHANE; METHANE,CHLORODIBROMO-; METHANE,DIBROMOCHLORO-; MONOCHLORODIBROMOMETHANE
General Use: Used as a laboratory reagent and a chemical intermediate in the manufacture of fire extinguishing agents, aerosols, propellants, refrigerants, and pesticides.

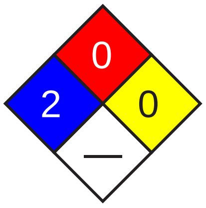
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Dibromochloromethane	124-48-1	ca 100% vol

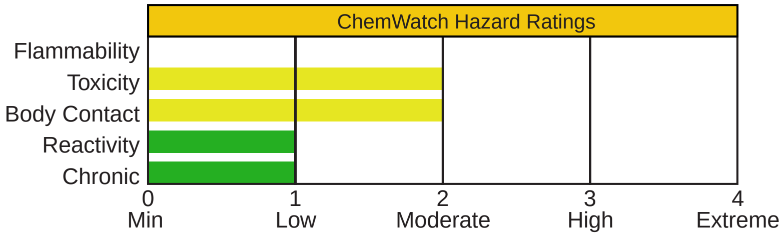
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
0	Flammability
0	Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, colorless to yellow liquid. Irritating to eyes/skin/respiratory tract. Other Acute Effects: causes varying degrees of CNS depression ranging from headache to unconsciousness.

Potential Health Effects

Target Organs: Eyes, skin, respiratory tract, central nervous system, liver.
Primary Entry Routes: Inhalation, eye and skin contact.
Acute Effects
Inhalation: Respiratory tract irritation, dizziness, headache, nausea and vomiting, possible unconsciousness, methemoglobinemia (presence of the non-oxygen carrying pigment, methemoglobin in the blood causing a lack of oxygenated blood in the body tissues), depression of REM (rapid eye movement) sleep, and liver damage.
Eye: Irritation.
Skin: Irritation.
Ingestion: Irritation of the gastrointestinal tract, nausea and vomiting, headache, dizziness, and possibly unconsciousness if large amounts are ingested.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class C, Possible human carcinogen; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Chronic Effects: Metabolism to carbon monoxide in the liver accounts for much of the methemoglobin produced and any liver damage. Exposure to acetone or chlordecone (kepone) potentiates the toxic effect of dibromochloromethane on the liver. Mutations have occured in animal studies.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Noncombustible.

Autoignition Temperature: Noncombustible.

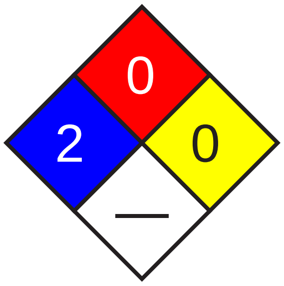
LEL: None reported.

UEL: None reported.

Extinguishing Media: Use agent suitable for surrounding fire.

General Fire Hazards/Hazardous Combustion Products: Carbon oxide(s), hydrogen chloride, bromine, and hydrogen bromide.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against inhalation and eye/skin contact.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers.

Large Spills: Dike far ahead of spill for later reclamation or disposal. *Do not* release into sewers or waterways. Damp mop any residue.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use only with adequate ventilation and appropriate PPE.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using dibromochloromethane, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from elevated temperatures and incompatibles (Sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose processes where possible to prevent vapor dispersion into work areas. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the liver.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. An organic vapor respirator may be necessary. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove dibromochloromethane from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to pale yellow.

Physical State: Liquid

Formula Weight: 208.28

Specific Gravity (H_2O=1, at 4 °C): 2.38

Refractive Index: 1.5482 at 68 °F (20 °C)

Boiling Point: 246.2 °F (119 °C)

Freezing/Melting Point: < -4 °F (< -20 °C)

Water Solubility: 4400 ppm at 71.6 °F (22 °C)

Other Solubilities: > 10% in acetone, benzene, ethyl ether, and ethanol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Dibromochloromethane is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does occur. Exposure to incompatibles.

Storage Incompatibilities: Strong bases, oxidizers, and magnesium.

Hazardous Decomposition Products: Thermal oxidative decomposition of dibromochloromethane can produce carbon oxide(s), hydrogen chloride, bromine, and hydrogen bromide gas(es).

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 370 mg/kg caused flaccid paralysis without anesthesia, somnolence, and tremor.

Mouse, oral, LD_{50}: 800 mg/kg caused changes in circulation, fatty liver degeneration, and hemorrhage.

Other Effects:

Rat, oral: 16.25 g/kg administered intermittently for 13 weeks caused fatty liver degeneration, changes in kidney tubules (including acute kidney failure) and death.

Rat, oral: 8,568 mg/kg administered intermittently for 9 weeks caused changes in RBC count, weight loss or decreased weight gain, and biochemical changes (transaminases).

Rat, oral: 14 g/kg administered intermittently for 14 days caused liver, kidney, and bladder changes, and death.

Tumorgenicity, mouse, oral: 52.5 g/kg administered continuously for 2 years caused liver tumors.

Human, lymphocyte: 400 µmol/L caused mutation.

S. typhimurium:10 mg/plate (+S9) caused mutation.

See *RTECS* PA6360000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, dibromochloromethane is moderately mobile and may leach to groundwater. Significant biodegradation can occur under anaerobic conditions, but not aerobic. In water, volatilization will occur with half-lives in rivers and streams ranging from 43 minutes to 16.6 days with an average of 46 hours. Aqueous hydrolysis can occur, but is not an important removal mechanism (half-life = 274 years). In the air, dibromochloromethane is expected to exist entirely in the vapor phase and undergo reaction with photochemically-produced hydroxyl radicals with an estimated half-life of 8.4 months.

Ecotoxicity: Data not found.

Henry's Law Constant: 8.5×10^{-4} atm/m^3 at 68 °F (20 °C)

Octanol/Water Partition Coefficient: log K_{ow} = 2.09 (calc.)

Section 13 - Disposal Considerations

Disposal: Dissolve or mix with a combustible solvent and burn in an incinerator equipped with an afterburner and scrubber. Wastewater treatment via three different concentration processes: solvent extraction, activated carbon, and resin absorption are investigated in the USEPA publication, *Management of Hazardous Waste Leachate*, EPA Contract No. 68-03-2766 p. E-191. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, liquid, n.o.s.
ID: UN3082
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, IB3, T4, TP1, TP29
Packaging: **Exceptions:** 155 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Material Safety Data Sheet Collection

Genium group inc.

1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

1,2-Dibromo-3-chloropropane
DIB3640

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: 1,2-Dibromo-3-chloropropane **CAS Number:** 96-12-8
Chemical Formula: $C_3H_5Br_2Cl$
Structural Chemical Formula: $BrCH_2CH(Br)CH_2Cl$
EINECS Number: 202-479-3
ACX Number: X1002622-5
Synonyms: BBC 12; BBCP; 1-CHLORO-2,3-DIBROMOPROPANE; 3-CHLORO-1,2-DIBROMOPROPANE; DBCP; 1,2-DIBROM-3-CHLOR-PROPAN; DIBROMCHLORPROPAN; 1,2-DIBROMO-3-CHLOROPROPANE; DIBROMOCHLOROPROPANE; 1,2-DIBROMO-3-CHLOROPROPANE (DBCP)-EM; 1,2-DIBROMO-3-CLORO-PROPANO; 1,2-DIBROOM-3-CHLOORPROPAAN; DURHAM NEMATICODE EM 17.1; EPA PESTICIDE CHEMICAL CODE 011301; FUMAGON; FUMAZON 86; FUMAZONE; FUMAZONE 86E; FUMAZONE 86; GRO-TONE NEMATODE GRANULAR; NEMABROM; NEMAFUME; NEMAGON; NEMAGON 20G; NEMAGON 20; NEMAGON 206; NEMAGON 90; NEMAGON SOIL FUMIGANT; NEMAGONE; NEMANAX; NEMANEX; NEMAPAZ; NEMASET; NEMATOCIDE; NEMATOCIDE EM 12.1; NEMATOCIDE EM 15.1; NEMATOCIDE SOLUTION EM 17.1; NEMATOX; NEMAZON; OS 1897; OS1897; OXY DBCP; PROPANE,1-CHLORO-2,3-DIBROMO-; PROPANE,1,2-DIBROMO-3-CHLORO-; SD 1897
General Use: Pesticide used as a soil fumigant to control nematodes during growth of field crops, vegetables, fruits and nuts, greenhouse and nursery crops and turf. US EPA suspended all registrations of end-use products during 1977, except for use on pineapples in Hawaii; this exception was revoked in 1985.

Section 2 - Composition / Information on Ingredients

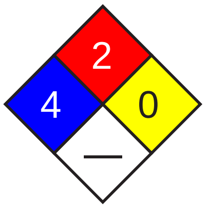
Name	CAS	%
1,2-dibromo-3-chloropropane	96-12-8	>98

OSHA PEL
TWA: 0.001 ppm; 29 CFR 1910.1044.

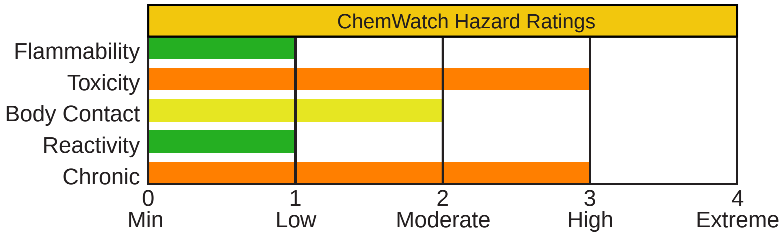
NIOSH REL

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS	
3	Health
2	Flammability
1	Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Amber-to-brown liquid; pungent odor. Irritating. Toxic. Other Acute Effects: pulmonary congestion/edema, CNS depression, malaise, headache, irritability. Chronic Effects: necrosis, dermatitis, infertility, severe liver/kidney damage. Possible cancer hazard. Combustible.

Potential Health Effects

Target Organs: central nervous system (CNS), skin, liver, kidneys, spleen, reproductive system, digestive system
Primary Entry Routes: inhalation, skin absorption
Acute Effects
Inhalation: The vapor is mildly discomforting to the upper respiratory tract. Inhalation hazard is increased at higher temperatures.

Low toxic concentrations have no strong warning odor.

Vapor concentrations of 60 ppm cause irritation of the eyes and respiratory tract, nausea, chills, central nervous system depression with apathy and ataxia and organ damage in rats. Deaths occurred within 72 hours. Degenerative kidney changes were noted in surviving animals with permanent scarring a feature. Secondary infections were common and recovery was slow.

In the case of iodized and brominated compounds, exposure effects cannot be described by simple central nervous system depression produced by other halogenated aliphatic hydrocarbons. Headache, nausea, ataxia (loss of muscle coordination), tremors, speech difficulties, visual disturbances, convulsions, paralysis, delirium, mania and apathy are all evidence of additional effects.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes.

The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin and may cause drying of the skin, which may lead to dermatitis.

Toxic effects may result from skin absorption.

Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).

This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.

Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Repeated application caused local necrosis of the dermis. Percutaneous absorption is enhanced by such carriers as propylene glycol and may result in systemic poisoning.

Ingestion: The liquid is highly discomforting and may be fatal if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Considered an unlikely route of entry in commercial/industrial environments.

Has caused human fatalities. Ingestion may result in acute gastrointestinal distress as well as pulmonary edema and organ damage, including disruption of spermatogenesis.

Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident, a single organ alone is (almost) never involved.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Not listed; EPA - Not listed; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Toxic effects are increased by consumption of alcohol.

Prolonged exposure to 12 ppm in laboratory animals including monkeys produced damage to kidney, sperm cells, seminiferous tubules, bronchioles, renal collecting tubes, lens, cornea and alimentary canal. Permanent eye may also result from chronic exposures to vapor. Pancytopenia in rats has also been recorded. Concentrations as low as 5 ppm have produced systemic effects including organ damage. Daily doses of 12 mg/kg for up to 73 weeks caused toxic tubular nephropathy in all rats tested. Affected kidneys often became fibrotic with scattered calcium deposits.

Production workers at several plants manufacturing DBCP have shown very low sperm counts. Decreased testicular size and increases in follicle stimulating hormone levels were also noted. It is unclear whether these disabilities are reversible.

When administered by gavage, 1,2-dibromo-3-chloropropane induced squamous cell carcinomas of the forestomach in rats and mice of both sexes and carcinomas of the mammary gland in female rats. Exposure by inhalation increased the incidence of adenocarcinomas and carcinomas or squamous cell carcinomas of the nasal cavity and squamous cell papillomas of the tongue in rats of both sexes, adrenal cortical adenomas of the pharynx in female rats. Inhalation also increased the incidence of carcinomas and squamous cell carcinomas of the nasal cavity in male mice; carcinomas, adenocarcinomas and squamous cell carcinomas of the nasal cavity in female mice; and alveolar/bronchiolar adenomas or carcinomas of the lung in mice of both sexes.

A cohort of chemical workers exposed to 1,2-dibromo-3-chloropropane and other compounds showed a slight increase in mortality from all cancers whilst another group showed a nonsignificant increase in mortality from cancer, especially lung cancer.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Avoid giving milk or oils.
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Do not give adrenalin (epinephrine) or related drugs.
Workers, other than pesticide applicators, who are accidentally exposed to DBCP spills must undergo immediate and late sperm counts and/or determination of serum levels of FSH, LH and testosterone (in males) and estrogen (in females).

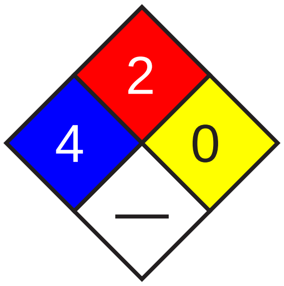
Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 76.667 °C Open Cup

Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Nonflammable liquid. However vapor will burn when in contact with high temperature flame. Ignition ceases on removal of flame.
May form a flammable/explosive mixture in an oxygen enriched atmosphere. Heating may cause expansion/vaporization with violent rupture of containers. Decomposes on heating and produces corrosive fumes of hydrochloric acid, carbon monoxide and small amounts of toxic phosgene.



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent spillage from entering drains or waterways.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Wipe up. Place in a suitable labeled container for waste disposal.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain or absorb spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.

Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid smoking, bare lights or ignition sources. When handling, DO NOT eat, drink or smoke. Avoid contact with incompatible materials.
Keep containers securely sealed when not in used. Avoid physical damage to containers. Always wash hands with soap and water after handling. Working clothes should be laundered separately.
Launder contaminated clothing before reuse.
Observe manufacturer's storing/handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check that all containers are clearly labeled and free from leaks.
DO NOT use aluminum or galvanized containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Butyl rubber gloves; Neoprene gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >0.001 to 0.05 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range >0.05 to 1 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >1 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless when pure or dark amber to dark brown liquid; miscible in aliphatic and aromatic hydrocarbons.

Physical State: Liquid
Odor Threshold: 0.0965 to 0.2895 mg/m^3
Vapor Density (Air=1): >1
Formula Weight: 236.35
Specific Gravity (H_2O=1, at 4 °C): 2.05
pH: Not applicable

pH (1% Solution): Not applicable
Boiling Point: 195.5 °C (384 °F) at 760 mm Hg
Freezing/Melting Point: 5 °C (41 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.1% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid reaction with oxidizing agents.
Avoid contact with water as the slow formation of hydrochloric acid results.
Haloalkanes are highly reactive. Some of the more lightly substituted lower members are highly flammable. Reaction with the lighter divalent metals may produce more reactive compounds analagous to Grignard reagents.
Prolonged contact with metal or other azides may produce explosive azides.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD$_{50}$: 170 mg/kg
Inhalation (rat) LC$_{50}$: 103 ppm/8 h
Subcutaneous (rat) LD$_{50}$: 100 mg/kg
Oral (mouse) LD$_{50}$: 257 mg/kg
Intraperitoneal (mouse) LD$_{50}$: 123 mg/kg
Oral (rabbit) LD$_{50}$: 180 mg/kg
Dermal (rabbit) LD$_{50}$: 1400 mg/kg
Reproductive effector in rats and rabbits
Olfaction, respiratory tract, kidney, adrenal cortex, and skin tumors, paternal effects, fetotoxicity, fetolethality and specific developmental abnormalities involving urogenital system recorded.
Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Irritation

Skin (rabbit): 10 mg - SEVERE
Eye (rabbit): 1% - mild

See *RTECS* TX 8750000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Released to soil it will likely volatilize or leach to groundwater. In alkaline soils, hydrolysis may be significant and biodegradation is possible but is expected to be slow relative to volatilization and leaching to groundwater. In water, it is expected to volatilize rapidly and hydrolyze slowly (half-life = 28 years at 25 °C). In groundwater, it is expected to persist due to its low estimated rate of hydrolysis (half-life = 141 years at 15 °C). Biodegradation may occur, but is expected to be slow relative to the rate of volatilization. Sorption to sediments and bioconcentration are not expected to be significant fate processes. In the atmosphere, vapor phase is expected to react with photochemically produced hydroxyl radicals with an estimated half-life of 12.19 days.

Ecotoxicity: LD$_{50}$ Anas platyrhynchos (mallard) 3-5 mo females oral 66.8 mg/kg (95% confidence limit 48.2-92.6 mg/kg) /95% active ingredient; LD$_{50}$ Phasianus colchicus (ring-necked pheasant 3-4 mo females 156 mg/kg (95% confidence limit 89.3-271 mg/kg) /95% active ingredient

Henry's Law Constant: estimated at 1.47 x10^{-4}

BCF: estimated at 11

Octanol/Water Partition Coefficient: log K$_{ow}$ = calculated at 2.43

Soil Sorption Partition Coefficient: K$_{oc}$ = 2.11

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Reclaim solvent at an approved site.
Evaporate or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Dibromochloropropane
ID: UN2872
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, T4, TP1
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U066 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 1 lb (0.454 kg)

SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification

Material Name: Dibutyl Phthalate **CAS Number:** 84-74-2
Chemical Formula: $C_{16}H_{22}O_4$
Structural Chemical Formula: $C_6H_4(CO_2C_4H_9)_2$
EINECS Number: 201-557-4
ACX Number: X1000920-8
Synonyms: AI-3-00283; 1,2-BENZENEDICARBOXYLIC ACID DIBUTYL ESTER; BENZENE-O-DICARBOXYLIC ACID DI-N-BUTYL ESTER; 1,2-BENZENEDICARBOXYLIC ACID,DIBUTYL ESTER; O-BENZENEDICARBOXYLIC ACID,DIBUTYL ESTER; BUTYL PHTHALATE; N-BUTYL PHTHALATE; N-BUTYLPHTHALATE; CELLUFLEX DPB; DBP; DBP (ESTER); DI BUTYL PHTHALATE; DIBUTYL 1,2-BENZENE-DICARBOXYLATE; DIBUTYL 1,2-BENZENEDICARBOXYLATE; DI-N-BUTYL PHTHALATE; DIBUTYL PHTHALATE; DI-N-BUTYLESTER KYSELINY FTALOVE; DIBUTYL-O-PHTHALATE; ELAOL; EPA PESTICIDE CHEMICAL CODE 028001; ERGOPLAST FDB; ERSOPLAST FDA; GENOPLAST B; HATCOL DBP; HEXAPLAS M/B; KODAFLEX DBP; PALATINOL C; PHTHALIC ACID DIBUTYL ESTER; PHTHALIC ACID,DIBUTYL ESTER; POLYCIZER DBP; PX 104; RC PLASTICIZER DBP; STAFLEX DBP; UNIFLEX DBP; UNIMOLL DB; WITCIZER 300
Derivation: Esterification of phthalic anhydride and butanol in the presence of sulfuric acid.
General Use: Used as an insect repellent for the impregnation of clothing; plasticizer in nitrocellulose lacquers, elastomers, explosives, and nail polish; as a solvent for perfumes, oils, textiles, lubricating agent, safety glass, and other chemicals.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Dibutyl phthalate	84-74-2	ca 100% vol

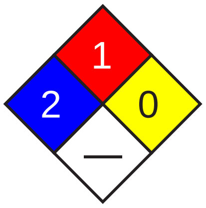
OSHA PEL
TWA: 5 mg/m^3.

NIOSH REL
TWA: 5 mg/m^3.

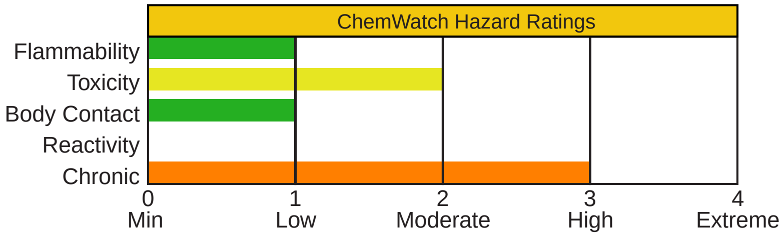
ACGIH TLV
TWA: 5 mg/m^3.

IDLH Level
4000 mg/m^3.

Section 3 - Hazards Identification



Fire Diamond



HMIS
① Health
① Flammability
⓪ Reactivity

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆
Oily, colorless to faint-yellow liquid; mild, ester odor. Irritating to skin. Other Acute Effects: possible allergic dermatitis, systemic toxicity can lead to conjunctivitis/kidney toxicity. Combustible.

Potential Health Effects

Target Organs: Skin, eyes, respiratory tract, kidneys.
Primary Entry Routes: Skin and eye contact, ingestion, inhalation.
Acute Effects
Inhalation: Because dibutyl phthalate has a low vapor pressure, it does not present a significant inhalation hazard unless heated or misted. Some respiratory tract irritation may occur.

Eye: Direct contact may cause irritation. Systemic toxicity can cause photophobia, lacrimation (watering), conjunctivitis, and swelling of the eyelids.

Skin: Irritation and contact burns are possible, but do not occur frequently. Allergic dermatitis has been reported after using antiperspirants and contact with plastics containing dibutyl phthalate (such as a watchband).

Ingestion: Accidental ingestion of 10 g (~40 mg/kg) in one person produced nausea and vomiting, dizziness, photophobia, swelling of the eyelids, watering of the eyes and conjunctivitis, and kidney toxicity (characterized by the presence of red and white blood cells and oxalate crystals in the urine).

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Workers in the artificial leather industry were studied and it was found that exposure to 1.7 to 66 mg/m^3 over a period of 19 years showed central nervous system toxicity after 6 to 7 years. Symptoms included pain, numbness, weakness, and spasms in the upper and lower extremities. Because there was concurrent exposure to other phthalates and a few adipates and sebacates, dibutyl phthalate cannot be singled out as the direct cause.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: If respiratory tract irritation is present, monitor pulmonary function tests and perform a chest x-ray. Support respiratory and cardiovascular function.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 315 °F (157.22 °C) CC; 354 °F (179 °C) OC

Autoignition Temperature: 757 °F (402 °C)

LEL: 0.5% v/v at 456 °F (235 °C)

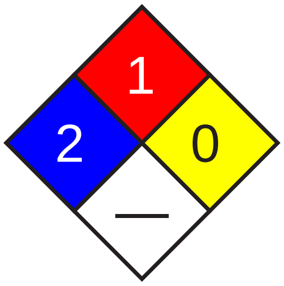
UEL: 2.5% v/v

Flammability Classification: Class IIIB Combustible Liquid

Extinguishing Media: Use dry chemical or carbon dioxide. Water spray and foam may cause frothing.

General Fire Hazards/Hazardous Combustion Products: Carbon oxide(s). Container may explode in heat of fire.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against inhalation and skin/eye contact.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers.

Large Spills: Dike far ahead of spill for later disposal. *Do not* release into sewers or waterways. Damp mop any residue.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use only with adequate ventilation and appropriate PPE. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using dibutyl phthalate, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around dibutyl phthalate. Provide general or local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin and kidneys.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyvinyl alcohol, fluorocarbon rubber, butyl rubber, and nitrile rubber are suitable materials for PPE with breakthrough times (BT) of > 8 hr. *Do not* use neoprene (BT = 1 to 4 hr), polyvinyl chloride, or natural rubber (BT < 1 hr). Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For <= 50 mg/m^3, use any dust and mist respirator with a full facepiece. For <= 125 mg/m^3, use any supplied-air respirator operated in continuous flow mode or any powered, air-purifying respirator with a dust and mist filter. For <= 250 mg/m^3, use any air-purifying full facepiece respirator with a high-efficiency particulate filter, any SCBA with a full facepiece, or any supplied-air respirator with a full facepiece. For <= 4000 mg/m^3, use any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove dibutyl phthalate from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Oily, colorless to faint yellow; mild ester odor; strong bitter taste.

Physical State: Liquid

Vapor Pressure (kPa): 1.1 mm Hg at 302 °F (150 °C); < 0.1 mm Hg at 68 °F (20 °C)

Bulk Density: 8.72 lb/gal at 68 °F (20 °C)

Formula Weight: 278.34

Specific Gravity (H_2O=1, at 4 °C): 1.0459 at 68 °F (20 °C)

Refractive Index: 1.4911 at 68 °F (20 °C)

Boiling Point: 644 °F (340 °C)

Freezing/Melting Point: -31 °F (-35 °C)

Viscosity: 0.203 poise at 68 °F (20 °C)

Surface Tension: 34 dyne/cm at 68 °F (20 °C)

Critical Temperature: 932 °F (500 °C)

Critical Pressure: 17 atm

Water Solubility: 13 mg/L at 77 °F (25 °C)

Other Solubilities: Soluble in alcohol, acetone, ether, and benzene.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Dibutyl phthalate is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, ignition sources, and incompatibles.

Storage Incompatibilities: Oxidizers, nitrates, acids, alkalis, and liquid chlorine (explosive reaction).

Hazardous Decomposition Products: Thermal oxidative decomposition of dibutyl phthalate can produce carbon oxides.

Section 11 - Toxicological Information

Acute Oral Effects:
Human, oral, TD_{Lo}: 140 mg/kg caused hallucinations, distorted perceptions, nausea and vomiting, and kidney and bladder changes.
Acute Inhalation Effects:
Rat, inhalation, LC_{50}: 4250 mg/m^3.
Acute Skin Effects:
Rat, skin, LD_{Lo}: 6 g/kg.
Other Effects:
Rat, oral: 22.75 mg/kg administered continuously for 1 yr. affected food intake and caused death.
Rat, oral: 28 g/kg administered intermittently for 14 days caused changes in testicular weight and death.
Rat, oral: 8400 mg/kg (male, 7 days prior to mating) affected the testes, epididymis, and sperm duct.
S. typhimurium: 100 µg/plate (+ S9) caused mutation.

See *RTECS* TI0875000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, dibutyl phthalate will adsorb moderately and slowly biodegrade (66 to 98% degradation in 26 weeks). Some leaching to groundwater can occur. In water, it is expected to adsorb to particulates and sediment (especially those high in fulvic acids). Volatilization is not rapid but can occur with a half-life of 47 days from a river 1 m deep, flowing 1 m/sec. with a wind speed of 3 m/sec. Hydrolysis does not normally occur except in oligotrophic, alkaline waters (half-life = 76 days at pH 9). In air, the majority of dibutyl phthalate remains in the particulate phase and is subject to gravitational settling. The small amount that exists in the vapor phase will react with photochemically-produced hydroxyl radicals with an estimated half-life of 18 hr.
Ecotoxicity: Bluegill, TL_m: 1234 ppm/24 hr; *Gymnodinium breve* (algae), LC_{50} = 200 µg/L/96 hr
Henry's Law Constant: 1.09×10^{-6} atm/m^3/mole
Octanol/Water Partition Coefficient: $\log K_{ow} = 4.9$

Section 13 - Disposal Considerations

Disposal: Dibutyl phthalate is a good candidate for liquid injection incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, liquid, n.o.s.
ID: UN3082
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, IB3, T4, TP1, TP29
Packaging: **Exceptions:** 155 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U069 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

1,1-Dichloroethane
MSDS 830
ETH8150

Section 1 - Chemical Product and Company Identification 54.1

Material Name: 1,1-Dichloroethane **CAS Number:** 75-34-3
Chemical Formula: $C_2H_4Cl_2$
Structural Chemical Formula: Cl_2CHCH_3
Synonyms: AETHYLIDENCHLORID; ASYMMETRICAL DICHLOROETHANE; CHLORINATED HYDROCHLORIC ETHER; CHLORURE D'ETHYLIDENE; CLORURO DI ETILIDENE; 1,1-DICHLOORETHAAN; 1,1-DICHLORAETHAN; 1,1-DICHLORETHANE; 1,1-DICHLOROETHANE; ALPHA ALPHA DICHLOROETHANE; DICHLOROETHANE,1,1-; 1,1-DICLOROETANO; ETHANE,1,1-DICHLORO-; ETHYLIDENE CHLORIDE; 1,1-ETHYLIDENE DICHLORIDE; ETHYLIDENE DICHLORIDE
General Use: Extraction solvent, fumigant.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,1-dichloroethane	75-34-3	>99

OSHA PEL
TWA: 100 ppm; 400 mg/m^3.

NIOSH REL
TWA: 100 ppm; 400 mg/m^3.

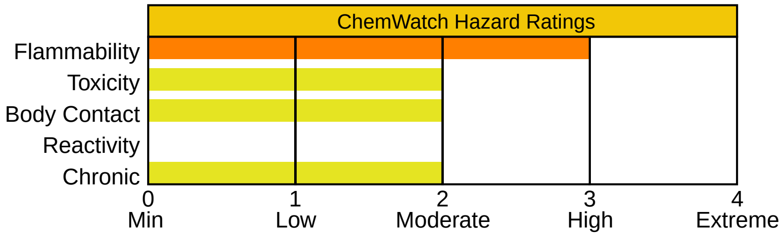
DFG (Germany) MAK
TWA: 100 ppm; 400 mg/m^3.

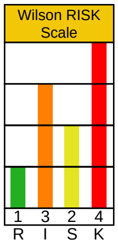
ACGIH TLV
TWA: 100 ppm; 405 mg/m^3.

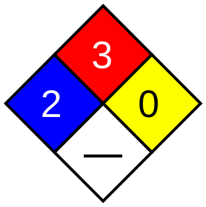
IDLH Level
3000 ppm.

Section 3 - Hazards Identification

HMIS	
2	Health
3	Flammability
0	Reactivity







Fire Diamond

ANSI Signal Word

Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; chloroform odor. Irritating to eyes/skin/respiratory tract. Also causes: dizziness, coughing, staggering, disturbed vision, irregular heartbeat, unconsciousness, coma, pulmonary edema. Chronic: rash, neurological effects. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact
Target Organs: skin, central nervous system (CNS), liver, kidneys
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and lungs.

1,1-dichloroethane is reported to produce salivation, sneezing and coughing in exposed workers. In the few cases of reported intoxication the anticipated anesthetic effects have been observed with associated dizziness, nausea and vomiting. In severe or fatal cases hepatic and renal injury has been described.

Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.

Depression of the central nervous system is the most outstanding effect of most halogenated aliphatic hydrocarbons. Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin).

Eye: The liquid is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The liquid is discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis from repeated exposures over long periods or if exposure is prolonged.

The liquid may cause more severe response, even a burn, if exposure is prolonged.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is discomforting to the gastrointestinal tract and harmful if swallowed. Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class C, Possible human carcinogen; MAK - Not listed.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Excessive exposure may cause kidney injury; liver injury is not likely.

Birth defects are unlikely. Even exposures having an adverse effect on the mother should have no effects on the fetus.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

Avoid giving milk or oils.

Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically. For ingestion, consider gastric lavage.

Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

Section 5 - Fire-Fighting Measures

Flash Point: 13.889 °C Open Cup

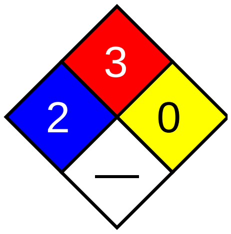
Autoignition Temperature: 458 °C

LEL: 5.6% v/v

UEL: 11.4% v/v

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.

Water spray or fog - Large fires only.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.

Severe fire hazard when exposed to heat, flame and/or oxidizers.

Vapor forms an explosive mixture with air.

Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.

Heating may cause expansion/decomposition with violent rupture of containers.

On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include hydrogen chloride, phosgene and carbon dioxide (CO_2).

Fire Incompatibility: Avoid reaction with strong oxidizing agents, alkalis, amines, aluminum and its alloys.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

Fight fire from a safe distance, with adequate cover.

If safe, switch off electrical equipment until vapor fire hazard removed.

Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Metal safety cans.
Packing as supplied by manufacturer.
Plastic containers may only be used if approved for flammable liquid.
Check that containers are clearly labeled and free from leaks.
DO NOT use aluminum containers.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.
Respiratory Protection:
Exposure Range >100 to <3000 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 3000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties

Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.

Glove Selection Index:
VITON.......................................C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, neutral, volatile mobile liquid with a chloroform odor and a sweet taste similar to saccharin. Mixes with alcohol, ether, acetone and benzene.

Physical State: Liquid
Vapor Pressure (kPa): 24.34 at 20 °C
Vapor Density (Air=1): 3.42
Formula Weight: 98.96
Specific Gravity (H_2O=1, at 4 °C): 1.174
Water Solubility: 0.5 g/100 ml water at 20 °C
Evaporation Rate: 11.6 (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 57.3 °C (135 °F)
Freezing/Melting Point Range: -96.9 °C (-142.42 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with strong oxidizing agents, alkalis, amines, aluminum and its alloys.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 725 mg/kg	Nil reported
Inhalation (rat) LC_{Lo}: 16000 ppm/4h	
Equivocal tumorigenic agent by RTECS criteria.	

See NIOSH, *RTECS* KI 0175000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on land, it will rapidly volatilize, although it may also leach into groundwater where its fate is unknown. Bioconcentration in aquatic organisms will not be important. If released in water it will be removed by volatilization with a half-life of 6-9 days, 5-8 days, and 24-32 hr, respectively in a typical pond, lake, or river. In the atmosphere, it will degrade (half-life 62 days) by reaction with photochemically produced hydroxyl radicals, and it will be scavenged by rain.
Ecotoxicity: LC_{50} Lepomis macrochirus (bluegill) 550 ppm/96 hr, static bioassay in fresh water at 23 °C; mild aeration applied after 24 hr (no specific isomer; LC_{50} Poecilia reticulata (guppies) 202 ppm/7 days. /Conditions of bioassay not specified; TLm Lagodon rhomboides (pinperch) 160 mg/l/24 hr. /Conditions of bioassay not specified; TLm Artemia salina (brine shrimp) 320 mg/l/24 hr. /Conditions of bioassay not specified
BCF: estimated at 1.3
Biochemical Oxygen Demand (BOD): 0.05 g/g, 10 days
Octanol/Water Partition Coefficient: log K_{ow} = 1.9
Soil Sorption Partition Coefficient: K_{oc} = estimated at 43

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: 1,1-DICHLOROETHANE
Hazard Class: 3.1
ID No.: 2362
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U076 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001; per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: ....1999-11 **Review Date:** 2000-07

1,2-Dichlorobenzene
DIC2350

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: 1,2-Dichlorobenzene **CAS Number:** 95-50-1
Chemical Formula: $C_6H_4Cl_2$
Structural Chemical Formula: $C_6H_4Cl_2$
EINECS Number: 202-425-9
ACX Number: X1001576-4
Synonyms: BENZENE,1,2-DICHLORO-; BENZENE,O-DICHLORO-; CHLOROBEN; CHLORODEN; CLOROBEN; DCB; O-DCB; O-DICHLOR BENZOL; O-DICHLORBENZENE; 1,2-DICHLOROBENZENE; O-DICHLOROBENZENE; ORTHO-DICHLOROBENZENE; DICHLOROBENZENE,ORTHO,LIQUID; O-DICHLOROBENZOL; DILANTIN DB; DILATIN DB; DIZENE; DOWTHERM E; EPA PESTICIDE CHEMICAL CODE 059401; ODB; ODCB; ORTHODICHLOROBENZENE; ORTHODICHLOROBENZOL; ORTHOSOL; SPECIAL TERMITE FLUID; TERMITKIL
General Use: Solvent for oils, resins, waxes, gums, tars, rubbers, asphalts, oxides of nonferrous metals. Has been used as heat transfer media. Component of dyes, metal polishes, degreasers for leather, metals and wool. Used as an insecticide and fumigant; industrial odor control. Solvent carrier in production of toluene diisocyanate.

Section 2 - Composition / Information on Ingredients

Name	**CAS**	**%**
1,2-dichlorobenzene	95-50-1	>95
1,4-dichlorobenzene	106-46-7	4-5

OSHA PEL
Ceiling: 50 ppm, 300 mg/m^3.

ACGIH TLV
TWA: 25 ppm; STEL: 50 ppm.

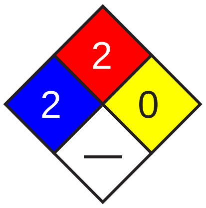
EU OEL
TWA: 20 ppm; STEL: 50 ppm.

NIOSH REL
Ceiling: 50 ppm (300 mg/m^3).

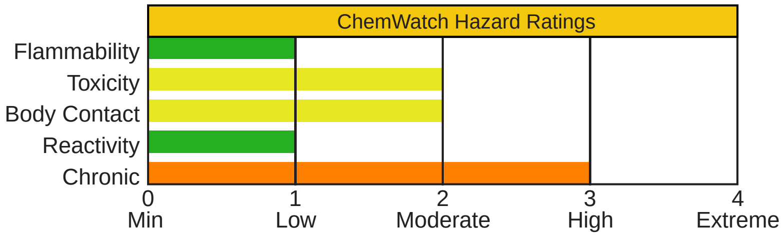
IDLH Level
200 ppm.

DFG (Germany) MAK
TWA: 10 ppm; PEAK: 20 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
2 Flammability
0 Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; aromatic odor. Irritating to eyes/skin/respiratory tract. Toxic. Other Acute Effects: blisters, burning pain in stomach, nausea, vomiting, diarrhea. Chronic Effects: headache, anorexia, weight loss, jaundice, cirrhosis. Combustible.

Potential Health Effects

Target Organs: liver, kidneys, skin, eyes
Primary Entry Routes: inhalation, skin absorption
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
The vapor from heated material is highly discomforting and harmful if inhaled.
Inhalation of vapor may result in nausea, headache. Intermittent exposure at 100 ppm in the workplace caused some irritation to both eyes and upper respiratory system.

Rats survived inhalation exposure for 2 hours at 977 ppm but died after 7 hour exposure. Rats surviving a 7 hour exposure at 539 ppm showed liver necrosis and kidney tubule damage. Liver damage was evident in other rats exposed from 50 to 800 ppm and during exposures lasting 0.5 and 1 hour at 390 ppm. Mouse exposed to the saturated vapor (calculated as between 2000 and 3000 ppm) showed prompt narcosis, followed by central respiratory depression and cyanosis - death occurred within 24 hours. 8000 ppm produced sedation in dogs exposed for 1 hour.
Rats exposed at a concentration of 450 ppm, 6 hours/day for up to 13 days showed pale, discolored kidneys.

Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The vapor is discomforting to the eyes.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Undiluted o-DCB applied to rabbit eye caused pain and slight conjunctival irritation. Irritation cleared within 5 days without residual injury.

Skin: The liquid is highly discomforting to the skin and it is absorbed by the skin and is capable of causing skin reactions which may lead to dermatitis or ulceration if exposure is prolonged.
Toxic effects may result from skin absorption.
The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).
This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.
Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.
o-DCB was irritating when applied to the skin of human subjects for 15-60 minutes. One worker developed a dermatitis following hand contact that was reported as sensitization after a follow-up patch test. Two subjects reported a burning sensation during a 1 hour exposure. A diffuse redness of the treated area progressed to a darker red color with blister formation within 24 hours. A brown pigment formed at the site which was apparent 3 months postexposure.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is highly discomforting and toxic if swallowed.
Ingestion may result in nausea, abdominal irritation, pain and vomiting.
Oral doses of 500 mg given over 13 weeks to mice and rats produced necrosis and hepatocellular degeneration and depletion of lymphocytes in both the spleen and thymus and renal tubular degeneration in rats.
Multifocal mineralization of the myocardial fibers of the heart and skeletal muscle was seen in mice. Necrosis of individual hepatocytes was seen in female mice given 250 mg/kg. At 125 mg/kg a few rats exhibited minimal hepatocellular necrosis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic inhalation exposure may cause changes to liver and kidney and hematological (blood) disorders.
There is some evidence to suggest a link between leukemia and exposure to dichlorobenzenes.
A 2 year study with rats and mice treated with oral doses of either 60 or 120 mg 5 days/ week produced a lower survival time of male rats receiving the higher dose. An increase in the incidence of tubular regeneration in the male mouse kidney was the only compound-related, non-neoplastic, histologic lesion observed and no evidence of carcinogenicity was seen during the study.
Four cases involving cancer and exposure to o-DCB have been reported.
These involved the development of peripheral leukoblastosis, chronic lymphoid leukemia and myeloblastic leukemia.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

See DOT ERG

Eye Contact: If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor.

Skin Contact: If skin contact occurs, remove contaminated clothing and wash skin thoroughly.

Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

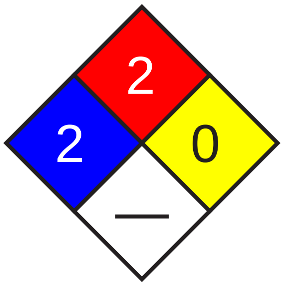
Note to Physicians: Treat symptomatically. Do not give adrenalin (epinephrine) or related drugs.

o-DCB is absorbed through the lungs, gastrointestinal tract and intact skin. High lipid solubility and low water solubility causes diffusion through most membranes. Metabolites include 3,4-dichlorophenol, 2,3-dichlorophenol and 3,4- and 4,5-dichlorocatechols. The conjugates excreted in the urine are mainly glucuronides.

Section 5 - Fire-Fighting Measures

Flash Point: 68.333 °C Open Cup
Autoignition Temperature: 648 °C
LEL: 2% v/v
UEL: 9% v/v
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Combustible liquid. Moderate fire hazard when exposed to heat or flame.
May form an explosive mixture with air.
Decomposes on heating and produces toxic fumes of hydrogen chloride, carbon monoxide (CO), carbon dioxide (CO_2) and minor amounts of chlorine.

See DOT ERG



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Avoid contact with hot aluminum and aluminum alloys.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: POLLUTANT -contain spillage. Environmental hazard - contain spillage.
Clean up all spills immediately.
Wear protective clothing, impervious gloves and safety glasses.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: POLLUTANT -contain spillage. Environmental hazard - contain spillage.
Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
Shut off all possible sources of ignition and increase ventilation.
No smoking or bare lights within area.
Stop leak if safe to do so.
Absorb or cover spill with sand, earth, inert material or vermiculite.
Recover liquid and place in labeled, sealable container for recycling.
Collect residues and seal in labeled drums for disposal.
Wash spill area with detergent and water.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Avoid contact with incompatible materials.
Avoid smoking, bare lights or ignition sources.
Avoid physical damage to containers.
Keep containers securely sealed when not in use.
Use in a well-ventilated area.
Wear personal protective equipment when handling.
When handling, DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.
If mist is present, use air supplied breathing apparatus.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream and Neoprene rubber gloves or PVA gloves.
Safety footwear or Rubber boots.
Respiratory Protection:
Exposure Range >50 to <200 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 200 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)
Other: Impervious protective clothing or Rubber apron.
Eyewash unit.
Ensure there is ready access to a safety shower.
Glove Selection Index:
VITON .... Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless to pale yellow liquid, pleasant aromatic odor. Soluble in alcohol, aromatics, acetone.

Physical State: Liquid	**pH:** Not applicable
Odor Threshold: 12 to 300 mg/m^3	**pH (1% Solution):** Not applicable
Vapor Pressure (kPa): 0.133 at 20 °C	**Boiling Point:** 180.5 °C (357 °F) at 760 mm Hg
Vapor Density (Air=1): 5.07	**Freezing/Melting Point:** -17 °C (1.4 °F)
Formula Weight: 147.00	**Volatile Component (% Vol):** 100 approx.
Specific Gravity (H_2O=1, at 4 °C): 1.305 at 20 °C	**Water Solubility:** 0.01% by weight
Evaporation Rate: < 1	

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers DO NOT use aluminum, galvanized or tin-plated containers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 500 mg/kg
Intraperitoneal (rat) LD_{50}: 840 mg/kg
Subcutaneous (rat) LD_{50}: 5000 mg/kg
Inhalation (rat) LD_{Lo}: 821 ppm/7 hr
Oral (mouse) LD_{50}: 4386 mg/kg
Intraperitoneal (mouse) LD_{50}: 1228 mg/kg
Oral (rabbit) LD_{50}: 500 mg/kg
Diffuse and zonal hepatocellular necrosis, lachrymation, general anesthesia, paternal effects, specific developmental anormalities (musculoskeletal system) recorded.

Irritation
Eye (rabbit): 100 mg/30 s rinse-mild

See *RTECS* CZ 4500000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it can be moderately to tightly adsorbed. Leaching from hazardous waste disposal areas has occurred and the detection in various groundwaters indicates that leaching can occur. Volatilization from soil surfaces may be an important transport mechanism. It is possible it will be slowly biodegraded in soil under aerobic conditions. Chemical transformation by hydrolysis, oxidation or direct photolysis are not expected to occur in soil. If released to water, adsorption to sediment will be a major environmental fate process based upon extensive monitoring data in the Great Lakes area and K_{oc} values. Analysis of Lake Ontario sediment cores has indicated the presence and persistence since before 1940. It is volatile from the water column with an estimated half-life of 4.4 hours from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec at 20 °C; adsorption to sediment will attenuate volatilization. Aerobic biodegradation in water may be possible, however, anaerobic biodegradation is not expected to occur. Experimental BCF values of 66-560 have been reported it has been detected in trout from Lake Ontario. Aquatic hydrolysis, oxidation and direct photolysis are not expected to be important. If released to air, it will exist predominantly in the vapor-phase and will react with photochemically produced hydroxyl radicals at an estimated half-life rate of 24 days in a typical atmosphere. Direct photolysis in the troposphere is not expected to be important. The in rainwater suggests that atmospheric removal via wash-out is possible.

Ecotoxicity: Aquatic toxicity: 13 ppm/*/marine plankton/no growth/ salt water *Time period not specified
Henry's Law Constant: 0.0024
BCF: rainbow trout 270 to 560
Biochemical Oxygen Demand (BOD): theoretical < 0.1 lb/lb, 1/8 days
Octanol/Water Partition Coefficient: log $K_{ow} = 3.38$
Soil Sorption Partition Coefficient: $K_{oc} = 280$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: o-Dichlorobenzene
ID: UN1591
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: + - Override definitions
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, T4, TP1
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U070 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

1,4-Dichlorobenzene
DIC2450

Section 1 - Chemical Product and Company Identification

Material Name: 1,4-Dichlorobenzene **CAS Number:** 106-46-7
Chemical Formula: $C_6H_4Cl_2$
Structural Chemical Formula: $C_6H_4Cl_2$
EINECS Number: 203-400-5
ACX Number: X1001577-1
Synonyms: 1,4-Dichlorobenzene; 1,4-DICHLOROBENZENE; BENZENE,1,4-DICHLORO-; BENZENE,P-DICHLORO-; P-CHLOROPHENYL CHLORIDE; PARA CRYSTALS; P-DCB; 1,4-DICHLOORBENZEEN; P-DICHLOORBENZEEN; 1,4-DICHLOR-BENZOL; P-DICHLORBENZOL; DI-CHLORICIDE; P-DICHLOROBENZENE; PARA-DICHLOROBENZENE; DICHLOROBENZENE,PARA,SOLID; P-DICHLOROBENZOL; PARA-DICHLOROBENZOL; DICHLOROCIDE; 1,4-DICLOROBENZENE; P-DICLOROBENZENE; EPA PESTICIDE CHEMICAL CODE 061501; EVOLA; GLOBOL; PARACIDE; PARADI; PARADICHLORBENZOL; PARADICHLOROBENZENE; PARADICHLOROBENZOL; PARADOW; PARAMOTH; PARANUGGETS; PARAZENE; PDB; PDCB; PERSIA-PERAZOL; SANTOCHLOR
General Use: As an insecticidal fumigant, moth repellant for fabric and fur, germicide. Deodorant toilet blocks, urinal disinfectant. As a space odorant. In dyes, intermediates, pharmacy, agriculture (fumigating soil); In the manufacture of 2,5-dichloroaniline.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,4-dichlorobenzene	106-46-7	>97

OSHA PEL
TWA: 75 ppm; 450 mg/m^3.

NIOSH REL

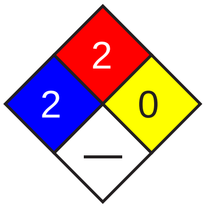
DFG (Germany) MAK
Skin.

ACGIH TLV
TWA: 10 ppm.

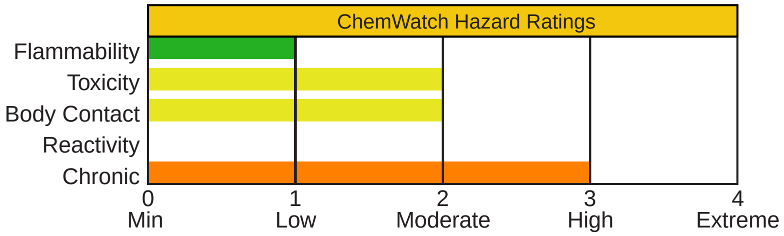
IDLH Level
150 ppm.

EU OEL
TWA: 20 ppm; STEL: 50 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
2 Flammability
0 Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Volatile, white crystals; mothball-like odor. Severely irritating. Other Acute Effects: hemolytic anemia, jaundice, methemglobinemia. Chronic Effects: lung granulomatosis, liver abnormalities, kidney damage, anemia, cataracts. Possible cancer hazard. Combustible.

Potential Health Effects

Target Organs: liver, respiratory system, eyes, kidneys, skin
Primary Entry Routes: inhalation, skin contact

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract if inhaled and the material may present a hazard from repeated exposures over long periods. The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

The physiological response to p-DCB is primarily injury to the liver and secondarily to the kidneys. Central nervous system depression will occur at concentrations that are extremely objectionable to the eyes and nose.

Individuals exposed to higher concentrations may show weakness, dizziness and weight loss. Vomiting may occur. Acute hemolytic anemia with methemoglobinemia has been reported.

Prolonged inhalation exposure may cause dizziness, headache nausea, vomiting, central nervous system depression and damage to liver and kidneys.

Rabbits exposed 8 hours/day for a total of 62 exposures in 83 days at 770-800 ppm exhibited tremors, weakness, and death along with edema of the cornea and opacity of the lens.

Eye: The material is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes if exposure is prolonged.

The vapor from heated material is highly discomforting to the eyes.

Vapors from heated material may cause mild corneal damage.

Solid particles in the eye are reported to be very painful. At workplace concentrations ranging from 50-170 ppm periodic medical examination found no evidence of adverse effects in workers with particular reference to ocular lesions including cataracts. Painful irritation of eyes and nose has been recorded at 80-160 ppm.

Skin: The material is moderately discomforting to the skin and it is absorbed by skin.

Toxic effects may result from skin absorption. Absorption by skin may readily exceed vapor inhalation exposure. Symptoms for skin absorption are the same as for inhalation. Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.

Skin contact may result in irritation, burning sensation, skin defatting and possible dermatitis. Skin contact resulted in dermatitis when workers handled cakes of the pure chemical. Prolonged occlusive contact will produce a burning sensation.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The material is discomforting and toxic if swallowed.

Large doses have caused tremor in exposed animals; insects exhibit symptoms resembling DDT poisoning.

Hepatic porphyria was produced in rats following seven consecutive doses of 770 mg p-DCB/kg. Slight to moderate corneal opacity was noted in rabbits following 3 weeks of daily dosing with 5000 mg/kg. Rats receiving a daily dose of 500 mg/kg for 20 days showed cloudy swelling and necrosis in the central areas of the liver lobules and swelling of the renal tubular epithelium. 100 mg/kg daily doses did not reproduce this finding. Pale and mottled kidneys were seen in rats given oral doses of 70 to 428 mg/kg/day for 28 days. Rats given 1200 mg/kg for 13 weeks showed degeneration and necrosis of hepatocytes, hypoplasia of the bone marrow, lymphoid depletion of the spleen and thymus, and epithelial necrosis of the nasal turbinates and small intestinal mucosa. At doses of 300 mg/kg male rats showed kidney damage characterized by degeneration or necrosis of the renal cortical tubular epithelial cells. Female rats did not show these lesions even at doses of 1500 mg/kg.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: In individuals exposed chronically to p-DCB, liver effects including jaundice, cirrhosis, and possible death may occur. Chronic exposure may also produce weakness, headache, rhinitis, twitching of the facial muscles. A woman who consumed 4 to 5 moth ball pellets daily for 2.5 years developed unsteady gait, tremors of the hand and general mental sluggishness which disappeared 4 months after exposure ceased. Eight workers manufacturing p-DCB based mothproofing agents for 1 to 7 months developed neural disorders including intensified muscle reflexes, mild clonus of the ankle and tremors of the fingers. They reported loss of appetite and hemopoietic changes.

Rats treated for 2 years with gastric intubation showed kidney lesion and in the male, hyperplasia of the thyroid at dose rates of 150 mg/kg.

Mice treated with 300 mg/kg in a similar 2 year gavage study showed liver changes characterized by hepatocellular degeneration. Thyroid follicular cell hyperplasia was increased in male but not female mice. Nephropathy consisting primarily of degeneration of the cortical tubular epithelium was seen and was more pronounced in males.

Rats, guinea pigs, rabbits, mice and monkeys exposed by inhalation 7 hours/day, 5 days/week for 140 exposures at 800 ppm exhibited tremor, weight loss and liver changes, including swelling and central necrosis in female rats, and swelling of the kidney epithelium.

An increase in liver tumors (e.g. renal tubular cell adenocarcinomas) was seen in male rats treated by gastric intubation doses of 150 mg/kg for 2 years. No evidence of carcinogenicity was seen in female rats. An increase incidence of hepatocellular carcinomas and adenomas was seen in mice treated with gavage doses of 300 mg/kg/day for 2 years. A positive dose-trend for adrenal gland pheochromocytomas in male mice was also reported.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

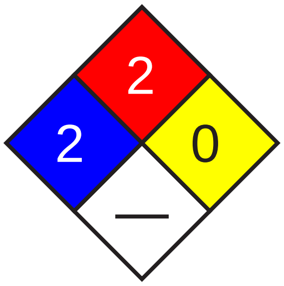
Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.
Avoid giving milk or oils.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.
EYES - Stain for evidence of corneal injury.
SKIN - Treat as for dermatitis.
RESPIRATION - Administer oxygen if available. The use of bronchodilators, expectorants and antitussives may help.
There is no antidote for systemic effects.
Readily absorbed after oral administration to rats and found in all organs with accumulation in adipose tissues. 90% of the dose is excreted within 48 hours. Two metabolites, 2,5-dichlorophenylmethylsulfone and 2,5-dichlorophenylsulfoxide are detected in the blood (though not the compound itself). Slow release from the adipose tissues is probably responsible for the persistence of these metabolites. 2,5-dichlorophenol is detected in plasma, urine, liver, kidneys and fatty tissues - in humans this metabolite is a useful monitor of exposure. An occupational exposure for 1 week to 7.4 ppm p-DCB produced an increase of p-DCB in the urine as a direct measurement.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: 65.556 °C Closed Cup
Autoignition Temperature: > 482 °C
LEL: 2.5% v/v
UEL: 16% v/v

Extinguishing Media: Water spray or fog; foam.
Dry chemical powder.
Alcohol stable foam.
Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Combustible. Slight fire hazard when exposed to heat or flame.
Heat may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit acrid smoke. May emit poisonous fumes.
Decomposes on heating and produces toxic fumes of hydrogen chloride, chlorine, carbon monoxide (CO), phosgene and carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result. Avoid contact with aluminum, powdered metals.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid contact with skin and eyes.
Control personal contact by using protective equipment.
Use dry clean-up procedures and avoid generating dust.

Place in a suitable labeled container for waste disposal.

Large Spills: Clear area of personnel and move upwind. Slippery when spilled.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Collect solid residues and seal in labeled drums for disposal.
Wash area with detergent and water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Glass container; Metal can. Steel drum.
DO NOT use aluminum or galvanized containers.
Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:
Exposure Range >75 to <150 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 150 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)

Other: Overalls. Eyewash unit.

Glove Selection Index:

NEOPRENE	Satisfactory; may degrade after 4 hours continuous immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Volatile, white crystals with penetrating, aromatic odor. Sublimes (evaporates) at room temperature. Soluble in alcohol, acetone aromatics.

Physical State: Divided solid
Odor Threshold: 15 to 30 ppm
Vapor Pressure (kPa): 1.33 at 54.8 °C
Vapor Density (Air=1): 5.08

Formula Weight: 147.0
Specific Gravity (H_2O=1, at 4 °C): 1.46
Evaporation Rate: Slow
pH (1% Solution): Not applicable.

Boiling Point: 174 °C (345 °F) at 760 mm Hg
Decomposition Temperature (°C): >55
Freezing/Melting Point: 53.1 °C (127.58 °F)
Water Solubility: 65.3 mg/L at 25 °C
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers. DO NOT use aluminum or galvanized containers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 2000-3000 mg/kg
Oral (human) LD_{Lo}: 857 mg/kg
Oral (human) TD_{Lo}: 300 mg/kg
Oral (rat) LD_{50}: 500 mg/kg
Dermal (rabbit) LD_{50}: >2000 mg/kg
Intraperitoneal (rat) LD_{50}: 2562 mg/kg
Oral (mouse) LD_{50}: 2950 mg/kg
Intraperitoneal (mouse) LD_{50}: 2000 mg/kg
Oral (rabbit) LD_{50}: 2830 mg/kg
Dermal (rabbit) LD_{50}: >2000 mg/kg
Eye effects, respiratory tract changes, diarrhea, specific developmental effects (cardiovascular system) recorded.

Irritation
Eye (human): 80 ppm

See *RTECS* HT 7525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it can be moderately to tightly adsorbed. Leaching from hazardous waste disposal areas has occurred and the detection in various groundwaters indicates that leaching can occur. Volatilization from soil surfaces may be an important transport mechanism. It is possible it will be slowly biodegraded in soil under aerobic conditions. Chemical transformation by hydrolysis, oxidation or direct photolysis are not expected to occur in soil. If released to water, volatilization may be the dominant removal process. The volatilization half-life from a model river one meter deep flowing one meter/sec with a wind velocity of 3 m/sec is estimated to be 4.3 hours at 20 °C. Adsorption to sediment will be a major environmental fate process based upon extensive monitoring data in the Great Lakes area and K_{oc} values based upon monitoring samples. Analysis of Lake Ontario sediment cores has indicated presence and persistence since before 1940. Adsorption to sediment will attenuate volatilization. Aerobic biodegradation in water may be possible, however, anaerobic biodegradation is not expected to occur. For the most part, experimental BCF values reported in the literature are less than 1000 which suggests that significant bioconcentration will not occur; however, a BCF of 1800 was determined for guppies in one study. Aquatic hydrolysis, oxidation and direct photolysis are not expected to be important. If released to air it will exist predominantly in the vapor-phase and will react with photochemically produced hydroxyl radicals at an estimated half-life rate of 31 days in typical atmosphere. Direct photolysis in the troposphere is not expected to be important. The detection in rain-water suggests that atmospheric removal via wash-out is possible.
Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 4.0 ppm/14 days /Conditions of bioassay not specified; LC_{50} Lepomis macrochirus (bluegill sunfish) 4.54 mg/l/24 hr; 4.3 mg/l/48 hr; 4.25 mg/l/96 hr /Static bioassay; LC_{50} Sheepshead minnow 7.5-10 mg/l/24 hr; 7.17 mg/l/48 hr; 7.4 mg/l/96 hr /Static bioassay
Henry's Law Constant: 0.0015
BCF: increases with log p
Octanol/Water Partition Coefficient: log $K_{ow} = 3.39$
Soil Sorption Partition Coefficient: $K_{oc} = 273$

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U072 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Issue Date: 2000-07

Ethyl Chloride
MSDS 538
ETH3350

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Ethyl Chloride **CAS Number:** 75-00-3
Chemical Formula: C_2H_5Cl
Structural Chemical Formula: H_3CCH_2Cl
Synonyms: AETHYLCHLORID; AETHYLCHLORIDE; AETHYLIS; AETHYLIS CHLORIDUM; ANODYNON; CHELEN; CHLOORETHAAN; CHLORENE; CHLORETHYL; CHLORIDUM; CHLOROAETHAN; CHLOROETHANE; CHLORURE D'ETHYLE; CHLORYL; CHLORYL ANESTHETIC; CLORENE; CLORETILO; CLOROETANO; CLORURO DI ETILE; DUBLOFIX; ETHANE,CHLORO-; ETHER CHLORATUS; ETHER CHLORIDUM; ETHER HYDROCHLORIC; ETHER MURIATIC; ETHYL CHLORIDE; ETYLU CHLOREK; HYDROCHLORIC ETHER; KELENE; MONOCHLORETHANE; MONOCHLOROETHANE; MURIATIC ETHER; NARCOTILE
General Use: Used in manufacture of tetraethyl lead, ethylcellulose, dyes, drugs and perfumes. Used as a refrigerant, alkylating agent, anesthetic, analytical reagent, solvent for phosphorus,sulfur, fats, oils, resins and waxes; insecticides.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethyl chloride	75-00-3	>98

OSHA PEL
TWA: 1000 ppm; 2600 mg/m^3.

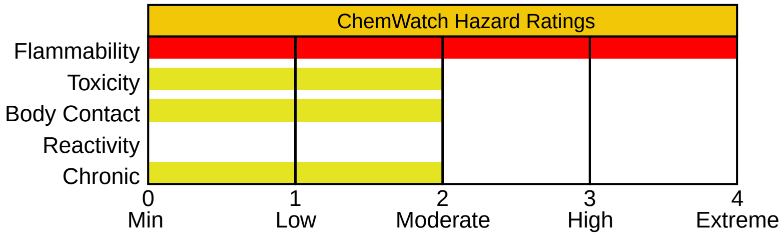
NIOSH REL
No data found.

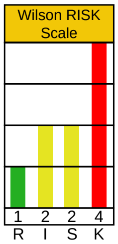
ACGIH TLV
TWA: 100 ppm; 264 mg/m^3.

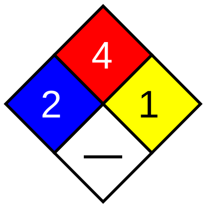
IDLH Level
3800 ppm; LEL.

Section 3 - Hazards Identification

HMIS
② Health
④ Flammability
① Reactivity







Fire Diamond

ANSI Signal Word
Danger!

Flammable

Compressed Gas

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas; ethereal, slightly pungent. Irritating to eyes/skin/respiratory tract. Compressed gas which can cause frostbite. Also causes: upon exposure to high concentrations: CNS depression, cardiac arrythmias, abdominal cramps. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin absorption
Target Organs: respiratory system, cardiovascular system
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract and lungs and may be harmful if inhaled. Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.

Depression of the central nervous system is the most outstanding effect of most halogenated aliphatic hydrocarbons. Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin).

Ethyl chloride administered to humans at 1.3%, 1.9%, 2.5% and 3.36% produced intoxication which increased with dose. Incoordination began at 2.5%.

At 3.36%, noisy talkativeness and incoordination was followed by cyanosis, nausea and vomiting during recovery. Memory loss began at 1.9% and increased at increasing doses.

Death occurred in guinea pigs exposed to 4%.

12% for 1 minute produced complete loss of equilibrium, a running movement, and scratching. Abdominal walls appeared to distend and a convulsive action of the intestines was observed. After 15-20 minutes struggling became less violent and respiration became shallow, rapid and of a convulsive type.

Death occurred in 30-40 minutes. At 2% and above ethyl chloride produced congestion, edema and hemorrhage of the lungs, congestion of the intestines with blood-filled contents, dilated hearts with degenerated musculature, congested brains, pancreas and suprarenals (often with hemorrhage), liver congestion with degeneration and slight edema and slight degeneration of the spleen and kidneys. Dogs anesthetised with ethyl chloride showed increased sensitivity to administered adrenalin

Eye: The vapor is highly discomforting to the eyes, may be to the upper respiratory tract following absorption, may cause chemical burns and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.

Skin: The liquid is discomforting to the skin.

Toxic effects may result from skin absorption.

Exposure limits with "skin" notation indicate that vapor and liquid may be absorbed through intact skin. Absorption by skin may readily exceed vapor inhalation exposure. Symptoms for skin absorption are the same as for inhalation. Contact with eyes and mucous membranes may also contribute to overall exposure and may also invalidate the exposure standard.

Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Male rats exposed via inhalation at 15000 ppm for 6 hours/day for 102 weeks, showed a significant increase in the numbers of benign and malignant epithelial tumors of the skin. Malignant astrocytomas of the brain were observed in exposed female animals.

Mice exposed at 15000 ppm for 6 hours/day, 5 days per week for 100 weeks showed an increase in alveolar and bronchiolar neoplasms of the lung in males and carcinomas of the uterus for the females. Hepatocellular neoplasms were present in both sexes. Nephropathy (characterized by scattered foci of tubular regeneration and minimal glomerulosclerosis) occurred in female mice and keryomegaly of the renal tubular cells increased in both sexes.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: In case of cold burns (frost-bite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing if possible and without rubbing.

Do not apply hot water or radiant heat. Apply a clean, dry dressing.

Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

Avoid giving milk or oils.

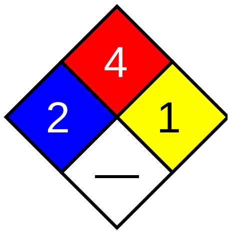
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: -50 °C Closed Cup
Autoignition Temperature: 519 °C
LEL: 3.8% v/v
UEL: 15.4% v/v
Extinguishing Media: Alcohol stable foam.
Bromochlorodifluoromethane (BCF) (where regulations permit).
Dry chemical powder.
Carbon dioxide.
Water spray or fog.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include phosgene and hydrogen chloride.
Fire Incompatibility: Reacts explosively with magnesium, zinc or potassium, sodium or their alloys.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Do not extinguish burning gas.
If safe to do so, stop flow of gas.
If flow of gas cannot be stopped, leave gas to burn.
Use water delivered as a fine spray to control the fire and cool adjacent area.
Do not approach cylinders suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills:
1. Avoid breathing vapor and any contact with liquid or gas. Protective equipment including respirator should be used.
2. Do NOT enter confined spaces were gas may have accumulated.
3. Shut of all sources of possible ignition and increase ventilation.
4. Clear area of personnel.
5. Stop leak only if safe to so do.
6. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve.
7. Keep area clear of personnel until gas has dispersed.

Large Spills:
1. Clear area of all unprotected personnel and move upwind.
2. Contact fire department and advise them of the location and nature of hazard.
3. May be violently or explosively reactive.
4. Wear full body clothing with breathing apparatus.
5. Prevent by any means available, spillage from entering drains and waterways.
6. Consider evacuation.
7. Shut off all possible sources of ignition and increase ventilation.
8. No smoking or bare lights within area.
9. Use extreme caution to prevent violent reaction.
10. Stop leak only if safe to so do.
11. Water spray or fog may be used to disperse vapor.
12. Do NOT enter confined space where gas may have collected.
13. Keep area clear until gas has dispersed.

Keep area clear of personnel until gas has dispersed.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.

Avoid contact with incompatible materials.
Avoid smoking, bare lights or ignition sources.
Avoid sources of heat.
Avoid physical damage to containers.
Wear protective clothing and gloves when handling containers.
Use in a well-ventilated area.
Keep containers securely sealed when not in use.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Vapor may travel a considerable distance to source of ignition.
DO NOT transfer gas from one cylinder to another.
Ground all lines and equipment.
Vapor may ignite on pumping or pouring due to static electricity.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Cylinder fitted with valve protector cap.
Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Cylinder valve must be closed when not in use or when empty.
Cylinder must be properly secured either in use or in storage.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment

Eyes: Close fitting gas tight goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVA gloves.

Respiratory Protection:
Exposure Range >1000 to <3800 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 3800 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: odor threshold unknown

Other: Overalls. Eyewash unit.
Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless gas at room temperature. Colorless, volatile liquid when compressed or at low temperatures. Ether-like odor. Burning taste. Soluble in alcohol and ether.

Physical State: Compressed gas
Vapor Pressure (kPa): 133.32 at 20 °C
Vapor Density (Air=1): 2.23
Formula Weight: 64.51
Specific Gravity (H_2O=1, at 4 °C): 0.92 at 0 °C(liq)
Water Solubility: 0.574 g/100 ml in water at 20 °C
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 12.3 °C (54 °F) at 760 mm Hg
Freezing/Melting Point Range: -138.7 °C (-217.66 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable under normal storage and handling conditions. Hydrolyzes with water to produce toxic and corrosive oxidizing materials. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY	IRRITATION
Inhalation (rat) LC_{50}: 160,000mg/m^3/2h	Nil reported
Inhalation (mouse) LC_{50}: 146,000 mg/m^3/2h	

See NIOSH, *RTECS* KH 7525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, the dominant environmental fate process will be reaction with photochemically generated hydroxyl radicals, estimated half-life of about 40 days. If released to surface water, volatilization will be the dominant process as half-lives ranging from 1.1-5.6 days have been predicted for representative bodies of water. In groundwater, where volatilization may not be able to occur, hydrolysis may be the most important removal mechanism. The hydrolysis half-life has been estimated to be 38 days at 25 °C. Very limited biodegradation data suggest that it may be biodegradable, but insufficient data are available to estimate the relative importance of biodegradation in the environment. Aquatic bioconcentration, adsorption, direct photolysis, and oxidation are not important. If released to soil, it will evaporate rapidly where release to air is possible. It is susceptible to significant leaching.

Ecotoxicity: No data found.

Henry's Law Constant: estimated at 0.00848

BCF: none

Octanol/Water Partition Coefficient: log K_{ow} = 1.43

Soil Sorption Partition Coefficient: K_{oc} = estimated at 143

Section 13 - Disposal Considerations

Disposal: Follow applicable federal, state, and local regulations.
Evaporate or incinerate residue at an approved site.
Return empty containers to supplier.
Ensure damaged or non-returnable cylinders are gas-free before disposal.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHYL CHLORIDE
Hazard Class: 2.1
ID No.: 1037
Packing Group: None
Label: Flammable Gas[2]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: ....1999-11 **Review Date:** 2000-07

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Ethylene Dichloride
DIC4250

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification

50/57

Material Name: Ethylene Dichloride **CAS Number:** 107-06-2
Chemical Formula: $C_2H_4Cl_2$
Structural Chemical Formula: ClH_2CCH_2Cl
EINECS Number: 203-458-1
Synonyms: AETHYLENCHLORID; 1,2-BICHLOROETHANE; BICHLORURE D'ETHYLENE; BORER SOL; BROCIDE; CHLORURE D'ETHYLENE; CLORURO DI ETHENE; 1,2-DCE; DESTRUXOL BORER-SOL; 1,2-DICHLOORETHAAN; 1,2-DICHLOR-AETHAN; DICHLOREMULSION; 1,2-DICHLORETHANE; DI-CHLOR-MULSION; DICHLOR-MULSION; 1,2-DICHLOROETHANE; ALPHA,BETA-DICHLOROETHANE; BETA-DICHLOROETHANE; DICHLORO-1,2-ETHANE; SYM-DICHLOROETHANE; DICHLOROETHYLENE; 1,2-DICLOROETANO; DUTCH LIQUID; DUTCH OIL; EDC; ENT 1,656; ETHANE DICHLORIDE; ETHANE,1,2-DICHLORO-; ETHYLEENDICHLORIDE; ETHYLENE CHLORIDE; 1,2-ETHYLENE DICHLORIDE; ETHYLENE DICHLORIDE; FREON 150; GLYCOL DICHLORIDE; NU-G00511; RY DICHLORO-1,2-ETHANE
Derivation: Prepared from reaction of acetone and hydrochloric acid, or ethylene and chloride gas.
General Use: Used primarily as an intermediate in the manufacture of vinyl chloride; also used as a degreaser, as a scavenger in leaded gasoline, in paint removers, in wetting and penetrating agents, in ore floatation processes, as a fumigant, and as a solvent for fats, oils, waxes and gums.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Ethylene dichloride	107-06-2	ca 100% vol

OSHA PEL
TWA: 50 ppm; Ceiling: 100 ppm, 200 ppm, 5-minute maximum peak in any 3 hours.

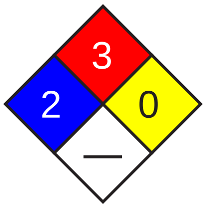
OSHA PEL Vacated 1989 Limits
TWA: 1 ppm; 4 mg/m^3; STEL: 2 ppm; 8 mg/m^3.

ACGIH TLV
TWA: 10 ppm, 40 mg/m^3.

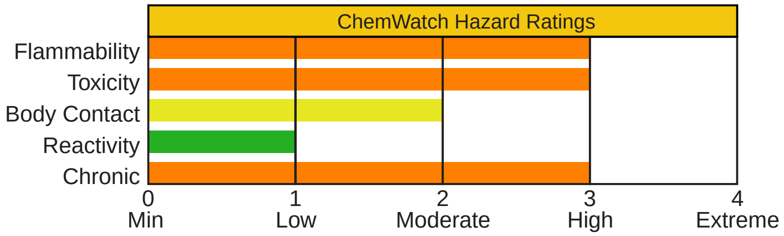
NIOSH REL
TWA: 1 ppm, 4 mg/m^3; STEL: 2 ppm, 8 mg/m^3.

IDLH Level
50 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② **Health**
③ **Flammability**
⓪ **Reactivity**

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Ethylene dichloride is a clear, colorless liquid with a sweet chloroform-like odor. Exposure to this chlorinated hydrocarbon can result in irritation to the nose, throat and lungs, intoxication, CNS depression, vomiting, dizziness, diarrhea, liver and kidney injury, cardiac arhythmia, coma and death. Ethylene dichloride is a possible human carcinogen. It can react violently with amines and finely divided alkali metals. This liquid is flammable, and its vapors can form explosive mixtures with air. When heated to decomposition, ethylene dichloride emits highly toxic gases including carbon oxides, hydrogen chloride, vinyl chloride and phosgene.

Potential Health Effects

Target Organs: Liver, kidneys, heart, gastrointestinal tract, respiratory tract, skin, CNS, eyes; in animal testing, adrenal glands; cancer sites: forestomach, mammary gland, and circulatory system

Primary Entry Routes: Inhalation, skin and/or eye contact/absorption

Acute Effects Note: Nursing infants of mothers exposed to ethylene dichloride are at risk.

Inhalation: Inhalation may result in respiratory tract irritation, pulmonary edema, dizziness, vomiting, coma and delayed death.

Eye: At high concentrations vapors are irritating. Contact with liquid may cause pain, irritation, lacrimation, and, if not rapidly removed, permanent clouding of the cornea.

Skin: Skin contact with this defatting agent can cause drying and chapping. Prolonged contact with the skin, as when held tightly on skin with clothing, produces severe irritation, moderate edema, and necrosis. Absorption can result in acute systemic effects; only large doses produce serious poisoning.

Ingestion: CNS depression, gastrointestinal upset, mental confusion, dizziness, nausea, and vomiting may result from ingestion and may pose an aspiration hazard. Deaths have occurred from ingestion of 8-200 mL.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: Liver and kidney disease, cardiovascular and CNS disorders; conditions requiring the use of insulin or anti-coagulants may be aggravated by exposure to ethylene dichloride.

Chronic Effects: Long term exposure can result in hepatotoxicity (liver damage), nephrotoxiciy (kidney damage), weight loss, low blood pressure, jaundice, oliguria (reduced urine excretion), anemia, CNS depression, insomnia, nausea, vomiting, pulmonary congestion, and adrenal gland damage. Animal studies suggest that immunologic suppression may occur. Repeated skin contact may produce dermatitis with rough, red, dry, cracking skin.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless advised otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not* induce vomiting. Consult physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Implement medical surveillance procedures for workers with potential for exposure. Monitor prothrombin time, serum glucose, electrolytes, liver function, and renal function in severe cases, and arterial blood gases and chest x-ray if respiratory tract irritation is present. Treat overexposure symptomatically and supportively.

Section 5 - Fire-Fighting Measures

Flash Point: 56 °F (13 °C) CC; 64°F (18 °C) OC

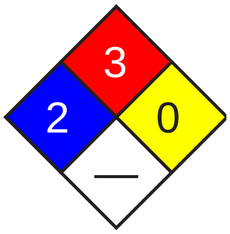
Autoignition Temperature: 775 °F (413 °C)

LEL: 6.2% v/v

UEL: 15.9% v/v

Flammability Classification: OSHA Class IB Flammable Liquid

Extinguishing Media: To extinguish fires involving this flammable liquid, use carbon dioxide, dry chemical, alcohol-resistant foam, water spray or fog. Water may be an ineffective extinguishing medium, but a water spray can be used to cool fire-exposed containers, and flush spills away from ignition sources.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Include carbon oxides, acetylene, vinyl chloride, hydrogen chloride, and phosgene gas. In still air or confined spaces the heavier-than-air vapors of ethylene dichloride may travel along low-lying surfaces to distant ignition sources and flashback. Forms dense soot on burning. Vapors may form explosive mixtures with air.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Remove containers from fire hazard area if feasible. Otherwise, cool fire-exposed containers until well after the fire is extinguished. Structural protective clothing is permeable, remain clear of smoke, water fallout, and water runoff. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, isolate area and deny entry. Remove sources of ignition, and provide maximum explosion-proof ventilation. Stay upwind and have cleanup personnel protect against inhalation and contact. Use appropriate foam to blanket release and suppress vapors.

Small Spills: Absorb ethylene dichloride with vermiculite, earth, sand or similar material.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways. Ground all tools. Use nonsparking equipment.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid inhalation of vapors, contact with skin and eyes. Use only with ventilation sufficient to maintain airborne concentrations at nonhazardous levels (see Sec. 2). Wear protective gloves, goggles, and clothing (see Sec. 2). Keep away from heat and ignition sources. Ground and bond containers during transfers to prevent static sparks.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed container in well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Ethylene dichloride is normally packaged under nitrogen gas.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where possible, transfer ethylene dichloride from drums or other storage containers to process containers in a closed system. Minimize ignition sources in surrounding low-lying areas where ethylene chloride vapors may collect. Electrically ground and bond all containers and equipment. Install Class I, Group D electrical equipment. Provide general or local explosion-proof exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Advise employees of potential health hazards associated with occupational exposure to ethylene dichloride. Consider preplacement and periodic medical exams with emphasis on the skin, eyes, respiratory tract, CNS, cardiovascular system, and liver and kidney function.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of Barricade™, Viton™, Teflon™, or Responder™ (Breakthrough Time (BT) >8 hr), if possible, or alternatively, polyvinyl alcohol, 4H™ (PE/EVAL) (BT >4 hr) to prevent prolonged or repeated skin contact. Butyl rubber, natural rubber, polyethylene, Neoprene, nitrile rubber, and polyvinyl chloride (BT < 1 hr) will rapidly degrade in the presence of ethylene dichloride, and are not recommended for protective clothing. Wear splash-proof chemical goggles and faceshield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. At concentrations above the NIOSH RELs, use any SCBA with full facepiece operated in pressure-demand or other positive-pressure mode, or any supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless with a sweet chloroform- like odor characteristic of chlorinated hydrocarbons.

Physical State: Liquid

Odor Threshold: Low: 4.3-5.7 ppm; high: 371 ppm

Vapor Pressure (kPa): 87 mm Hg at 77 °F (25 °C)

Formula Weight: 98.96

Specific Gravity (H_2O=1, at 4 °C): 1.26 at 69 °F (20 °C)

Refractive Index: 1.445 at 69 °F (20 °C)

Boiling Point: 182.3 °F (83.5 °C)

Freezing/Melting Point: -31.9 °F (-35.5 °C)

Viscosity: 0.84 cP at 68 °F (20 °C)

Surface Tension: 32.2 dynes/cm

Ionization Potential (eV): 11.05 eV

Water Solubility: 8.7 g/L at 68 °F (20 °C)

Other Solubilities: Alcohol, chloroform, ether, acetone, carbon tetrachloride

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Ethylene dichloride is stable at room temperature in closed containers under normal storage and handling conditions. However, over time, it slowly decomposes, becomes acidic and darkens in color. Hazardous polymerization cannot occur. Heat and incompatibles.

Storage Incompatibilities: Violent reactions can result from contact with liquid ammonia; nitrogen tetraoxide; chlorine; dimethylaminopropylamine; finely divided metals including aluminum, potassium, and magnesium; other alkalis, amines, strong oxidizers, strong acids, strong bases, and reducing agents. Ethylene dichloride can corrode steel, iron and other metals.

Hazardous Decomposition Products: Thermal oxidative decomposition of ethylene dichloride produces carbon oxides (CO_x), acetylene, vinyl chloride, hydrogen chloride (HCl), and phosgene gas.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 670 mg/kg.

Human, LD_{Lo}: 286 mg/kg produced toxic effects including ulceration or bleeding from stomach, nausea or vomiting, and fatty liver degeneration.

Human, TD_{Lo}: 428 mg/kg produced somnolence, cough, nausea or vomiting.

Human, TD_{Lo}: 892 mg/kg produced hypermotility, diarrhea, nausea or vomiting, and liver effects.

Acute Inhalation Effects:

Human, inhalation, TC_{Lo}: 4000 ppm/1 hr produced flaccid paralysis without anesthesia, coma, and nausea or vomiting.

Rat, inhalation, TC_{50}: 1000 ppm/7 hr produced coma, cyanosis, and body temperature decrease.

Acute Skin Effects:

Rabbit, skin, LD_{50}: 2800 mg/kg produced lacrimation, general anesthesia, and ataxia.

Irritation Effects:

Rabbit, ocular, 63 mg, 24 hr, caused severe irritation.

Other Effects:

Multiple Dose Toxicity Effects: Rat, inhalation, 1500 ppm/7 hr/5 days administered intermittently produced respiratory depression, changes in kidney, ureter or bladder tubules, and death.

Guinea pig, inhalation, 100 ppm/226 day, 7 hr/day, caused body weight loss, and increased liver weight.

Mouse, oral, 4.89 mg/kg/14 day, caused a 30% decrease in leukocyte number and suppressed humoral immune response.

Reproductive Effects: Rat, intrauterine, 1.5 ppm, day 7- term, resulted in increased rates of fetal heart defects.

Genetic Effects: Rat, oral, 150 mg/kg, resulted in DNA damage.

Tumorigenicity - Rat, inhalation, 5 ppm/7 hr/78 weeks, administered intermittently, resulted in production of tumors (skin and appendages) and leukemia.

Rat, oral, 47 mg/kg/day/78 weeks, caused increase in hemangiosarcomas of the circulatory system, squamous cell carcinomas of the forestomach, mammary gland adenocarcinomas and fibroadenomas.

See NIOSH, *RTECS* KI0525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Because of its moderately high vapor pressure, ethylene dichloride will readily evaporate from surface water (estimated half-life several hours to 10 days), as well as soil. It is not known to bioaccumulate. In the atmosphere, ethylene dichloride may be transported over long distances, and will degrade primarily by photo-oxidation (half-life: 1 month). In groundwater, this chemical does not readily degrade. Ethylene dichloride does not readily sorb and is highly mobile in the soil column.

Ecotoxicity: Stonefly (*Pteronarcys*), LC_{50}=100 mg/L/96 hr; rainbow trout (*Salmo gairdneri*), LC_{50}=225 mg/L/96 hr; bluegill (*Lepomis macrochirs*), LC_{50}=1430 mg/L/96 hr; fathead minnow (*Pimephales promelas*), LC_{50}=136 mg/L/96 hr.

Henry's Law Constant: 1.10×10^{-3} atm-m^3/mole

Octanol/Water Partition Coefficient: log K_{ow} = 1.48

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Ethylene dichloride
Hazard Class: 3
ID No.: UN1184
Packing Group: II
Label: Flammable Liquid, Poison

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U077 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Issue Date: 2004-07

Ethanol
ETH1300

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Ethanol **CAS Number:** 64-17-5
Chemical Formula: C_2H_6O
Structural Chemical Formula: CH_3CH_2OH
EINECS Number: 200-578-6
ACX Number: X1001962-0
Synonyms: ABSOLUTE ETHANOL; AETHANOL; AETHYLALKOHOL; ALCOHOL; ALCOHOL ANHYDROUS; ALCOHOL DEHYDRATED; ALCOHOL,ANHYDROUS; ALCOHOL,ETHYL; ALCOOL ETHYLIQUE; ALCOOL ETILICO; ALGRAIN; ALKOHOL; ALKOHOLU ETYLOWEGO; ANHYDROL; COLOGNE SPIRIT; COLOGNE SPIRITS (ALCOHOL); ETANOLO; ETHANOL; ETHANOL 200 PROOF; ETHANOL SOLUTION; ETHYL ALCOHOL; ETHYL ALCOHOL ANHYDROUS; ETHYL HYDRATE; ETHYL HYDROXIDE; ETHYLALCOHOL; ETOH; ETYLOWY ALKOHOL; FERMENTATION ALCOHOL; GRAIN ALCOHOL; JAYSOL; JAYSOL S; METHYLCARBINOL; MOLASSES ALCOHOL; POTATO ALCOHOL; SD ALCOHOL 23-HYDROGEN; SPIRIT; SPIRITS OF WINE; SPIRT; TECSOL; TECSOL C
General Use: Used in alcoholic beverages in suitable dilution; general solvent in laboratory and industry; manufacture of denatured alcohol; pharmaceuticals (lotions, tonics, colognes); in perfumes; organic synthesis.
As an octane booster in gasoline; an antiseptic.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethanol	64-17-5	>96

OSHA PEL
TWA: 1000 ppm; 1900 mg/m^3.

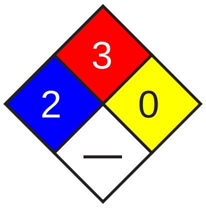
ACGIH TLV
TWA: 1000 ppm.

NIOSH REL
TWA: 1000 ppm, 1900 mg/m^3.

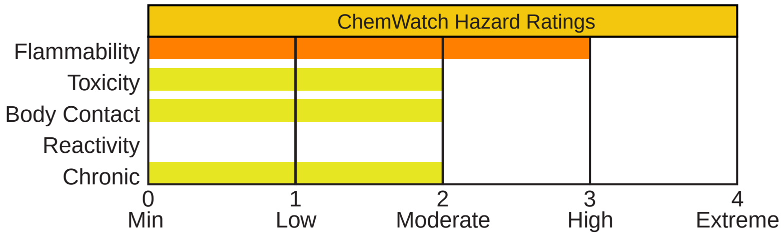
IDLH Level
3300 ppm (10% LEL).

DFG (Germany) MAK
TWA: 500 ppm; PEAK: 1000 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
3	Flammability
0	Reactivity

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; ethanol odor. Irritating to eyes/skin/respiratory tract. Also causes: headache, nervousness, dizziness, tremors, fatigue, nausea, unconsciousness (high concentrations). Chronic: dermatitis, somnolence, lack of concentration. Flammable.

Potential Health Effects

Target Organs: mucous membranes, eyes, central nervous system (CNS)
Primary Entry Routes: ingestion, inhalation, eye contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination with dizziness, disorientation, mental confusion, slurred speech.

The common signs of overexposure in animals include ataxia, incoordination and drowsiness for those surviving narcosis. The narcotic dose for rats after 2 hours exposure is 19260 ppm.

Eye: The liquid may produce eye discomfort causing transient smarting, blinking. The vapor is discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Splashes may cause immediate stinging and burning with reflex closure of the lid and tearing, transient injury of the corneal epithelium and hyperemia of the conjunctiva. Foreign-body type discomfort may persist for up to 2 days but healing is usually spontaneous and complete.

Skin: The liquid is mildly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis.

The material may accentuate any pre-existing dermatitis condition.

Contact with cuts, abraded skin is painful, but this is transient.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: The liquid is highly discomforting and harmful if swallowed in quantity and may cause dizziness, disorientation, mental confusion, slurred speech and may even be fatal if swallowed in large quantity.

Small amounts or low dose rates are regarded as practically non-harmful.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Ingestion may result in intoxication, drunkenness.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Long-term exposure to ethanol may result in progressive liver damage with fibrosis or may exacerbate liver injury caused by other agents.

Repeated ingestion of ethanol by pregnant women may adversely effect the central nervous system of the developing fetus producing effects collectively described as fetal alcohol syndrome. These include mental and physical retardation, learning disturbances, motor and language deficiency, behavioral disorders and reduced head size.

Consumption of ethanol (in alcoholic beverages) may be linked to the development of Type I hypersensitivities in a small number of individuals.

Symptoms, which may appear immediately after consumption, include conjunctivitis, angiedema, dyspnea, and urticarial rashes. The causative agent may be acetic acid, a metabolite.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.

Note: DO NOT INDUCE VOMITING in an unconscious person.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to ethanol:

1.Acute ingestion in non-tolerant patients usually responds to supportive care with special attention to prevention of aspiration, replacement of fluid and correction of nutritional deficiencies (magnesium, thiamine pyrodoxine, Vitamins C & K).

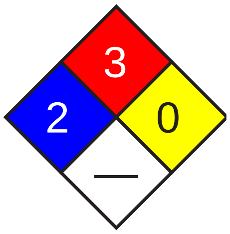
2.Give 50% dextrose (50-100 mL) IV to obtunded patients following blood draw for glucose determination.

3.Comatose patients should be treated with initial attention to airway, breathing, circulation and drugs of immediate importance (glucose, thiamine).

4.Decontamination is probably unnecessary more than 1 hour after a single observed ingestion. Cathartics and charcoal may be given but are probably not effective in single ingestions.

5.Fructose administration is contra-indicated due to side effects.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 13 °C Closed Cup
Autoignition Temperature: 363 °C
LEL: 3.3% v/v
UEL: 19% v/v
Extinguishing Media: Alcohol stable foam; dry chemical powder; carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Fire Incompatibility: Avoid reaction with oxidizers, peroxides, strong acids, acid chlorides, acid anhydrides, strong alkalis.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.

Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Glass container or Plastic container or Plastic drum.
Plastic container may be used only if approved for use with flammable solvents.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. None required when handling small quantities.
OTHERWISE: General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream and Wear chemical protective gloves, eg. PVC.
Wear safety footwear.
Do NOT use this product to clean the skin.
Respiratory Protection:
Exposure Range >1000 to <3300 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 3300 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Other: Overalls. Eyewash unit. Ensure there is ready access to an emergency shower.
Glove Selection Index:

BUTYL	Best selection
NITRILE+PVC	Best selection
PE/EVAL/PE	Best selection
NEOPRENE	Best selection
NITRILE	Best selection
PVC	Satisfactory; may degrade after 4 hours continuous immersion
NATURAL+NEOPRENE	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless highly flammable liquid. Sweet, fragrant odor. Burning taste. Mixes with ether, chloroform. Material is hygroscopic. Vapor is heavier than air.

Physical State: Liquid
Vapor Pressure (kPa): 5.3 at 20 °C
Vapor Density (Air=1): 1.9 at 20 °C
Formula Weight: 46.08
Specific Gravity (H_2O=1, at 4 °C): 0.79 at 20 °C
Evaporation Rate: 3.2 Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 78.5 °C (173 °F)
Freezing/Melting Point: -114.1 °C (-173.38 °F)
Volatile Component (% Vol): < 100
Water Solubility: > 10% in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers, peroxides and alkali metals e.g. sodium, potassium, lithium.
DO NOT store in aluminum containers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 7060 mg/kg
Oral (human) LD_{Lo}: 1400 mg/kg
Oral (man) TD_{Lo}: 50 mg/kg
Oral (man) TD_{Lo}: 1.40 mg/kg
Oral (woman) TD_{Lo}: 256 mg/kg/12 wks
Inhalation (rat) LC_{50}: 20,000 ppm/10h

Irritation
Skin (rabbit): 20 mg/24 hr-moderate
Skin (rabbit): 400 mg (open)-mild
Eye (rabbit): 100 mg/24 hr-moderate
Eye (rabbit): 500 mg SEVERE

See NIOSH, *RTECS* KJ 5075000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When spilled on land it is apt to volatilize, biodegrade, and leach into the ground water, but no data on the rates of these processes could be found. Its fate in ground water is unknown. When released into water it will volatilize and probably biodegrade. It would not be expected to adsorb to sediment or bioconcentrate in fish. Although no data on its biodegradation in natural waters could be found, laboratory tests suggest that it may readily biodegrade and its detection in water systems may be due in part to its extensive use in industry with possible relatively steady and large levels of discharges. When released to the atmosphere it will photodegrade in hours (polluted urban atmosphere) to an estimated range of 4 to 6 days in less polluted areas. Rainout should be significant.

Ecotoxicity: EC_{50} Pimephales promelas (fathead minnows) 12.9 g/l/96 hr; age 30 days old, water hardness 47.3 mg/l ($CaCO_3$), temp 24.3 °C, pH 7.60, dissolved oxygen 6.8 mg/l, alkalinity 43.7 mg/l ($CaCO_3$); tank vol: 6.3 l; additions: 3.81 vol/day /Flow-through bioassay; LC_{50} Pimephales promelas (fathead minnows) 14.2 g/l/96 hr (95% confidence limit 13.4-15.1 g/l); age 30 days old, water hardness 47.5 mg/l ($CaCO_3$), temp 24.0 °C, pH 7.56, dissolved oxygen 6.6 mg/l, alkalinity 40.9 mg/l ($CaCO_3$); tank vol: 6.3 l; Toxicity Threshold (Cell Multiplication Inhibition Test) Entosiphon sulcatum (protozoa) 65 mg/l; LC_{50} Salmo gairdneri (rainbow trout) 13000 mg/l/96 hr at 12 °C (95% confidence limit 12000-16000 mg/l), wt 0.8 g /static bioassay; Toxicity Threshold (Cell Multiplication Inhibition Test) Microcystis aeruginosa (algae) 1450 mg/l; LC_{50} Palaemonetes > 250 mg/l/96 hr at 21 °C, mature /static bioassay

Henry's Law Constant: 5×10^{-6}

BCF: none likely

Biochemical Oxygen Demand (BOD): 125%, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = -0.31$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHANOL (ETHYL ALCOHOL) OR ETHANOL SOLUTION (ETHYL ALCOHOL SOLUTION)
Hazard Class: 3.1
ID No.: 1170
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information: ETHYL ALCOHOL

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed

TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

Ethylbenzene
MSDS 385
ETH3050

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Ethylbenzene **CAS Number:** 100-41-4
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_5{\bullet}C_2H_5$
Synonyms: AETHYLBENZOL; BENZENE,ETHYL-; EB; ETHYL BENZENE; ETHYLBENZEEN; ETHYLBENZENE; ETHYLBENZOL; ETILBENZENE; ETYLOBENZEN; PHENYLETHANE
General Use: Used in the manufacture of cellulose acetate, styrene and synthetic rubber; solvent or diluent; component of automotive and aviation gasoline.
Component of many petroleum hydrocarbon solvents, thinners.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethylbenzene	100-41-4	>95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 125 ppm; 545 mg/m^3.

ACGIH TLV
TWA: 100 ppm; 434 mg/m^3;
STEL: 125 ppm; 543 mg/m^3.

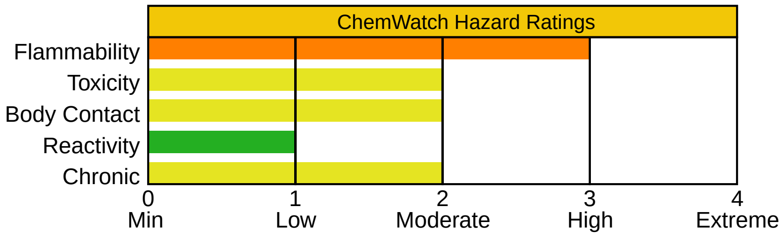
NIOSH REL
TWA: 100 ppm; 435 mg/m^3.
STEL: 125 ppm; 545 mg/m^3.

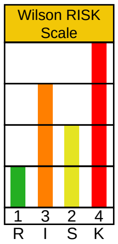
IDLH Level
800 ppm; LEL.

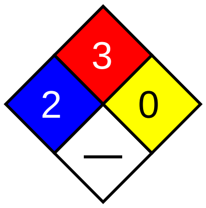
DFG (Germany) MAK
TWA: 100 ppm; 440 mg/m^3.

Section 3 - Hazards Identification

HMIS	
2	Health
3	Flammability
0	Reactivity







Fire Diamond

ANSI Signal Word

Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; pungent odor. Irritating to eyes/skin/respiratory tract. Also causes: chest constriction, vertigo, narcosis, cramps, respiratory paralysis. Chronic: fatigue, sleepiness, headache, blood disorders, lymphocytosis. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact
Target Organs: eyes, respiratory system, skin, central nervous system (CNS), blood
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Inhalation of vapor may aggravate a pre-existing respiratory condition such as asthma, bronchitis, emphysema.

When humans were exposed to the 100 and 200 ppm for 8 hours about 45-65% is retained in the body. Only traces of unchanged ethyl benzene are excreted in expired air following termination of inhalation exposure.

Humans exposed to concentrations of 23-85 ppm excreted most of the retained dose in the urine (mainly as metabolites).

Guinea pigs that died from exposure had intense congestion of the lungs and generalized visceral hyperemia. Rats exposed for three days at 8700 mg/m^3 (2000 ppm) showed changes in the levels of dopamine and noradrenaline in various parts of the brain.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Two drops of the material in to the conjunctival sac produced only slight irritation of the conjunctival membrane but no corneal injury.

Skin: The liquid is discomforting to the skin if exposure is prolonged and is capable of causing skin reactions which may lead to dermatitis.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

The mean rate of absorption of liquid ethyl benzene applied to 17.3 cm2 area of the forearm of seven volunteers for 10-15 minutes was determined to be 38 mg/cm2/hr. Immersion of the whole hand in aqueous solutions of ethyl benzene (112-156 mg/l) for 1 hour yielded mean absorption rates of 118 and 215.7 ug/cm2/hr. The rate of absorption is thus greater than that of aniline, benzene, nitrobenzene, carbon disulfide and styrene.

Repeated application of the undiluted product to the abdominal area of rabbits (10-20 applications over 2-4 weeks) resulted in erythema, edema and superficial necrosis. The material did not appear to be absorbed through the skin in sufficient quantity to produce outward signs of toxicity.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce considerable gastrointestinal discomfort and may be harmful or toxic if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Industrial workers exposed to a maximum level of ethyl benzene of 0.06 mg/l (14 ppm) reported headaches and irritability and tired quickly. Functional nervous system disturbances were found in some workers employed for over 7 years whilst other workers had enlarged livers.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. DO NOT induce vomiting.

Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.

Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink.

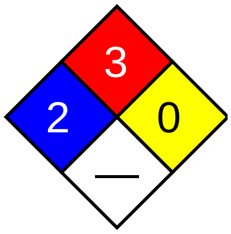
Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance
4. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines. Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6. Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 12.8 °C Closed Cup
Autoignition Temperature: 432 °C
LEL: 1.6% v/v
UEL: 7% v/v

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves or Nitrile gloves.
Protective footwear.

Respiratory Protection:
Exposure Range >100 to <800 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 800 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Eyewash unit.

Glove Selection Index:

VITON	A
TEFLON	A

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid; floats on water. Aromatic solvent odor. Soluble in alcohol, benzene, carbon tetrachloride and ether.

Physical State: Liquid
Vapor Pressure (kPa): 1.333 at 25.9 °C
Vapor Density (Air=1): 3.66
Formula Weight: 106.17
Specific Gravity (H_2O=1, at 4 °C): 0.8670 at 20 °C
Water Solubility: 0.01% by weight
Evaporation Rate: Fast
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 136.2 °C (277 °F) at 760 mm Hg
Freezing/Melting Point Range: -95 °C (-139 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 3500 mg/kg	Skin (rabbit): 15 mg/24h mild
Inhalation (human) TC_{Lo}: 100 ppm/8h	Eye (rabbit): 500 mg - SEVERE
Inhalation (rat) LC_{Lo}: 4000 ppm/4h	
Intraperitoneal (mouse) LD_{50}: 2642 mg/kg~	
Dermal (rabbit) LD_{50}: 17800 mg/kg~	

Liver changes, utheral tract, effects on fertility, specific developmental abnormalities (musculoskeletal system) recorded.

NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

See NIOSH, *RTECS* DA 0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it exist predominantly in the vapor phase based on its vapor pressure where it will photochemically degrade by reaction with hydroxyl radicals (half-life 0.5 to 2 days) and partially return to earth in rain. It will not be subject to direct photolysis. Releases into water will decrease in concentration by evaporation and biodegradation. The time for this decrease and the primary loss processes will depend on the season, and the turbulence and microbial populations in the particular body of water. Representative half-lives are several days to 2 weeks. Some may be adsorbed by sediment but significant bioconcentration in fish is not expected to occur based upon its octanol/water partition coefficient. It is only adsorbed moderately by soil. It will not significantly hydrolyze in water or soil.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) 275 mg/l 96 hr in a static unmeasured bioassay; LC_{50} Pimephales promelas (fathead minnow) 12.1 mg/l/96 hr (confidence limit 11.5 - 12.7 mg/l), flow-through bioassay with measured concentrations, 26.1 °C, dissolved oxygen 7.0 mg/l, hardness 45.6 mg/l calcium carbonate, alkalinity 43.0 mg/l; Toxicity threshold (cell multiplication inhibition test): Pseudomonas putida (bacteria) 12 mg/l ; LC_{50} Palaemonetes pugio (grass shrimp, adult) 14,400 ug/l/24 hr in a static unmeasured bioassay; LC_{50} Palaemonetes pugio (grass shrimp, larva) 10,200 ug/l/24 hr in a static unmeasured bioassay; Toxicity threshold (cell multiplication inhibition test): Microcystis aeruginosa (algae) 33 mg/l; Scenedesmus quadricauda (green algae) > 160 mg/l

Henry's Law Constant: 8.44×10^{-3}

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): theoretical 2.8%, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 3.15$

Soil Sorption Partition Coefficient: $K_{oc} = 164$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHYLBENZENE
Hazard Class: 3.1
ID No.: 1175
Packing Group: II
Label: Flammable Liquid [3]

Additional Shipping Information: PHENYL ETHANE

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: ....1999-11 **Review Date:** 2000-07

Section 1 - Chemical Product and Company Identification 61

Material Name: Fluoranthene **CAS Number:** 206-44-0
Chemical Formula: $C_{16}H_{10}$
EINECS Number: 205-912-4
ACX Number: X1001738-4
Synonyms: 1,2-BENZACENAPHTHENE; BENZENE,1,2-(1,8-NAPHTHALENEDIYL)-; BENZENE,1,2-(1,8-NAPHTHYLENE)-; BENZO (J,K) FLUORENE; BENZO(J,K)FLUORENE; BENZO(JK)FLUORENE; FLUORANTHENE; IDRYL; 1,2-(1,8-NAPHTHALENE)BENZENE; 1,2-(1,8-NAPHTHALENEDIYL)BENZENE; 1,2-(1,8-NAPHTHYLENE)BENZENE
Derivation: Fluoranthene is derived from coal tar and from the pyrolytic processing of organic raw materials such as coal or petroleum at high temperatures.
General Use: Fluoranthene is a constituent of coal tar and petroleum derived asphalt used as a lining material to protect the interior of steel and ductile-iron potable water pipes and storage tanks; used as a research chemical and medication.

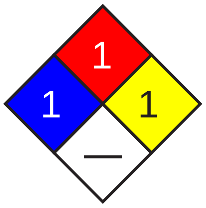
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Fluoranthene	206-44-0	ca 98% wt

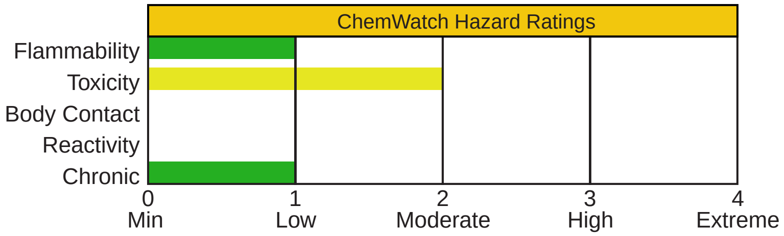
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
① Health
① Flammability
① Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless to pale yellow solid. Irritating to eyes/skin/respiratory tract. Chronic: mutagenic and tumorigenic effects, possible kidney/bladder cancer. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, and respiratory system
Primary Entry Routes: Inhalation, skin/eye contact, ingestion
Acute Effects Note: In general, polynuclear aromatic hydrocarbons (PAH's) have a low order of acute toxicity in humans. The following effects from exposure are based on analogy to phenol and coal tar.
Inhalation: Causes irritation of the mucous membranes and upper respiratory tract.
Eye: Contact causes eye irritation and burning.
Skin: Contact causes skin irritation and burning.
Ingestion: Causes nausea, tachycardia, cardiac arrhythmias, pulmonary edema, and respiratory arrest.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: Persons with existing skin disorders may be more susceptible to the effects of coal tar pitches.

Chronic Effects: Cough and bronchitis, photosensitivity of the eyes and skin, coal tar warts, erythema, and acneiform lesions, leukoplakia, mild hepatotoxicity, and hematuria. Laboratory experiments have shown mutagenic and tumorigenic effects. Some PAH's have been associated with kidney, skin, bladder, lung, and gastrointestinal cancers. PAH's may cross the placenta and are excreted in breast milk in animals.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, lacrimation, or photophobia persist.

Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not* induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Monitor arterial blood gases, pulmonary function, and chest x-ray for patients with significant exposure. If cough or difficulty breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If bronchospasm and wheezing occur, consider treatment with inhaled sympathomimetic agents. Inhalation exposure to PAH's may be complicated by exposure to other substances which produce acute respiratory and systemic effects. Treat according to clinical presentation and exposure history. Treat dermal irritation or burns with standard topical therapy. Patients developing dermal hypersensitivity may require treatment with systemic or topical corticosteroids or antihistamines.

Section 5 - Fire-Fighting Measures

Flash Point: Data not found.

Autoignition Temperature: Data not found.

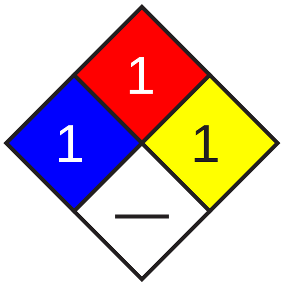
LEL: Data not found.

UEL: Data not found.

Extinguishing Media: Extinguish with water spray, carbon dioxide, dry chemical powder or appropriate foam.

General Fire Hazards/Hazardous Combustion Products: Emits toxic fumes of carbon monoxide and carbon dioxide.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Cleanup personnel should protect against exposure (Sec. 8).

Small Spills: If in solid form, *do not* sweep! Spills of hot coal tar may be covered with sand. Carefully scoop up or vacuum (with a HEPA filter).

Large Spills: For large spills, dike far ahead of spill for later disposal. *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Wear personal protective clothing and equipment to prevent vapor inhalation and contact with skin or eyes (Sec. 8). To prevent skin absorption of coal tar products, *do not* use solvents to clean hands. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from heat, light, ignition sources, and incompatibles. Control storage conditions to prevent overheating and pressure buildup in containers of coal tar products. Design and operate transfer and storage systems to prevent blockage by condensed coal tar products.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor dispersion into the work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure. Institute a complete respiratory protection program which includes regular training, maintenance, inspection, cleaning, and evaluation. Make available to employees exposed to coal tar pitch volatiles a complete history and physical examination with emphasis on the oral cavity, respiratory tract, bladder, and kidneys. Examine the skin for evidence of chronic disorders, for premalignant and malignant lesions, and evidence of hyperpigmentation or photosensitivity. Obtain a urinalysis including specific gravity, albumin, glucose, and a microscopic examination of centrifuged sediment, as well as a test for red blood cells. Also perform a complete blood count to search for leukemia and aplastic anemia. Employees having 5 or more years of exposure or who are 45 years of age or older should have a urinary cytology exam. Employees having 10 or more years of exposure or who are 45 year of age or older should have a sputum cytology examination, a 14" x 17" chest roentgenogram, and periodic measure of FVC and FEV (1 sec).

Personal Protective Clothing/Equipment: Wear chemically protective gloves, aprons, and gauntlets to prevent any skin contact. Employees handling drums, cans, or other large containers of coal tar products shall wear impervious shoes or boots with safety toe caps. Protect leather safety shoes with impervious coverings such as rubbers. Wear cup type or rubber-framed chemical safety goggles with a full length, plastic face shield (20 cm min.), per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not protective eye devices. Appropriate eye protection must be worn instead of contact lenses. *Do not* wear contacts while working with fluoranthene.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For exposure to concentrations <= 2 mg/m^3, wear a chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high efficiency filter or any supplied-air respirator or any SCBA; for exposure to concentrations <= 10 mg/m^3, wear a chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high efficiency filter, or a gas mask with a chin style or a front- or back- mounted organic vapor canister and with a full facepiece and a fume or high efficiency filter, or any supplied-air respirator with a full facepiece, helmet, or hood or any SCBA with a full facepiece; for exposure to concentrations <= 200 mg/m^3, wear a type C supplied-air respirator operated in pressure-demand or other positive-pressure or continuous flow mode, or a powered air- purifying respirator with an organic vapor cartridge and a high efficiency particulate filter; for exposure to concentrations <= 400 mg/m^3 , wear a type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure mode, or with a full facepiece, helmet, or hood operated in continuous flow mode. For exposure to concentrations >= 400 mg/m^3 or for emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes and place in a closed container in the change room. Launder daily before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless to pale yellow
Physical State: Solid; needles or plates from alcohol
Vapor Pressure (kPa): 0.01 mm Hg at 68 °F (20 °C)
Formula Weight: 202.2
Density: 1.252 g/mL at 0°C/4°C
Specific Gravity (H_2O=1, at 4 °C): 1.252
Boiling Point: 707 °F (375 °C)
Freezing/Melting Point: 230 °F (110 °C)

Ionization Potential (eV): 7.95 +/- 0.3 eV
Water Solubility: Insoluble; 0.20 to 0.26 mg/L
Other Solubilities: Soluble in acetic acid, benzene, carbon disulfide, chloroform, and ether; at 72 °F (22 °C): 5-10 mg/mL 95% ethanol, >= 100 mg/mL acetone, and >= 100 mg/mL DMSO

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Fluoranthene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid contact with chemical incompatibles, heat, and sources of ignition.

Storage Incompatibilities: Include strong oxidizing agents.

Hazardous Decomposition Products: Thermal oxidative decomposition of fluoranthene can produce toxic fumes of carbon monoxide and carbon dioxide.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 2 g/kg.
Acute Skin Effects:
Rabbit, skin, LD_{50}: 3180 mg/kg.
Other Effects:
Multiple Dose Toxicity Effects: Rat, oral, 67500 mg/kg administered for 90 days intermittently produced toxic effects: kidney, ureter, and bladder - changes in tubules (including acute renal failure, acute tubular necrosis); blood - normocytic anemia, changes in leukocyte (WBC) count.
Genetic Effects: Bacteria, *S Typhimurium*, 5 µg/plate (-S9) induced mutations in microorganisms.
Human, lymphocyte, 2 µmol/L induced mutations in mammalian somatic cells.
Hamster, ovary, 9 mg/L induced sister chromatid exchange.
Rat, embryo, 50 mg/L induced morphological transformation.
Mouse, skin, 280 mg/kg administered for 58 weeks intermittently produced toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors; tumorigenic - tumors at site of application.

See *RTECS* LL4025000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Fluoranthene degrades slowly in soil. When released to water, fluoranthene is expected to bioconcentrate into aquatic organisms. In the unadsorbed state it will degrade by photolysis. It appears to be stable in sediment for decades or more. Biodegradation in a few years in the presence of acclimated organisms is expected to occur. Fluoranthene released in the atmosphere will photodegrade in the free state. Fluoranthene will rapidly become adsorbed to sediment and particulate matter in the water column. Fluoranthene adsorbs strongly to soil. It is expected to remain in the upper layers of soil. However, it has been detected in groundwater samples, which demonstrates that it can be transported there by some other process. log K_{ow}: 4.90
Ecotoxicity: *Lepomis macrochirus*/ LC_{50}: 4.0 mg/L/96 hr
BCF: 2.58 (rainbow trout)
Soil Sorption Partition Coefficient: $K_{oc} = 6.6 \times 10^4$

Section 13 - Disposal Considerations

Disposal: Fluoranthene is a good candidate for disposal by rotary kiln or fluidized bed forms of incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Not specifically listed.

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U120 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection

Genium group inc.

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Issue Date: 2006-06

Hexachlorobutadiene
HEX3200

Section 1 - Chemical Product and Company Identification 61

Material Name: Hexachlorobutadiene **CAS Number:** 87-68-3
Chemical Formula: C_4Cl_6
Structural Chemical Formula: $Cl_2C=CClCCl=CCl_2$
EINECS Number: 201-765-5
ACX Number: X1003073-6
Synonyms: 1,3-BUTADIENE,1,1,2,3,4,4-HEXACHLORO-; 1,3-BUTADIENE,HEXACHLORO-; C 46; DOLEN-PUR; GP-40-66:120; HCBD; HEXACHLOR-1,3-BUTADIEN; HEXACHLORBUTADIENE; 1,1,2,3,4,4-HEXACHLORO-1,3-BUTADIENE; HEXACHLOROBUTADIENE; 1,3-HEXACHLOROBUTADIENE; HEXACHLOROBUTADIENE; HEXACHOLOROBUTADIENE; PERCHLOROBUTADIENE
General Use: Pesticide with limited applications. Primarily encountered as a by-product of certain processes associated with chlorination of hydrocarbons. Solvent for elastomers, heat-transfer fluid, transformer and hydraulic fluid, wash liquor for the removal of C4 and higher hydrocarbons.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
hexachlorobutadiene	87-68-3	>98

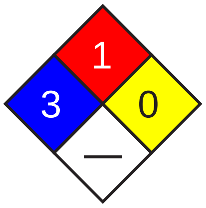
OSHA PEL

NIOSH REL
TWA: 0.02 ppm (0.24 mg/m^3); skin.

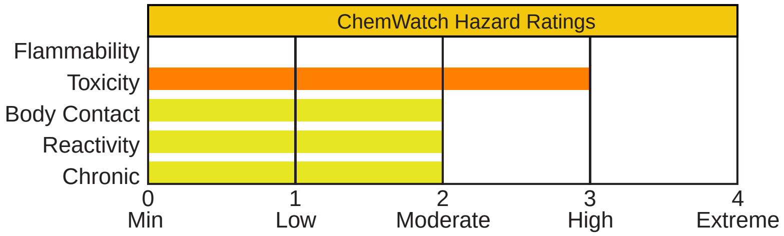
DFG (Germany) MAK
Skin.

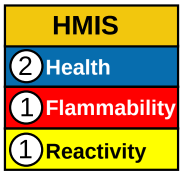
ACGIH TLV
TWA: 0.02 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear liquid; mild turpentine odor. Irritating to eyes/respiratory tract. Toxic. Other Acute Effects: kidney/nervous system damage, hypotension, cardiac disease, nervous function disturbances. Chronic Effects: cardiac disease, chronic bronchitis, hepatitis.

Potential Health Effects

Target Organs: kidneys, liver (in animals)
Primary Entry Routes: inhalation, ingestion, skin absorption
Acute Effects
Inhalation: The vapor is mildly discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Vapors may cause coughing and shortness of breath. Intoxication may produce neurotoxic syndromes including motor stimulation, incoordination, spasms, convulsions, opisthotonus, paralysis and delayed death.
Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.

Depression of the central nervous system is the most outstanding effect of most halogenated aliphatic hydrocarbons. Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin).

Eye: The liquid is discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is discomforting to the eyes.

The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin and is capable of causing allergic skin reactions.

Toxic effects may result from skin absorption.

Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Cutaneous necrosis at sites of application may occur. Fatty liver degeneration and renal epithelium necrosis following dermal application have been reported in animal studies. Sensitization reactions have been reported in previously exposed individuals.

Ingestion: The liquid is discomforting to the gastrointestinal tract may be harmful if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Considered an unlikely route of entry in commercial/industrial environments.

A single dose of 100 mg/kg in rats produced tubular necrosis of the kidneys, increased urinary secretion, hyperproteinuria and damage to organic cation transport.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class C, Possible human carcinogen; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Workers repeatedly exposed to a combination of hexachlorobutadiene and polychlorobutane reported hypotensions, heart disorders, epigastric and chest pain, chronic bronchitis, olfactory disorders, chronic liver disease and nervous function disorders including sleep disorders, nausea and hand trembling. Repeated exposure of rats to 10-250 ppm produced weight loss, nose and respiratory irritation and injury, slight anemia, degeneration of or enlarged adrenals, kidney damage and death. Severe injury to lungs, liver and kidney have been reported in other studies. Lifetime by rats at 20 mg/kg/day produced caused multiple toxicological effects including increased male mortality, decreased body weight gain, increased urinary excretion of coproporphyrin and increased terminal weights of kidneys. Kidney hyperplasia and neoplasia of the renal tubular epithelium was also noted. Some of these neoplasms were noted as nodules in the kidneys and were diagnosed as renal tubular adenomas or adenocarcinomas. Intermediate dose levels of 2.0 mg/kg/day produced urinary excretion of coproporphyrin (females only) and increased hyperplasia of renal tubular epithelium but did not appear to produce treatment related neoplasms.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

See
DOT
ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

Avoid giving milk or oils.

Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable

Autoignition Temperature: 610 °C

Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit). Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Nonflammable liquid. However vapor will burn when in contact with high temperature flame. Ignition ceases on removal of flame. May form a flammable/explosive mixture in an oxygen enriched atmosphere. Heating may cause expansion/vaporization with violent rupture of containers. Decomposes on heating and produces corrosive fumes of hydrochloric acid, carbon monoxide and small amounts of toxic phosgene.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

Use water delivered as a fine spray to control fire and cool adjacent area.

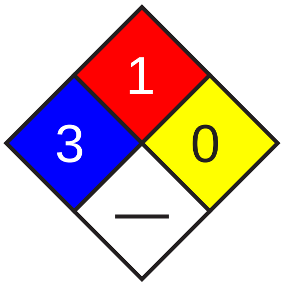
Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

See DOT ERG



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.

Avoid breathing vapors and contact with skin and eyes.

Control personal contact by using protective equipment.

Contain and absorb spill with sand, earth, inert material or vermiculite.

Wipe up. Place in a suitable labeled container for waste disposal.

Large Spills: Clear area of personnel and move upwind.

Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

Increase ventilation.

No smoking or bare lights within area.

Stop leak if safe to do so.

Contain and absorb spill with sand, earth, inert material or vermiculite.

Collect and seal in labeled drums for disposal.

If contamination of drains or waterways occurs, advise emergency services.

After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

See DOT ERG

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.

Wear protective clothing when risk of overexposure occurs.

Use in a well-ventilated area. Prevent concentration in hollows and sumps.

DO NOT enter confined spaces until atmosphere has been checked.

DO NOT allow material to contact humans, exposed food or food utensils.

Avoid smoking, bare lights or ignition sources. When handling, DO NOT eat, drink or smoke. Avoid contact with incompatible materials.

Keep containers securely sealed when not in used. Avoid physical damage to containers. Always wash hands with soap and water after handling. Working clothes should be laundered separately.

Launder contaminated clothing before reuse.

Use good occupational work practices. Observe manufacturer's storing/handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: DO NOT use aluminum or galvanized containers.

Check that containers are clearly labeled.

Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.

If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVA gloves. Polyethylene gloves.
Viton gloves.
PVC boots.

Respiratory Protection:
Exposure Range >0.02 to 1 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range >1 to 20 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >20 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: odor threshold unknown

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, heavy liquid with mild odor. Soluble in alcohol, diethyl ether.

Physical State: Liquid
Odor Threshold: 12 mg/m^3
Vapor Pressure (kPa): 2.93 at 100 °C
Vapor Density (Air=1): 8.99
Formula Weight: 260.74
Specific Gravity (H_2O=1, at 4 °C): 1.5542

pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 215 °C (419 °F) at 760 mm Hg
Freezing/Melting Point: -21 °C (-5.8 °F)
Water Solubility: Insoluble

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of heat source and direct sunlight.
Decomposes in the presence of moisture to produce corrosive acid.
Storage in unsealed containers.
Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid reaction with oxidizing agents.
Attacks natural rubber.
Haloalkenes are highly reactive. Some of the more lightly substituted lower members are highly flammable; many members of the group are peroxidizable and polymerizable.

Section 11 - Toxicological Information

<u>Toxicity</u>
Oral (rat) LD_{50}: 82 mg/kg
Oral (mouse) LD_{50}: 87 mg/kg
Inhalation (mouse) LC_{50}: 370 mg/m^3
Dermal (mouse) LD_{50}: 150 mg/kg
Intraperitoneal (mouse) LD_{50}: 76 mg/kg
Oral (cat) LD_{50}: 187 mg/kg
Dermal (rabbit) LD_{50}: 100 mg/kg
Somnolence, irritability, effects on fertility, fetotoxicity, specific developmental abnormalities (central nervous system), effects on newborn recorded.

<u>Irritation</u>
Skin (rabbit): 810 mg/24h - mod
Skin (rabbit): 500 mg/24h - mild
Eye (rabbit): 162 mg - mild

See *RTECS* EJ 0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When released to soil surfaces, it is expected to rapidly evaporate. In aerobic zones of soil, it may biodegrade. It will probably adsorb strongly to soils (estimated K_{oc} = 5181) so leaching will probably not be rapid except in sandy soils. Estimated half-lives are 3-30 days in river water and 30-300 days in lake and ground waters. Because of its relatively high log K_{ow} value (4.90), it will sorb to sediments, suspended sediments and biota. Henry's Law constants are 1.03 x10^{-2} atm-cu m/mole (25 °C) and 2.40 x10^{-2} atm-cu m/mole (20 °C); thus, volatilization from unfrozen water will be rapid. It has a long half-life in the atmosphere with estimates ranging from months to over a year.

Ecotoxicity: TL_m Carassius quratus (goldfish): 0.09 mg/l at 17.5 °C (Renewal bioassay); LC_{50} Fathead minnow 0.09 mg/l/96 hr (confidence limit, 0.09-0.10 mg/l), age 31 days, 24.9 °C, 8.0 mg/l dissolved oxygen, 45.0 mg/l $CaCO_3$ as water hardness, pH 7.42 /Conditions of bioassay not specified

Henry's Law Constant: 1.03 x10^{-2}

BCF: rainbow trout 5800

Octanol/Water Partition Coefficient: log K_{ow} = 4.90

Soil Sorption Partition Coefficient: K_{oc} = 5181

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Reclaim solvent at an approved site.
Evaporate or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Hexachlorobutadiene
ID: UN2279
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, T4, TP1
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U128 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Indeno[1,2,3-cd]pyrene
IND3480

Section 1 - Chemical Product and Company Identification

Material Name: Indeno[1,2,3-cd]pyrene **CAS Number:** 193-39-5
Chemical Formula: $C_{22}H_{12}$
EINECS Number: 205-893-2
ACX Number: X1004975-9
Synonyms: IDENO(1,2,3-CD)PYRENE; INDENO(1,2,3-C,D) PYRENE; INDENO(1,2,3-CD)PYRENE; INDENO[1,2,3-CD]PYRENE; INDENO(1,2,3-C,D)PYRENE; INDENOPYRENE; IP; 1,10-(1,2-PHENYLENE)PYRENE; 1,10-(O-PHENYLENE)PYRENE; 1,10-(ORTHO-PHENYLENE)PYRENE; 2,3-O-PHENYLENEPYRENE; 2,3-ORTHO-PHENYLENEPYRENE; 2,3-PHENYLENEPYRENE; O-PHENYLENEPYRENE; ORTHO-PHENYLENEPYRENE
General Use: Laboratory standard used in cancer research. Found in automotive and diesel exhaust, cigarette smoke condensate, benzene and pyrene pyrolysis products, soot, coal tar and coal tar pitch and petroleum asphalt.

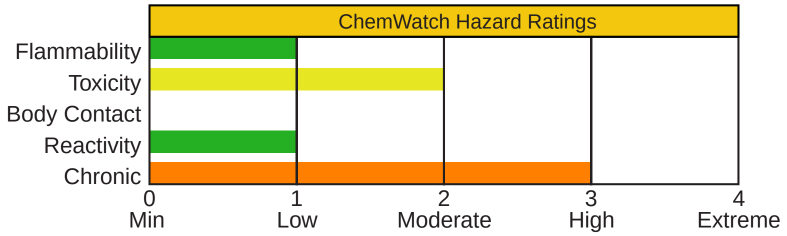
Section 2 - Composition / Information on Ingredients

Name	CAS	%
indeno[1,2,3-cd]pyrene	193-39-5	>98

OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Yellow plates or needles. May cause irritation to eyes/skin. Also causes: may be harmful by inhalation, ingestion, or skin absorption.

Potential Health Effects

Target Organs: No data found.
Primary Entry Routes: accidental skin and eye contact and inhalation of generated dusts
Acute Effects
Inhalation: The dust is harmful and discomforting to the upper respiratory tract.
Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Eye: The dust may be discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to windburn), temporary impairment of vision and/ or other transient eye damage/ ulceration.
Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material.
Toxic effects may result from skin absorption.
Ingestion: The solid/dust is discomforting to the gastrointestinal tract and harmful if swallowed.
Considered an unlikely route of entry in commercial/industrial environments.
Carcinogenicity: NTP - Listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: The so-called polycyclic aromatic hydrocarbons (PAHs) comprise a large family; some members occur in coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified, in animal studies, as amongst the most highly active carcinogens.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: • If dust is inhaled, remove to fresh air.
- Encourage patient to blow nose to ensure clear breathing passages.
- Rinse mouth with water. Consider drinking water to remove dust from throat.
- Seek medical attention if irritation or discomfort persist.
- If fumes or combustion products are inhaled, remove to fresh air.
- Lay patient down. Keep warm and rested.
- Other measures are usually unnecessary.

Eye Contact: If this product comes in contact with the eyes:
- Immediately hold the eyes open and flush with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Seek medical attention if pain persists or recurs.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: If product comes in contact with the skin:
- Immediately remove all contaminated clothing, including footwear (after rinsing with water).
- Wash affected areas thoroughly with water (and soap if available).
- Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. If swallowed, and if more than 15 minutes from a hospital:
- Induce vomiting with Ipecac syrup, or fingers down the back of the throat, only if conscious. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. Note: Wear a protective glove when inducing vomiting by mechanical means.
- Seek medical attention without delay.
- In the meantime, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
- If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided. Further action will be the responsibility of the medical specialist.
- If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

See DOT ERG

Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
- Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, i.e., flame or spark, will cause fire or explosion. Dust clouds generated by the fine grinding of the solid are a particular hazard; accumulations of fine dust may burn rapidly and fiercely if ignited
- Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
- Build-up of electrostatic charge may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e., nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves for fire only.
- Prevent, by any means available, spillage from entering drains or waterways.
- Use fire fighting procedures suitable for surrounding fire.
- Do not approach containers suspected to be hot.
- Cool fire-exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See
DOT
ERG

Small Spills: • Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Wear protective clothing, gloves, safety glasses and dust respirator.
- Use dry clean up procedures and avoid generating dust.
- Vacuum up or sweep up.
- Place in clean drum then flush area with water.

Large Spills: • Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or waterways.
- No smoking, bare lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse/absorb vapor.
- Contain or absorb spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
- If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of overexposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- Do not enter confined spaces until atmosphere has been checked.
- Do not allow material to contact humans, exposed food or food utensils.
- Avoid smoking, bare lights or ignition sources.
- When handling, do not eat, drink or smoke.
- Avoid contact with incompatible materials.
- Keep containers securely sealed when not in used.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately. Launder contaminated clothing before reuse.
- Observe manufacturer's storage/handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Glass container. Plastic container. Metal can. Metal drum. Packing as recommended by manufacturer. Check that all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Supplied-air type respirator may be required in special circumstances. An approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields. Chemical goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, e.g. PVC. Wear safety footwear.

Other: • Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Off-white powder.
Physical State: yellow plates or needles
Vapor Pressure (kPa): 1.0 x10^{-1} mm Hg
Vapor Density (Air=1): not applicable
Formula Weight: 276.34
Evaporation Rate: not applicable
pH: not applicable
pH (1% Solution): not applicable

Boiling Point: 530 °C (986 °F)
Freezing/Melting Point: 162.5 °C (324.5 °F) to 164 °C (327.2 °F)
Volatile Component (% Vol): negligible
Water Solubility: 0.062 mg/L water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Substance has been shown to be mutagenic in at least one assay, or belongs to a family of chemicals producing damage or change to cellular DNA.

See *RTECS* NK9300000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil it will sorb strongly (estimated K_{oc}= 20,146) and hence is not expected to leach. No information was found about volatilization from, hydrolysis in, or biodegradation in soil. Released to water it will sorb strongly to suspended particulate matter, biota and sediments. Although there is a high potential to bioconcentrate in most aquatic organisms, it may not in fish since fish contain microsomal oxidase, which allows polyaromatic hydrocarbons to be metabolized. No information was found about volatilization, photolysis, hydrolysis, or biodegradation in water. It will probably be persistent in the aquatic environment and concentrate in sediments. Almost all released to the atmosphere will be sorbed to particulate matter; thus its atmospheric fate will primarily depend on physical processes such as dry and wet deposition. However, a computer-estimated half-life in the vapor phase is about 20 hours due to reaction with photochemically produced hydroxyl radicals.
Ecotoxicity: No data found.
Henry's Law Constant: 5.89 x10^{-10}
BCF: estimated at 5.9407 x10^{4}
Octanol/Water Partition Coefficient: log K_{ow} = 6.584
Soil Sorption Partition Coefficient: K_{oc} = 2.0146 x10^{4}

Section 13 - Disposal Considerations

Disposal: • Recycle wherever possible or consult manufacturer for recycling options.
• Follow applicable local, state, and federal regulations.
• Bury residue in an authorized landfill.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging: **Exceptions:** 153 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U137 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Iron
IRO1000

Section 1 - Chemical Product and Company Identification

Material Name: Iron

CAS Number: 7439-89-6

Chemical Formula: Fe

Structural Chemical Formula: Fe

EINECS Number: 231-096-4

ACX Number: X1002535-7

Synonyms: ANCOR EN 80/150; ARMCO IRON; CARBONYL IRON; EFV 250/400; EO 5A; EO5A; FERROVAC E; FERRUM; GS 6; IRON; LOHA; NC 100; PZH-2; PZH1M1; PZH2M; PZH2M1; PZH2M2; PZH3; PZH3M; PZH4M; PZH-1M3; PZHO; REMKO; SUY B-2; SUY-B 2; 3ZHP

General Use: Used in magnets; automobile parts; catalyst in ammonia synthesis; high frequency cores; medicinal and dietary substances; powder metallurgy products. Major ingredient in steel.

Section 2 - Composition / Information on Ingredients

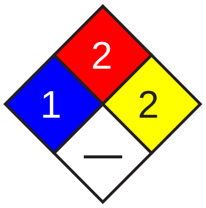
Name	CAS	%
iron, powder	7439-89-6	>99

OSHA PEL

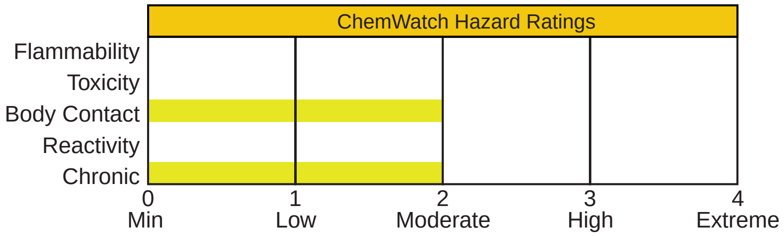
NIOSH REL
TWA: 5 mg/m^3; as Fe.

ACGIH TLV
TWA: 5 mg/m^3; as Fe, dust and fume.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
2	Flammability
1	Reactivity

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Black-gray powder. Irritating to eyes/respiratory tract. Other Acute Effects: conjunctivitis, "rust ring" on cornea. Chronic Effects: mottling of lungs, fibrosis of pancreas, diabetes mellitus, liver cirrhosis, cardiac toxicity. Flammable. Pyrophoric.

Potential Health Effects

Target Organs: eyes, respiratory system, liver, pancreas

Primary Entry Routes: eyes, inhalation, ingestion

Acute Effects

Inhalation: The solid/dust is abrasive to the upper respiratory tract.
Inhalation of dust may cause breathing difficulty and upper respiratory tract damage.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Eye: The dust may produce eye discomfort and abrasive eye inflammation.
The material is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

Contact with the eye may cause mechanical abrasion or foreign body penetration of the eyeball. Iron particles embedded in the eye may produce a condition known as ocular siderosis; effects include discoloration of the cornea and iris, and pupillary effects such as poor reaction to light and accomodation. Particles entering the lens may produce cataracts. A rare consequence of ocular siderosis is glaucoma.

Skin: The solid/dust is abrasive to the skin.

Irritation and skin reactions are possible with sensitive skin.

Ingestion: Not normally a hazard due to the physical form of product.

The material is a physical irritant to the gastrointestinal tract.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems. The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

Welding fume with high levels of ferrous materials may lead to particle deposition in the lungs (siderosis) after long exposure.

This clears up when exposure stops.

Chronic exposure to iron dusts may lead to eye disorders.

Chronic excessive iron intakes have been associated with hemosiderosis and consequent possible damage to the liver and pancreas.

High levels of iron may raise the risk of cancer. This concern stems from the theory that iron causes oxidative damage to tissues and organs by generating highly reactive chemicals, called free radicals, which subsequently react with DNA. Cells may be disrupted and may be become cancerous. People whose genetic disposition prevents them from keeping tight control over iron (e.g. those with the inherited disorder, hemochromatosis) may be at increased risk.

Iron overload in men may lead to diabetes, arthritis, liver cancer, heart irregularities and problems with other organs as iron builds up.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.

Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.

Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water.

Seek medical attention if irritation or discomfort persist.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

For acute or short-term repeated exposures to iron and its derivatives:

1.Always treat symptoms rather than history.

2. In general, however, toxic doses exceed 20mg/kg of ingested material (as elemental iron) with lethal doses exceeding 180 mg/kg.

3. Control of iron stores depend on variation in absorption rather than excretion. Absorption occurs through aspiration, ingestion and burned skin.

4.Hepatic damage may progress to failure with hypoprothrombinemia and hypoglycemia. Hepatorenal syndrome may occur.

5.Iron intoxication may also result in decreased cardiac output and increased cardiac pooling which subsequently produces hypotension.

6.Serum iron should be analysed in symptomatic patients.

Serum iron levels (2-4hrs postingestion) greater that 100 ug/dL indicate poisoning with levels, in excess of 350 ug/dL, being potentially serious.

Emesis or lavage (for obtunded patients with no gag reflex) are the usual means of decontamination.

7.Activated charcoal does not effectively bind iron.

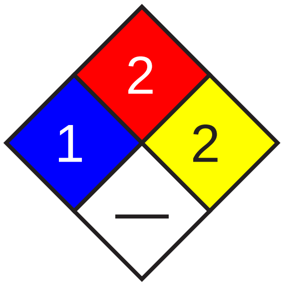
8.Catharsis (using sodium sulfate or magnesium sulfate) may only be used if the patient already has diarrhea.

9.Deferoxamine is a specific chelator of ferric (3+) iron and is currently the antidote of choice. It should be administered parentally.

Copper, magnesium, aluminum, antimony, iron, manganese, nickel (and their compounds) in welding, galvanizing or smelting operations all give rise to thermally produced particulates of smaller dimension than might be produced if the metals are divided mechanically. Where insufficient ventilation or respiratory protection is available these particulates may produce "metal fume fever" in the worker.
1.Onset occurs in 4-6 hours generally on the evening following exposure.
Tolerance develops in workers but may be lost over the weekend. (Monday Morning Fever).
2.Pulmonary function tests may indicate reduced lung volumes, small airway obstruction and decreased carbon monoxide diffusing capacity but these abnormalities resolve after several months.
3.Although mildly elevated urinary levels of heavy metal may occur they do not correlate with clinical effects.
4.The general approach to treatment is recognition of the disease, supportive care and prevention of exposure.
5.Seriously symptomatic patients should receive chest x-rays, have arterial blood gases determined and be observed for the development of tracheobronchitis and pulmonary edema.

Section 5 - Fire-Fighting Measures

Autoignition Temperature: >410 °C
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.
General Fire Hazards/Hazardous Combustion Products: Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result. Reacts with acids producing flammable/explosive hydrogen (H_2) gas.
Decomposes on heating and produces toxic fumes of metal oxides.



Fire Diamond

Fire Incompatibility: Avoid contact with strong oxidizing agents, acids, moisture, halogens and phosphorus.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Remove all ignition sources.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Minor hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Avoid generating dust.
Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.

Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved dust respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
Metal dusts must be collected at the source of generation as they are potentially explosive.

1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.
2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0. 5 meter/sec.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses; safety glasses with side shields.
Chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Rubber gloves; PVC gloves.
Safety footwear.

Other: Overalls. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Dark grey-black powder. Soluble in organic acids, dilute mineral acids, hot concentrated sulphuric acid and hot concentrated nitric acid. Fine metal particles produced when ground, sawn or filed can burn. High concentration of fine particles in air may present an explosion hazard.

Physical State: Divided solid
Vapor Pressure (kPa): 0.13 at 1787 °C
Vapor Density (Air=1): Not applicable
Formula Weight: 55.85
Specific Gravity (H_2O=1, at 4 °C): 7.86
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 3000 °C (5432 °F)
Freezing/Melting Point: 1535 °C (2795 °F)
Volatile Component (% Vol): Nil
Water Solubility: Insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of heat source and ignition source. Storage in unsealed containers.
Presence of extreme humidity.
Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with acids, strong oxidizing agents, halogens and phosphorus.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 98600 mg/kg

Irritation
Nil reported

See *RTECS* NO 4565500, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: None

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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(518) 842-4111

Iron (III) Oxide
FER4100

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 50/57

Material Name: Iron (III) Oxide **CAS Number:** 1309-37-1
Chemical Formula: Fe_2O_3
EINECS Number: 215-168-2
Synonyms: 11554 RED; ANCHRED STANDARD; ANHYDROUS IRON OXIDE; ANHYDROUS OXIDE OF IRON; ARMENIAN BOLE; BAUXITE RESIDUE; BLACK OXIDE OF IRON; BLENDED RED OXIDES OF IRON; BURNT SIENNA; BURNT UMBER; BURNTISLAND RED; C.I. 77491; C.I. PIGMENT RED 101; C.I. PIGMENT RED 101 AND 102; C.I. PIGMENT RED 102; CALCOTONE RED; CAPUT MORTUUM; COLCOTHAR; COLLOIDAL FERRIC OXIDE; CROCUS MARTIS ADSTRINGENS; DEANOX; DEANOX DNX PIGMENTS; EISENOXYD; ENGLISH RED; FERRIC OXIDE; FERRIC OXIDE (COLLOIDAL); FERRUGO; HODGSONS MINOX TERRACOTTA OXIDE F2766; INDIAN RED; IRON (III) OXIDE; IRON OXIDE; IRON OXIDE PIGMENTS; IRON OXIDE RED; IRON RED; IRON SESQUIOXIDE; IRON(III) OXIDE IRON(III)OXIDE; JEWELER'S ROUGE; LEVANOX RED 130A; LIGHT RED; MANUFACTURED IRON OXIDES; MARS BROWN; MARS RED; NATURAL HEMATITE; NATURAL IRON OXIDES; NATURAL RED OXIDE; OCHRE; PRUSSIAN BROWN; QUICK ROUGE; RADDLE; RED IRON OXIDE; RED OCHRE; RED OXIDE; RED OXIDE D3452; RED OXIDE D6984; RED OXIDE OF IRON; ROUGE; RUBIGO; SIENNA; SPECULAR IRON; STONE RED; SUPRA; SYNTHETIC IRON OXIDE; VENETIAN RED; VITRIOL RED; VOGEL'S IRON RED; YELLOW FERRIC OXIDE; YELLOW OXIDE OF IRON
Derivation: By the action of air, steam, or carbon dioxide on iron. An especially pure grade is produced by precipitating hydrated ferric oxide from a solution of iron salts, dehydrating, and reducing with hydrogen. Occurs naturally in nature as the mineral maghemite (gamma-form) and hematite (alpha-form).
General Use: In welding and silver finishing; as a polishing agent for glass, precious metals, and diamonds; in magnets, magnetic tapes; as a catalyst; as a component of cement, thermite, and feed additive; in the manufacturing of ferrites for electronic uses, metallurgy, and gas purification; as red and brown pigments in paints, coatings, and rubber.

Section 2 - Composition / Information on Ingredients

Name	**CAS**	**%**
Iron (III) oxide, technical, pure	1309-37-1	96% (minimum)

Grades Available - Synthetic iron oxides of high purity are available as single oxides or blends of iron oxides in a range of colors that include yellow, orange, tan, red, maroon, brown and black.

OSHA PEL
TWA: 10 mg/m^3.

OSHA PEL Vacated 1989 Limits
STEL: 1 mg/m^3; as Fe (salts).

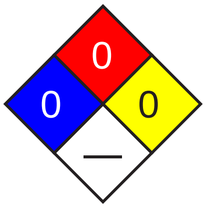
ACGIH TLV
TWA: 5 mg/m^3.

NIOSH REL
TWA: 5 mg/m^3.

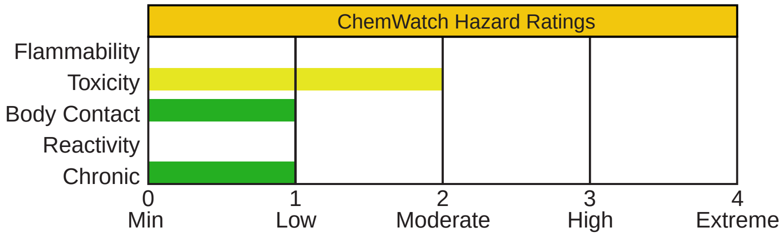
IDLH Level
2500 mg/m^3; as Fe.

DFG (Germany) MAK
TWA: 1.5 mg/m^3; measured as respirable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond



HMIS
1 Health
0 Flammability
0 Reactivity

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Iron (III) oxide's appearance is dependent upon size and shape of particles and the amount of combined water. As particle size increases, color changes from light red to dark violet. Dust or fume inhalation causes metal fume fever, a flu-like illness. Symptoms include fever and chills, chest tightness, coughing and a metallic taste. Eye or skin contact causes irritation. Prolonged eye exposure leads to permanent iron staining of the eyes.

Potential Health Effects

Target Organs: Respiratory system, eyes and skin

Primary Entry Routes: Inhalation, skin and/or eye contact

Acute Effects

Inhalation: Iron oxide (fume) inhalation causes metal fume fever, a flu-like illness with symptoms of metallic taste, fever and chills, accompanied by aches, chest tightness and cough.

Eye: Contact causes irritation.

Skin: Contact causes irritation.

Ingestion: Unintentional ingestion of iron (III) oxide dust is possible, leading to irritation of the gastrointestinal tract.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Respiratory disease.

Chronic Effects: Heavy dust exposure can cause cough and phlegm production. Repeated or prolonged contact can cause permanent iron staining of the eyes. A 6 to 10 yr exposure to iron oxide may produce siderosis, a benign pneumoconiosis with changes in chest x-ray indistinguishable from fibrotic pneumoconiosis. However, siderosis does not progress to fibrosis. Concurrent exposure to other materials released during welding could result in a mixed-dust pneumoconiosis with possible loss of pulmonary function.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support respiratory and cardiovascular functions as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist if pain or irritation continue.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically and supportively.

Section 5 - Fire-Fighting Measures

Flash Point: Not applicable; noncombustible solid.

Autoignition Temperature: Not applicable.

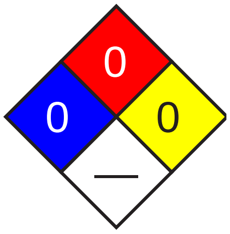
LEL: Not applicable.

UEL: Not applicable.

Extinguishing Media: Use agents suitable for surrounding fire. Iron oxide (dust and fume) does not burn.

General Fire Hazards/Hazardous Combustion Products: Dust ignites on contact with hydrogen trisulfide.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode or 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 SCBA operated in pressure demand or other positive pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, isolate, ventilate area and deny entry. Cleanup personnel should protect against dust inhalation and skin and eye contact.

Small Spills: Carefully scoop up spilled iron oxide and place in sealed containers for reclamation or disposal.

Large Spills: Immediately cover large dry spills with a plastic sheet or tarp to minimize dust dispersion, until cleanup can begin. *Do not* release into sewers or waterways. *Do not* sweep. Use a vacuum, with appropriate HEPA filter, or wet method to reduce dust during cleanup.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Train employees on the proper use and handling of iron (III) oxide. Avoid generating dusting conditions. Use only with ventilation sufficient to maintain airborne concentrations as low as possible. Where dusty conditions exist, use of dust-proof goggles and appropriate respirator are recommended (see Sec. 8) along with appropriate personal protective equipment when working with this material.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area. Keep away from incompatibles (see Sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose operations where feasible and/or provide local exhaust ventilation. Use of respirators and protective equipment is less effective than the aforementioned controls, but is sometimes necessary. Avoid dust generation. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the respiratory tract. For person exposed to iron oxide fume at potentially hazardous levels, perform a 14 x 17 chest roentgenogram; FVC and FEV (1 sec.). Repeat these examinations on an annual basis. X-ray is considered necessary only when indicated by results of pulmonary function testing. Train employees in proper use of personal protective equipment and inform of potential health hazards associated with long-term occupational exposure to iron (III) oxide dust or fumes. Stress good housecleaning procedures to minimize iron (III) oxide dust accumulation and/or dispersion.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear dust-proof safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Where exposure to iron (III) oxide dust or fumes occur follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations < 50 mg/m^3 wear any dust, mist, and fume respirator or a supplied-air respirator. For concentration < 125 mg/m^3 use any supplied-air respirator operated in a continuous-flow mode or any powered, air purifying respirator with a dust, mist, and fume filter. For concentrations < 250 mg/m^3 use an air-purifying, full-facepiece respirator with a high-efficiency particulate filter; or any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous- flow mode; or any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter. For concentrations < 2500 mg/m^3 use any supplied-air respirator operated in a pressure-demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Reddish-brown solid. Although, depending upon shape of particles and the amount of combined water, color changes with increasing particle size from light red to dark violet.

Physical State: Solid

Vapor Pressure (kPa): ~ 0 mm Hg

Formula Weight: 159.7

Specific Gravity (H_2O=1, at 4 °C): 5.24

Refractive Index: 3.01, 2.94

Freezing/Melting Point: 2849 °F (1565 °C)

Water Solubility: Insoluble

Other Solubilities: Soluble in sulfuric and hydrochloric acids, slightly soluble in nitric acid.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Iron (III) oxide is stable at room temperature in closed containers under normal storage and handling conditions. However, it will oxidize rapidly upon exposure to dampness or salty air, causing rust. Hazardous polymerization cannot occur. Contact with incompatibles listed above and dust or fume generation.

Storage Incompatibilities: Explosion may occur during reduction of iron oxide with carbon monoxide, due to the formation of pentacarbonyl iron at temperatures between 32-302 °F (0-150 °C). Other incompatible materials include calcium hypochlorite, aluminum, cesium carbide, ethylene oxide, and hydrazine. Mixtures with aluminum + calcium silicide + sodium nitrate may explode if ignited. Mixtures with aluminum + sulfur react violently if heated. Ignites on contact with hydrogen trisulfide.

Hazardous Decomposition Products: Thermal decomposition of iron (III) oxide can produce iron oxide fume.

Section 11 - Toxicological Information

Acute Skin Effects:

Dog, subcutaneous, LD_{Lo}: 30 mg/kg.

Rat, subcutaneous: 135 mg/kg caused tumors at the site of application (cited by RTECS as an equivocal tumorigenic agent).

Other Effects:

Rat, inhalation: 500 µg/m^3/24 hr/61 days continuously caused toxic effects of the brain and coverings - other degenerative changes, blood changes in the serum composition; and biochemical effects - true cholinesterase.

See NIOSH, *RTECS* NO7400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Not listed.

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Isophorone
ISO4600

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

Material Name: Isophorone

CAS Number: 78-59-1

Chemical Formula: $C_9H_{14}O$

Structural Chemical Formula: $C(O)CHC(CH_3)CH_2C(CH_3)_2CH_2$

EINECS Number: 201-126-0

ACX Number: X1003116-6

Synonyms: 2-CYCLOHEXEN-1-ONE,3,5,5-TRIMETHYL-; EPA PESTICIDE CHEMICAL CODE 047401; ISOACETOPHORONE; ISOFORON; ISOFORONE; ISOOCTOPHERONE; ALPHA-ISOPHORON; ISOPHORON; ALPHA-ISOPHORONE; ISOPHORONE; IZOFORON; 1,1,3-TRIMETHYL-3-CYCLOHEXENE-5-ONE; 3,5,5-TRIMETHYL-2-CYCLOHEXENE-1-ONE; 3,5,5-TRIMETHYL-2-CYCLOHEXEN-1-ON; 3,3,5-TRIMETHYL-5-CYCLOHEXEN-1-ONE; 3,5,5-TRIMETHYL-2-CYCLO-HEXEN-1-ONE; 3,5,5-TRIMETHYL-2-CYCLOHEXEN-1-ONE; 3,5,5-TRIMETHYL-2-CYCLOHEXENONE; 3,5,5-TRIMETHYL-5-CYCLOHEXEN-1-ONE; TRIMETHYLCYCLOHEXENONE; 3,5,5-TRIMETIL-2-CICLOESEN-1-ONE

General Use: This unsaturated cyclic ketone is used as a solvent for resins (particularly vinyl resins applied by roller coating), lacquers, fats, and oils; and in the manufacture of pesticides and herbicides.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Isophorone	78-59-1	ca 100% vol.

Trace Impurities: beta-Isophorone (1-3%)

OSHA PEL
TWA: 25 ppm; 140 mg/m^3.

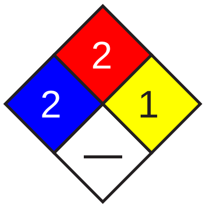
NIOSH REL
TWA: 4 ppm (23 mg/m^3).

DFG (Germany) MAK
TWA: 2 ppm; PEAK: 4 ppm.

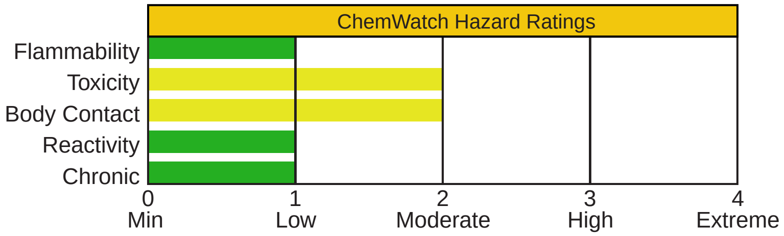
ACGIH TLV
Ceiling: 5 ppm.

IDLH Level
200 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
2 Flammability
0 Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless to pale yellow liquid; sharp peppermint to camphor-like odor. Severely irritating to eyes; irritating to skin. Other Acute Effects: headache, nausea, kidney/liver damage, CNS depression. Questionable carcinogen (experimental animal data). Combustible.

Potential Health Effects

Target Organs: Eyes, skin, central nervous system (CNS), cardiovascular system (CVS), respiratory system, blood, liver, kidneys

Primary Entry Routes: Inhalation, ingestion, skin or eye contact/absorption

Acute Effects

Inhalation: Inhalation may result in gasping, respiratory tract irritation, olfactory fatigue, conjunctival irritation, headache, nausea, intoxication, and, at high concentrations, noncardiovascular pulmonary edema, kidney and liver damage, gastrointestinal (GI) tract irritation, lowered body temperature and pulse rate, tachycardia (excessively rapid heart rate), decreased respiration rate, aspiration chemical pneumonia, narcosis, and seizures. Because of its relatively low vapor pressure, this chemical does not present a significant inhalation hazard.

Eye: Lacrimation (tearing), severe irritation, and permanent corneal damage may result from eye contact with liquid. Low concentrations (25 ppm) of isophorone vapor can also cause irritation.

Skin: Skin contact can cause irritation, parathesia (abnormal skin sensations), dermatitis, and second degree burns after long exposure. Isophorone can be absorbed through the skin, potentially causing systemic effects.

Ingestion: Nausea, vomiting, GI tract irritation, metabolic acidosis, aspiration pneumonia, liver and kidney damage, spleen damage, leukopenia, CNS depression and seizures may result from ingestion of isophorone.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A3, Animal carcinogen; EPA - Class C, Possible human carcinogen; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Medical Conditions Aggravated by Long-Term Exposure: Toxic reactions to halogenated hydrocarbons may be potentiated by exposure to isophorone.

Chronic Effects: Long term exposure may result in chronic irritation of, and discharge from, the nose and eyes; drying and cracking of the skin; liver and kidney damage or cancer (based on animal studies); CNS depression. Workers exposed to vapor concentrations of 5-8 ppm for one month complained of fatigue and malaise.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing and cardiovascular function as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

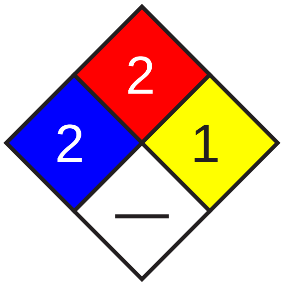
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 4-8 ounces of water or milk. *Do not* induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: If respiratory tract is irritated consider chest x-ray. Keep victim under observation for delayed pulmonary edema. For workers with potential for long-term exposure to isophorone, consider: liver and kidney function tests; interviewing for brain effects; cerebellar, autonomic and peripheral nervous system evaluation; complete blood count; urinalysis (for increased conjugated glucuronic acid).

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: 184 °F (84.4 °C), Closed Cup

Autoignition Temperature: 864 °F (462 °C)

LEL: 0.8% v/v

UEL: 3.8% v/v

Flammability Classification: OSHA IIIA Combustible Liquid.

Extinguishing Media: Use carbon dioxide, dry chemical, foam, water as fog or spray. Water may be ineffective in putting out a fire involving isophorone, and a water stream may spread the flames.

General Fire Hazards/Hazardous Combustion Products: Combustion of isophorone can produce carbon oxides. In still air or confined spaces isophorone vapors may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.

Fire-Fighting Instructions: If feasible, remove containers from fire hazard area. Otherwise, cool fire-exposed containers until well after fire is extinguished. If tank, railcar or tank truck is involved in fire, isolate for 1/2 mile (800 m) in all directions. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing will only provide limited protection.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate area and deny entry. Remove sources of ignition, and provide maximum explosion-proof ventilation. Stay upwind and have cleanup personnel protect against inhalation and contact.

Small Spills: Absorb isophorone with vermiculite, earth, sand or similar material.

Large Spills: For large spills, consider downwind evacuation of at least 100 ft (300 m). Dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways. Ground all equipment. Use nonsparking tools during clean-up.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid contact with skin and eyes, and vapor inhalation. Use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels (see Sec. 2). Wear gloves, goggles, and personal protective clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use nonsparking tools to open and close containers.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources, oxidizers and incompatibles. Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose operations and/or provide local explosion-proof exhaust ventilation at the site of chemical release. Where possible, transfer isophorone from drums or other storage containers to process containers in a closed system. Minimize sources of ignition in surrounding low-lying areas. Electrically bond and ground all containers and equipment. Install Class I, Group D Electrical Equipment. Provide general or local explosion-proof exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Advise employees of potential health hazards associated with occupational exposure to isophorone. Consider preplacement and periodic medical exams with emphasis on the skin, eyes, respiratory tract, CNS, kidneys, and liver.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of polyvinyl alcohol, butyl rubber, or Responder^{TM} (Breakthrough Time (BT) >8 hr) if possible, or alternatively, 4H^{TM} (PE/EVAL) (BT >4 hr) to prevent prolonged or repeated skin contact. Natural rubber, neoprene, nitrile rubber, polyvinyl chloride, and Viton^{TM} may degrade after contact and are *not* recommended. Wear splash-proof chemical goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations over 4 ppm, use a full facepiece respirator with an organic vapor cartridge. For increased protection, use a full facepiece, powered, air-purifying respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear to pale yellow, with a peppermint to camphor-like odor.

Physical State: Liquid
Odor Threshold: 1 to 50 mg/m^3
Vapor Pressure (kPa): 0.38 mm Hg at 68 °F (20 °C)
Formula Weight: 138.22
Specific Gravity (H_2O=1, at 4 °C): 0.9229 at 68 °F (20 °C)
Evaporation Rate: 0.03

Refractive Index: 1.478 at 68 °F (20 °C)
Boiling Point: 419 °F (215 °C)
Freezing/Melting Point: 17 °F (-8 °C)
Viscosity: 2.62 cP at 68 °F (20 °C)
Water Solubility: 1.2 mg/mL
Other Solubilities: Ethyl alcohol, ether, acetone

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Isophorone is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid sources of ignition, sparks, heat and incompatibles.

Storage Incompatibilities: Strong oxidizers, strong bases, alkalis, amines.

Hazardous Decomposition Products: Thermal oxidative decomposition of isophorone can produce carbon oxides.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 1870 mg/kg.
Acute Inhalation Effects:
Rat, inhalation, LC_{Lo}: 1840 ppm/4 hr caused lacrimation, dyspnea, hypermotility, diarrhea.
Human, inhalation, TC_{Lo}: 25 ppm produced conjunctive irritation, and changes to the lungs, thorax or respiration and olfactory organs.
Acute Skin Effects:
Rabbit, skin, LD_{50}: 1.5 mL/kg.
Irritation Effects:
Guinea pig, eye, standard Draize test: 840 ppm/4 hr, resulted in severe irritation.
Rabbit, eye: 920 µg produced severe irritation.
Rabbit, skin, standard Draize test: 100 mg/24 hr, resulted in mild irritation.
Other Effects:
Mouse, lymphocyte cells: 400 mg/L produced mutations.
Tumorigenicity: Rat, 180 g/kg/2 yr, administered intermittently, resulted in bladder tumors.
Rat, liver cells: 5 mmol/L, resulted in unscheduled DNA synthesis.
Rat, inhalation, TC_{Lo}: 500 ppm/8 hr/6 wk, administered intermittently produced toxic effects on the respiratory tract, caused changes in the tubules and/or glomeruli of the kidney, ureter and/or bladder, and death.

See *RTECS* GW7700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Isophorone may volatilize from water (half-life 7.5 days) and soil. Once in the atmosphere, it may be removed by wet or dry deposition. This ketone does not bioaccumulate. Isophorone is believed to be subject to biodegradation. It will react with ozone (half-life 39 min), and photochemically-produced hydroxyl radicals (half-life 3 hr). Direct photolysis and chemical hydrolysis are unimportant. Adsorption is not believed to be an important process; isophorone will leach through the soil column.
Ecotoxicity: *Cyprinodon variagatus* (sheepshead minnow), LC_{50}=166-295 mg/L/96 hr; *Mysidopsis bahia* (Mysid shrimp), LC_{50}=12.9 mg/L/96 hr; *Selenastrum capricornutum* (alga), EC_{50}=122 mg/L/96 hr; toxic effect: cell number reduced.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Combustible liquid, n.o.s.
ID: NA1993
Hazard Class: Combustible liq
Packing Group: III - Minor Danger
Symbols: D G
Label Codes: None
Special Provisions: IB3, T1, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Isopropyl Alcohol
ISO5300

Issue Date: 2004-07

Section 1 - Chemical Product and Company Identification

Material Name: Isopropyl Alcohol **CAS Number:** 67-63-0
Chemical Formula: C_3H_8O
Structural Chemical Formula: $(CH_3)_2CHOH$
EINECS Number: 200-661-7
ACX Number: X1001458-1
Synonyms: ALCOJEL; ALCOOL ISOPROPILICO; ALCOOL ISOPROPYLIQUE; ALCOSOLVE; ALCOSOLVE 2; AVANTIN; AVANTINE; CHROMAR; COMBI-SCHUTZ; (COMPONENT OF) HIBISTAT; DIMETHYL CARBINOL; DIMETHYLCARBINOL; EPA PESTICIDE CHEMICAL CODE 047501; HARTOSOL; 2-HYDROXYPROPANE; IMSOL A; IPA; ISOHOL; ISOPROPANOL; ISOPROPYL ALCOHOL; ISO-PROPYLALKOHOL; LUTOSOL; 1-METHYLETHANOL; 1-METHYLETHYL ALCOHOL; PETROHOL; PRO; 2-PROPANOL; I-PROPANOL; N-PROPAN-2-OL; PROPAN-2-OL; PROPOL; 2-PROPYL ALCOHOL; I-PROPYL ALCOHOL; SEC-PROPYL ALCOHOL; I-PROPYLALKOHOL; SECONDARY PROPYL ALCOHOL; SPECTRAR; STERISOL HAND DISINFECTANT; TAKINEOCOL; VISCO 1152
Derivation: Treating propylene with sulfuric acid and then hydrolyzing or direct hydration of propylene using superheated steam. Most commonly available as rubbing alcohol (70% IPA).
General Use: As a solvent for gums, shellac, and essential oils, chemical intermediate, dehydrating agent, vehicle for germicidal compounds, de-icing agent for liquid fuels; for denaturing ethyl alcohol, preserving pathological specimens; in extraction of alkaloids, quick-drying inks and oils, and an ingredient of skin lotions, cosmetics, window cleaner, liquid soaps, and pharmaceuticals.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Isopropyl alcohol	67-63-0	100% vol.

Most commonly sold as 70% isopropyl alcohol (rubbing alcohol).

OSHA PEL
TWA: 400 ppm; 980 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 400 ppm; 980 mg/m^3;
STEL: 500 ppm; 1225 mg/m^3.

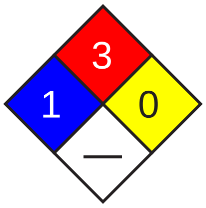
ACGIH TLV
TWA: 200 ppm; STEL: 400 ppm.

NIOSH REL
TWA: 400 ppm, 980 mg/m^3;
STEL: 500 ppm, 1225 mg/m^3.

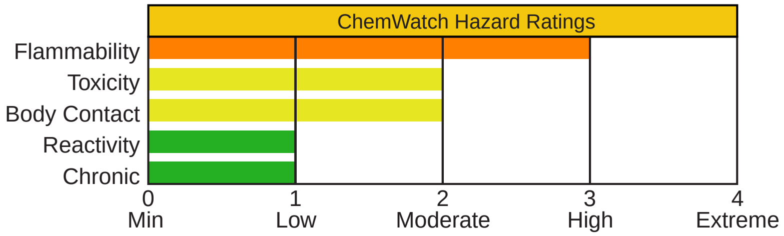
IDLH Level
2000 ppm (10% LEL).

DFG (Germany) MAK
TWA: 200 ppm; PEAK: 400 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
3	Flammability
0	Reactivity

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Isopropyl alcohol is a highly flammable, volatile liquid. It is considered more toxic than ethyl alcohol, but less toxic than methyl alcohol. Inhalation can cause irritation of the eyes and respiratory tract and central nervous system depression at high concentrations. Repeated skin contact may cause dermatitis. Systemic toxicity appears to occur mostly in cases of heavy ingestion or inhalation. There is recent evidence that skin absorption may be more likely to cause systemic effects than previously thought.

Potential Health Effects

Target Organs: Eyes, skin, respiratory system.

Primary Entry Routes: Inhalation, ingestion, skin contact/absorption.

Acute Effects

Inhalation: Vapor inhalation is irritating to the respiratory tract and can cause central nervous system depression at high concentrations. Volunteers exposed to 400 ppm for 3 to 5 min experienced mild eye and respiratory irritation. At 800 ppm, irritation was not severe, but most people found the air uncomfortable to breathe.

Eye: Exposure to the vapor or direct contact with the liquid causes irritation and possible corneal burns.

Skin: Some irritation may occur after prolonged exposure.

Ingestion: Accidental ingestions have provided the most information on isopropyl alcohol toxicity. Symptoms include nausea and vomiting, headache, facial flushing, dizziness, lowered blood pressure, mental depression, hallucinations and distorted perceptions, difficulty breathing, respiratory depression, stupor, unconsciousness, and coma. Kidney insufficiency including oliguria (reduced urine excretion), anuria (absent urine excretion), nitrogen retention, and edema (fluid build-up in tissues) may occur. One post-mortem examination in a case of heavy ingestion showed extensive hemorrhagic tracheobronchitis, broncho pneumonia, and hemorrhagic pulmonary edema. Death can occur in 24 to 36 h post-ingestion due to respiratory paralysis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Dermatitis or respiratory or kidney disorders.

Chronic Effects: Repeated skin contact can cause drying of skin and delayed hypersensitivity reactions in some individuals.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. Vomiting may be contraindicated because of the rapid onset of central nervous system depression. Gastric lavage is preferred.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Diagnostic test: acetone in urine. Isopropyl alcohol is oxidized in the body to acetone where it is excreted by the lungs or kidneys. Some acetone may be further metabolized to acetate, formate, and finally carbon dioxide. Probable oral lethal dose is 240 mL.

Section 5 - Fire-Fighting Measures

Flash Point: 53 °F (12 °C), Closed Cup

Burning Rate: 2.3 mm/min.

Autoignition Temperature: 750°F (399°C)

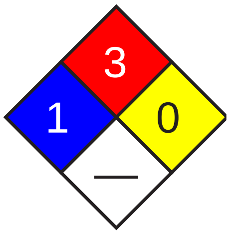
LEL: 2 % v/v

UEL: 12.7 % v/v at 200 °F

Flammability Classification: Class 1B Flammable Liquid

Extinguishing Media: Carbon dioxide, dry chemical, water *spray* (solid streams can spread fire), alcohol- resistant foam, or fog.

General Fire Hazards/Hazardous Combustion Products: Carbon oxides and acrid smoke. Container may explode in heat of fire. Vapors may travel to an ignition source and flash back. Isopropyl alcohol poses an explosion hazard indoors, outdoors, and in sewers.



Fire Diamond

Fire-Fighting Instructions: If possible without risk, move container from fire area. Apply cooling water to container side until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Water spray may reduce vapor, but may not prevent ignition in closed spaces.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use non-sparking tools to open containers.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using isopropyl alcohol, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec 10). Install electrical equipment of Class 1, Group D.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around IPA. Provide general or local exhaust ventilation systems to maintain airborne levels below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin, kidneys, and respiratory system. Be extra cautious when using IPA concurrently with carbon tetrachloride because animal studies have shown it enhances carbon tetrachloride's toxicity.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Nitrile rubber (breakthrough time > 8 hr), Neoprene and Teflon (breakthrough time > 4 hr) are suitable materials for PPE. Do not use PVA, PVC or natural rubber (breakthrough time < 1 hr). Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use any powered, air purifying respirator with organic vapor cartridges or any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s). For < 10,000 ppm, use any supplied-air respirator (SAR) operated in continuous-flow mode. For < 12,000 ppm, use any air- purifying, full facepiece respirator (gas mask) with a chin-style, front-or back-mounted organic vapor canister or any SCBA or SAR with a full facepiece. For emergency or entrance into unknown concentrations, use any SCBA or SAR (with auxiliary SCBA) with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove isopropyl alcohol from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless with a slight odor and bitter taste.

Physical State: Liquid

Odor Threshold: 22 ppm (reported from 1 to 610 ppm)

Vapor Pressure (kPa): 44 mm Hg at 25 °F (77 °C)

Formula Weight: 60.09

Density: 0.78505 at 68°F (20 °C)

Refractive Index: 1.375 at 68 °F (20 °C)

Boiling Point: 180.5 °F (82.5 °C)

Freezing/Melting Point: -129.1 °F (-89.5 °C)

Viscosity: 2.1 cP at 77 °F (25 °C)

Surface Tension: 20.8 dyne/cm at 77 °F (25 °C)

Ionization Potential (eV): 10.10 eV

Critical Temperature: 455 °F (235 °C)

Critical Pressure: 47 atm

Water Solubility: > 10 %

Other Solubilities: Soluble in alcohol, ether, chloroform, and benzene. Insoluble in salt solutions.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Isopropyl alcohol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, ignition sources, and incompatibles.

Storage Incompatibilities: Include acetaldehyde, chlorine, ethylene oxide, acids and isocyanates, hydrogen + palladium, nitroform, oleum, phosgene, potassium *t*-butoxide, oxygen (forms unstable peroxides), trinitromethane, barium perchlorate, tetrafluoroborate, chromium trioxide, sodium dichromate + sulfuric acid, aluminum, aluminum triisopropoxide, and oxidizers. Will attack some forms of plastic, rubber, and coatings.

Hazardous Decomposition Products: Thermal oxidative decomposition of isopropyl alcohol can produce carbon oxides and acrid smoke.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 5045 mg/kg caused a change in righting reflex, and somnolence (general depressed activity).

Human, oral, TD_{Lo}: 223 mg/kg caused hallucinations, distorted perceptions, lowered blood pressure, and a change in pulse rate.

Human, oral, LD_{Lo}: 3570 mg/kg caused coma, respiratory depression, nausea, and vomiting.

Irritation Effects:

Rabbit, eye: 100 mg caused severe irritation.

Rabbit, skin: 500 mg caused mild irritation.

Other Effects:

Rat, inhalation: 3500 ppm/7 hr given from 1 to 19 days of pregnancy caused fetotoxicity.

See NIOSH, *RTECS* NT8050000, for additional data.

Section 12 - Ecological Information

Environmental Fate: On soil, IPA will volatilize or leach into groundwater. Biodegradation is possible but rates are not found in available literature. It will volatilize (est. half-life = 5.4 days) or biodegrade in water. It is not expected to bioconcentrate in fish. In the air, it reacts with photochemically produced hydroxyl radicals with a half-life of one to several days. Because it is soluble, removal by rain, snow or other precipitation is possible.

Ecotoxicity: Guppies (*Poecilia reticulata*) LC_{50} = 7,060 ppm/7 days; fathead minnow (*Pimephales promelas*) LC_{50} = 11,830 mg/L/1 hr. BOD = 133 %/5 days.

Octanol/Water Partition Coefficient: log K_{ow} = 0.05

Section 13 - Disposal Considerations

Disposal: Microbial degradation is possible by oxidizing isopropyl alcohol to acetone by members of the genus *Desulfovibrio*. Spray waste into incinerator (permit-approved facilities only) equipped with an afterburner and scrubber. Isopropyl alcohol can be settled out of water spills by salting with sodium chloride. Note: Salt may harm aquatic life, so weigh the benefits against possible harm before application. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Triple rinse containers.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Isopropanol or isopropyl alcohol
Hazard Class: 3
ID No.: UN1219
Packing Group: II
Label: Flammable Liquid

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
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Lead
MSDS 713
LEA1000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Lead **CAS Number:** 7439-92-1
Chemical Formula: Pb
Structural Chemical Formula: Pb
Synonyms: C.I. 77575; C.I. PIGMENT METAL 4; GLOVER; KS-4; LEAD; LEAD FLAKE; LEAD INORGANIC; LEAD METAL; LEAD S2; LEAD SZ; OLOW; OMAHA & GRANT; PB-S 100; PLUMBUM
General Use: Used as a construction material in chemical reaction equipment (tank piping,etc.); manufacture of tetraethyl lead; pigments for paints.
Used in pottery glazes, glass, ceramics, bearing metal and alloys, solder and other lead alloys.
Also used in metallurgy of steel and other metals, cable sheathing, storage batteries, radiation shielding and ammunition.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
lead	7439-92-1	>99

OSHA PEL
STEL: 0.05 mg/m^3; as Pb inorganic.

ACGIH TLV
TWA: 0.05 mg/m^3.

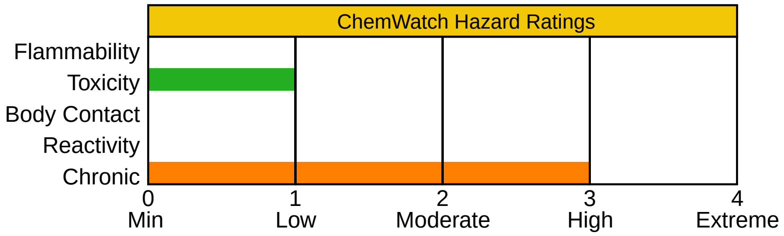
NIOSH REL
TWA: 0.1 mg/m^3.

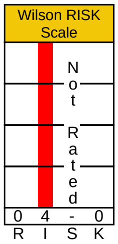
IDLH Level
100 mg/m^3; as Pb.

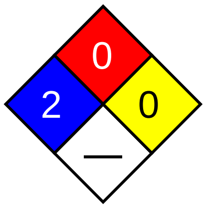
DFG (Germany) MAK
TWA: 0.1 mg/m^3.

Section 3 - Hazards Identification

HMIS	
3	Health
1	Flammability
0	Reactivity







Fire Diamond

ANSI Signal Word
Danger!

Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Bluish-white, silvery, or gray metal. Cumulative poison. Repeated low exposures causes: severe neurological effects, blood/kidney damage. Possible cancer hazard. Reproductive damage (sterility, decreased fertility) and developmental damage to fetus.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion
Target Organs: blood, central nervous system (CNS), peripheral nervous system, kidneys, gastrointestinal (GI) tract
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.
Eye: The dust may be discomforting to the eyes.
Skin: The material may be mildly discomforting to the skin.
Prolonged exposure may cause skin reactions.
Skin absorption is not considered a significant route of exposure.
Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed.
In rats intestinal lead absorption is bidirectional and does not follow a linear relationship with oral dose.

Acute effects of exposure are generally minor because of its relative insolubility and physical form. Unusual instances of exposure have been reported in inadequately ventilated indoor firing ranges (as fume), in the application of surma, a mascara-like cosmetic agent, to the conjunctival surfaces in Asian countries and in lead-smelting and associated occupations.

In humans lead metabolism fits into a three compartment model. The first compartment in which lead has a half-life of about 35 days includes the blood; it receives blood from the gut and delivers some of it to the urine and communicates with the other two pools. The second compartment in which lead has a similar half-life includes the soft tissues which contain about half the blood level; they share lead with hair, nails, sweat, saliva, bile and other digestive secretions. The skeleton is the third compartment and contains the vast bulk of the total body burden, possesses a very long half-life and demonstrates a difference between the dense and less dense components to bind lead.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: Symptoms of exposure include headache, fatigue, sleep disturbances, abdominal pains and decreased appetite. Overexposure to lead in the form of dust has toxic effects on the lungs and kidneys and on the nervous system resulting in mental disturbances and anemia.

Skin absorption is not considered to be a significant route of exposure.

Worker exposure to lead must be kept to a minimum, especially in cases where lead is worked at temperatures whereby lead vapors are evolved e.g. metal refining.

Lead is an accumulative poison and exposure even to small amounts can raise the body's content to toxic levels.

Potential adverse effects on the offspring of pregnant workers have been cited in the literature.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water.

Seek medical attention if irritation or discomfort persist.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: 1.Gastric acids solubilize lead and its salts and lead absorption occurs in the small bowel.

2.Particles of less than 1um diameter are substantially absorbed by the alveoli following inhalation.

3.Lead is distributed to the red blood cells and has a half-life of 35 days.

It is subsequently redistributed to soft tissue & bone-stores or eliminated.The kidney accounts for 75% of daily lead loss; integumentary and alimentary losses account for the remainder.

4.Neurasthenic symptoms are the most common symptoms of intoxication.

Lead toxicity produces a classic motor neuropathy.

Acute encephalopathy appears infrequently in adults.

Diazepam is the best drug for seizures.

5.Whole-blood lead is the best measure of recent exposure; free erythrocyte protoporphyrin (FEP) provides the best screening for chronic exposure. Obvious clinical symptoms occur in adults when whole-blood lead exceeds 80 ug/dL.

6.British Anti-Lewisite is an effective antidote and enhances fecal and urinary excretion of lead. The onset of action of BAL is about 30 minutes and most of the chelated metal complex is excreted in 4-6 hours, primarily in the bile.

Adverse reaction appears in up to 50% of patients given BAL in doses exceeding 5 mg/kg. CaNa2EDTA has also been used alone or in concert with BAL as an antidote.

D-penacillamine is the usual oral agent for mobilization of bone lead; its use in the treatment of lead poisoning remains investigational.

2-3-dimercapto-1-propanesulfonic acid (DMPS) and dimercaptosuccinic acid (DMSA) are water soluble analogues of BAL and their effectiveness is undergoing review.

As a rule, stop BAL if lead decreases below 50 ug/dL; stop CaNa2EDTA if blood lead decreases below 40 ug/dL or urinary lead drops below 2 mg/24 hrs.

BIOLOGICAL EXPOSURE INDEX - BEI

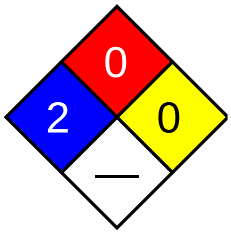
These represent the determinants observed in specimens collected from a healthy worker who has been exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Lead in blood	50 ug/100 mL	Not Critical	B
Lead in urine	150 ug/gm creatinine	Not critical	B
Zinc Protoporphyrin in blood	250 ug/100 mL erythrocytes OR 100 ug/100 mL blood	After 1 month exposure	B

B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: Not available; probably noncombustible
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: There is no restriction on the type of extinguisher which may be used.
General Fire Hazards/Hazardous Combustion Products: Noncombustible.
Not considered to be a significant fire risk; however, containers may burn.
Moderate fire hazard, in the form of dust, when exposed to heat or flames.
Decomposition products may include toxic lead dust and lead oxide fumes.



Fire Diamond

Fire Incompatibility: Incompatible with strong acids, oxidants, ammonium nitrate, chlorine trifluoride and sodium azide.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Use fire fighting procedures suitable for surrounding area.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
If safe to do so, remove containers from path of fire.
Cool fire-exposed containers with water spray from a protected location.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective clothing, gloves, safety glasses and dust respirator.
Use dry clean-up procedures and avoid generating dust.
Vacuum up.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Control personal contact by using protective equipment and dust respirator.
Prevent spillage from entering drains, sewers or waterways.
Recover product wherever possible. Avoid generating dust. Sweep / shovel up.
If required, wet with water to prevent dusting.
Put residues in labeled plastic bags or other containers for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.

Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved dust respirator.
Correct fit is essential to obtain adequate protection.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Impervious gloves; rubber gloves.
Rubber boots.
Protective footwear.

Respiratory Protection:
Exposure Range >0.05 to 0.5 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >0.5 to 2.5 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >2.5 to 50 mg/m^3: Powered Air Purifying Respirator, Half or Full Facepiece or Hood
Exposure Range >50 to 100 mg/m^3: Supplied Air Respirator with Full Facepiece, Hood, Helmet, or Suit, operated in a Positive Pressure Mode
Exposure Range >100 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)
Note: (29CFR 1910.1025) for general industry

Other: Overalls. Eyewash unit. Skin cleansing cream.
Provide adequate ventilation in warehouse or closed storage areas.
General and local exhaust ventilation usually required to maintain airborne dust levels to safety levels.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Bluish-white, silvery-gray metal. Malleable, lustrous when freshly cut and tarnishes when exposed to air. Reacts with strong acids like nitric acid, sulphuric or hydrochloric acid. Attacked by water in presence of oxygen. Poor electrical conductor. Lead fumes are formed at temperatures above 500-700 °C.

Physical State: Divided solid
Vapor Pressure (kPa): 0.24 at 1000 °C
Vapor Density (Air=1): Not applicable
Formula Weight: 207.19
Specific Gravity (H_2O=1, at 4 °C): 11.34
Water Solubility: Insoluble in water
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 1740 °C (3164 °F)
Freezing/Melting Point Range: 327.4 °C (621.32 °F)
Volatile Component (% Vol): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Hazardous polymerization will not occur. Stable under normal storage conditions.

Storage Incompatibilities: Avoid storage with strong acids, oxidants, ammonium nitrate, chlorine trifluoride and sodium azide.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (woman) TD_{Lo}: 450 mg/kg/6 years	Nil Reported
Inhalation (human) TC_{Lo}: 0.01 mg/m^3	

WARNING: Lead is a cumulative poison and has the potential to cause abortion and intellectual impairment to unborn children of pregnant workers.

See NIOSH, *RTECS* OF 7525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released or deposited on soil, it will be retained in the upper 2-5 cm of soil, especially soils with at least 5% organic matter or a pH 5 or above. Leaching is not important under normal conditions although there is some evidence to suggest that it is taken up by some plants. Generally, the uptake from soil into plants is not significant. It is expected to slowly undergo speciation to the more insoluble sulfate, sulfide, oxide, and phosphate salts. It enters water from atmospheric fallout, runoff or wastewater; little is transferred from natural ores. It is a stable metal and adherent films of protective insoluble salts form that protect the metal from further corrosion. That which dissolves tends to form ligands. It is effectively removed from the water column to the sediment by adsorption to organic matter and clay minerals, precipitation as insoluble salt (the carbonate or sulfate, sulfide), and reaction with hydrous iron and manganese oxide. Under most circumstances, adsorption predominates. It does not appear to bioconcentrate significantly in fish but does in some shellfish such as mussels. When released to the atmosphere, it will generally be in dust or adsorbed to particulate matter and subject to gravitational settling and be transformed to the oxide and carbonate.

Ecotoxicity: LC_{50} Japanese quail (Coturnix japonica), males or females, 14 days old, oral (5-day ad libitum in diet) >5,000 ppm; at 1000, 2236 & 5000 onset of toxic signs began at 7, 7 & 7 days and remissed at 11, 11 & 12 days, respectively, no mortality was observed; control references were dieldrin & dicrotophos; corn oil diluent was added to diet at ratio of 2:98 by wt; (extreme concentrations: 1,000-5,000 ppm)

BCF: freshwater fish 1.38 to 1.65

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NONE
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a) 10 lb (4.535 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Research Date:............................1999-11 **Review Date:** 2000-07

Material Safety Data Sheet Collection
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Magnesium
MAG1840

Section 1 - Chemical Product and Company Identification

Material Name: Magnesium **CAS Number:** 7439-95-4
Chemical Formula: Mg
EINECS Number: 231-104-6
Synonyms: MAGNESIO; MAGNESIUM; MAGNESIUM CLIPPINGS; MAGNESIUM PELLETS; MAGNESIUM POWDERED; MAGNESIUM RIBBONS; MAGNESIUM SHEET; MAGNESIUM TURNINGS; NORSK HYDRO NORMAG MAGNESIUM; RIEKE'S ACTIVE MAGNESIUM; RMC
Derivation: By the reduction of magnesium oxide with ferrosilicon (Pidgeon process) or by electrolysis of fused magnesium chloride (Dow sea water process).
General Use: In aluminum alloys for structural parts, diecast auto parts, space vehicles, missiles; in the production of zirconium, titanium, zinc, nickel, and iron; as a powder for flash photography and pyrotechnics; in anti-knock gasoline additives, cathodic protection, desulfurizing iron in steel manufacture, dry and wet batteries, precision instruments, and optical mirrors; as a reducing agent; and in magnesium compounds and Grignard syntheses.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Magnesium	7439-95-4	99.9% wt

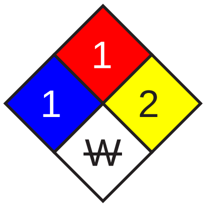
Trace Impurities: aluminum, copper, iron, manganese, nickel, and silicon

OSHA PEL
No data found.

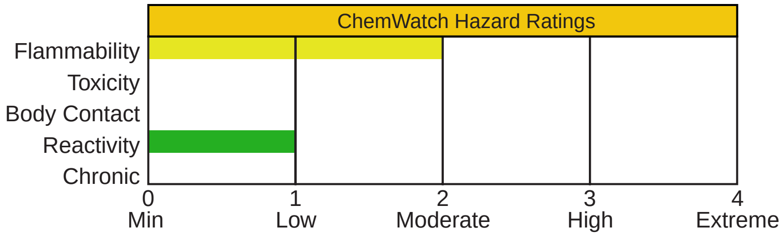
NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
① Flammability
② Reactivity

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Magnesium is a silvery white metal; odorless. Dust and fume inhalation causes respiratory tract irritation. Inhalation of magnesium fumes causes metal fume fever. Molten metal causes thermal burns. Magnesium metal powder is a dangerous fire hazard when wet. It may ignite spontaneously. The powder also forms explosive mixtures with air which may be ignited by a spark.

Potential Health Effects

Target Organs: Respiratory tract, skin, eyes, digestive tract
Primary Entry Routes: Inhalation, skin contact (with penetration of metal particles)
Acute Effects
Inhalation: Dust inhalation causes irritation of the upper respiratory tract resulting in atrophic nasopharyngitis. Inhalation of magnesium fumes can cause metal fume fever with febrile conditions, cough, a feeling of pressure on the chest, and leukocytosis (an increase in the number of leukocytes circulating in the blood).
Eye: Contact with dust may cause conjunctivitis. Fume irritates eyes.
Skin: Magnesium particles imbedded in the skin can produce sores that resist healing and an accumulation of gas under the skin and gaseous blebs (small blisters). Molten magnesium causes thermal burns.

Ingestion: Highly unlikely route of exposure. However, ingestion of substantial amounts of magnesium may cause hypermagnesemia with nausea, vomiting, hypotension, ECG changes, and neuromuscular transmission impairment, drowsiness, sweating, unsteadiness, and respiratory paralysis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Respiratory and digestive disorders.

Chronic Effects: May cause digestive disturbances including peptic ulcers. With overexposure to dust and fume, chronic respiratory irritation is expected.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water. Consult a physician or ophthalmologist if pain and/or irritation develop.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water to remove loose particles. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center for significant ingestion. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically and supportively. For cases of ingestion, monitor EKG and vital signs frequently. Hemodialysis is the most effective method to remove significant quantities of magnesium. Magnesium is more toxic if renal function is impaired.

Section 5 - Fire-Fighting Measures

Flash Point: The solid is difficult to ignite. Finely divided magnesium powder may be ignited by spark or flame or even spontaneously when damp.

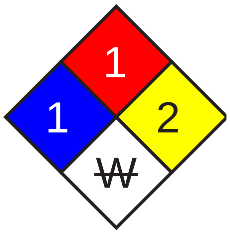
Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Extinguishing Media: *Do not* use water or foam. Use dry sand, sodium chloride powder, graphite powder, or Met-L-X powder.

General Fire Hazards/Hazardous Combustion Products: Magnesium oxide. Magnesium may ignite itself if it is exposed to air or in the presence of moisture, particularly with water-oil emulsion. It may reignite itself after the fire is extinguished. Its violent reaction with water will generate flammable and explosive hydrogen.



Fire Diamond

Fire-Fighting Instructions: Protect eyes and skin against flying particles. Avoid direct viewing of magnesium fires as eye injury may result. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition and water sources, and isolate and ventilate area. Cleanup personnel should protect against dust and fume inhalation and skin and eye contact.

Small Spills: Carefully place in clean, dry, metal containers and remove to clean, dry storage. Keep away from water.

Large Spills: Cover with plastic sheet to prevent dispersion. *Do not* release into sewers or waterways. Use nonsparking tools during clean-up. *Do not* use water. *Do not* dry sweep.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid dust and fume inhalation and contact with skin and eyes. Use with ventilation sufficient to reduce airborne concentrations to the lowest feasible level. Practice good personal hygiene procedures. Thoroughly wash after handling. Use nonsparking tools when working with or near magnesium. Prohibit open flames or electrical or gas cutting or welding equipment where magnesium dust is produced or handled. During machining, do not use dull cutting tools, rub tool on work after cutting operation is complete, or machine with light (thin) cuts at high speeds as magnesium fires may result.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store finely divided chips or shavings in detached fire-resistive building. Protect from moisture and keep away from chlorine, bromine, iodine, acids, other incompatibles (see Sec. 10) and possible ignition sources. Protect molten magnesium by an atmosphere of sulfur dioxide gas.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose operations and/or ventilate at the site of chemical release to prevent dust dispersion into the work area. To eliminate ignition sources, ground and bond all containers and equipment. Dust-ignition proof electrical equipment (Class II, Group E) is required. Construct buildings in which magnesium is cast or machined of nonflammable materials and without protuberances or ledges on which magnesium dust might accumulate. Collect magnesium grinding dust in a dust collector specifically approved for this purpose. Remove collected material frequently. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the hazards associated with magnesium. Train in safe work practices. Practice good housekeeping procedures. Frequently collect magnesium turnings and borings, store them in a clean, dry, metal-covered container labeled "Magnesium Only."

Personal Protective Clothing/Equipment: Wear protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. For casting the metal, wear leather aprons and hand protection to protect against the "spatter" of small particles. For machining or buffing, wear overalls to which small metal fragments will not adhere. Wear protective eyeglasses or chemical safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator equipped with particulate (dust/fume/mist) filters. For exposure to potentially high concentrations, use a supplied-air respirator with a full facepiece operated in the positive-pressure mode; or with a full facepiece, hood, or helmet in the continuous flow mode; or a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or other positive-pressure mode. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Silvery white metal; odorless

Physical State: Solid

Vapor Pressure (kPa): 1 mm Hg at 1149.8 °F (621 °C)

Formula Weight: 24.305

Density: 1.738 g/cm^3 at 68 °F (20 °C)

Boiling Point: 2024.6 °F (1107 °C)

Freezing/Melting Point: 1202 °F (650 °C)

Water Solubility: Insoluble in cold water; slightly soluble with decomposition in hot water

Other Solubilities: Soluble in mineral acids; *insoluble* in chromium trioxides

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Magnesium is stable at room temperature in closed containers under normal storage and handling conditions. Magnesium slowly oxidizes in air. It is strongly attacked by salt air. Hazardous polymerization cannot occur. Contact with incompatibles (listed above) and heat and ignition sources.

Storage Incompatibilities: Reacts violently with water (evolves highly flammable hydrogen gas), chlorinated solvents, methanol, hydrogen peroxide, oxidizing agents, sulfur compounds, animal and vegetable oils, acids (evolves hydrogen), metal oxides, metal cyanides, metal oxide salts, oxygen, and tellurium compounds.

Hazardous Decomposition Products: Thermal oxidative decomposition of magnesium can produce magnesium oxide.

Section 11 - Toxicological Information

No data found.

See NIOSH, *RTECS* OM2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: Data not found.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Magnesium [or] magnesium alloys (with more than 50% magnesium in pellets, turnings, or ribbons)
Hazard Class: 4.1
ID No.: UN1869
Packing Group: III
Label: 4.1

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Not listed
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Issue Date: 2003-02

Manganese
MAN2060

Section 1 - Chemical Product and Company Identification

Material Name: Manganese **CAS Number:** 7439-96-5
Chemical Formula: Mn
EINECS Number: 231-105-1
Synonyms: COLLOIDAL MANGANESE; CUTAVAL; MAGNACAT; MANGAN; MANGAN NITRIDOVANY; MANGANESE; MANGANESE FUME; MANGANESE METAL: COLLOIDAL MANGANESE; MANGANESE POWDER; MANGANESE-55 SYNONYMS OF OTHER COMPOUNDS VARY DEPENDING UPON THE SPECIFIC MANGANESE COMPOUND; MANGANESE,DUST AND FUME; TRONAMANG
Derivation: Derived from manganese ore by aluminum or carbon reduction, leaching roasted ore, or electrolitically from chloride solution.
General Use: As a component of steel, steel alloys, cast iron, superalloys and nonferrous alloys; for rock crushers; railway points and crossings; wagon buffers; in the manufacturing of ceramics, matches, glass, dyes, welding rods; as a chemical intermediate for high purity salts; purifying and scavenging agent in metal production; in the production of batteries.

Section 2 - Composition / Information on Ingredients

Name	**CAS**	**%**
Manganese	7439-96-5	ca 97-99.9% pure

Trace Impurities: Include iron, zinc, copper, silica, alumina, lime, magnesia, baria, water, carbon dioxide, organic matter, sulfur, phosphorous, and arsenic.

OSHA PEL
Ceiling: 5 mg/m^3; as Mn, fume.

OSHA PEL Vacated 1989 Limits
TWA: 1 mg/m^3; STEL: 3 mg/m^3; as Mn. Other Values: mg/m^3, Ceiling mg/m^3; 5.

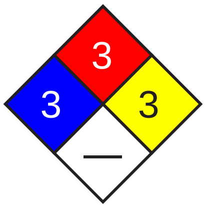
ACGIH TLV
TWA: 0.2 mg/m^3.

NIOSH REL
TWA: 1 mg/m^3; STEL: 3 mg/m^3.

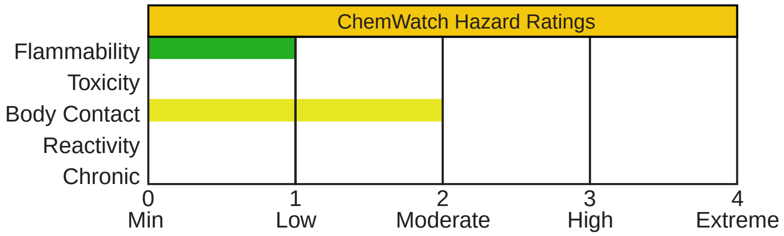
IDLH Level
500 mg/m^3; as Mn.

DFG (Germany) MAK
TWA: 0.5 mg/m^3; ceiling, measured as inhalable fraction of the aerosol, substances with systemic effects, onset of effect greater than 2 hours, half-life greater than shift length, strongly cumulative.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
① Flammability
① Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Manganese is a lustrous, brittle, reddish-grey or silvery powder. It is odorless. Irritating to eyes and skin. Fume inhalation causes: metal fume fever, managanese pneumonitis. Dust and powder are moderately flammable and explosive when exposed to flame.

Potential Health Effects

Target Organs: Eyes, skin, respiratory system, nervous system, kidneys, blood
Primary Entry Routes: Inhalation

Acute Effects

Inhalation: May cause metal fume fever, manganese pneumonitis, asthma, pleuritis (inflammation of the lung cavity membrane), and psychosis. Metal fume fever is characterized by fever, chills, nausea, weakness, body aches, frontal headache, occasional blurred vision, low back pain, muscle cramping, shallow respiration, throat dryness and irritation, dry cough, a sweet or metallic taste, and chest tightness occurring over several hours.

Eye: Irritation, conjunctivitis, corneal damage.

Skin: Irritation, dermatitis.

Ingestion: Large doses cause gastrointestinal tract irritation.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Alcoholism, chronic infections, chronic obstructive lung disease, diseases of the excreting organs, iron deficiency, low calcium levels, or vitaminosis may increase susceptibility to manganese. Those with psychological or neurological disorders should not work with manganese.

Chronic Effects: Affects the central nervous system (CNS) to cause manganese poisoning, or manganism. Symptoms include headache, sleepiness, personality changes, psychosis, irritability, inappropriate laughing/crying to visual hallucinations, double vision, slurred speech, uncontrolled impulse behavior, impotence, euphoria, tinnitus, abnormal reaction to painful stimuli, excess salivation, trembling in extremities and head, impaired walking, muscle weakness, lack of facial expression, other signs similar to Parkinson's disease. May damage the kidneys and liver.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. Monitor for symptoms of systemic effects.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

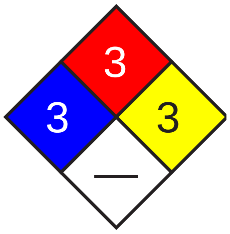
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: If symptoms develop or overexposure is suspected, consider chest x-ray and liver function tests. Plasma and urine manganese levels do not correlate well with severity of symptoms.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Not applicable, combustible solid

Autoignition Temperature: Manganese dust clouds: 842 °F (450 °C)

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use dry chemical extinguishing agent designed for metal fires.

General Fire Hazards/Hazardous Combustion Products: Include manganese oxides (MnO_x). Dust and powder are moderately explosive when exposed to flame or heated in carbon dioxide. Reacts with water or steam to release flammable hydrogen gas.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Tag container as defective and return to supplier. Use spark-proof tools and explosion proof equipment. Cleanup personnel should protect against exposure.

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills: *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: To avoid dust inhalation use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels (see Sec. 2). Avoid skin and eye contact. Wear personal protective clothing and equipment to prevent contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from heat, ignition sources, water, steam, and incompatibles.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid dust dispersion into the work area. Ventilate at the site of dust or fume release. To prevent static sparks, electrically ground and bond all containers and equipment. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (see Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the nervous system, blood, lungs, and kidneys.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For exposures <=10 mg/m^3 use a dust and mist respirator, except single-use and quarter-mask respirators, or supplied-air respirator; <=25 mg/m^3 use a supplied-air respirator operated in continuous-flow mode, or any powered, air-purifying respirator with a dust and mist filter; <=50 mg/m^3 use an air- purifying, full-facepiece respirator with a high-efficiency particulate filter, any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode or has a full facepiece, any powered, air-purifying respirator with a tight- fitting facepiece and a high-efficiency particulate filter, or any SCBA with a full facepiece; <=500 mg/m^3 use any supplied-air respirator operated in a pressure-demand or other positive-pressure mode; Emergency or planned entry into unknown concen trations or IDLH conditions: any SCBA 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 SCBA operated in a pressure-demand or other positive-pressure mode; Escape: any air-purify ing, full-facepiece respirator with a high-efficiency particulate filter or any appropriate escape-type SCBA. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Reddish-gray, silvery powder or hard gray metal; odorless.

Physical State: Solid

Vapor Pressure (kPa): 1 mm Hg at 2357.6 °F (1292 °C

Formula Weight: 54.94

Density: 7.3 g/cm^3

Specific Gravity (H_2O=1, at 4 °C): 7.2

Boiling Point: 3564 °F (1962 °C)

Freezing/Melting Point: 2265.8 °F (1241 °C) to 2276.6 °F (1247 °C)

Ionization Potential (eV): 7.43402 +/-0.00002 eV

Water Solubility: Insoluble; reacts at high temperatures

Other Solubilities: Soluble in dilute mineral acids and aqueous solutions of sodium or potassium bicarbonate.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Manganese is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid contact with chemical incompatibles, heat, and sources of ignition.

Storage Incompatibilities: Include hydrogen peroxide, bromine pentafluoride, fluorine, chlorine and heat, sulfur dioxide and heat, nitrogen dioxide, ammonium nitrate, oxidants, nitrogen dioxide, nitric acid, phosphorus, nitryl fluoride, acids, concentrated potassium and sodium hydroxides. Reacts with water at 212 °F (100 °C) to release hydrogen. Mixtures of aluminum dust and manganese dust may explode in air.

Hazardous Decomposition Products: Thermal oxidative decomposition of manganese can produce manganese oxides (MnO_x).

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 9 g/kg.
Acute Inhalation Effects:
Man, inhalation, TC_{Lo}: 2300 µg/m^3 produced toxic effects: brain and coverings - other degenerative changes; behavioral - change in motor activity (specific assay and muscle weakness.
Irritation Effects:
Rabbit, eye, standard Draize test: 500 mg/24 hr caused mild irritation.
Rabbit, skin, standard Draize test: 500 mg/24 hr caused mild irritation.
Other Effects:
Rat, intramuscular: 400 mg/kg for 1 year, intermittent, produced tumors at site of application (equivocal tumorigenic agent by RTECS criteria).

See NIOSH, *RTECS* OO9275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Manganese undergoes complex geochemical cycling, and can accumulate in the top layer of sediment in lakes.
Ecotoxicity: Data not found.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Toxic solid, inorganic n.o.s.
Hazard Class: 6.1
ID No.: UN3288
Packing Group: II
Label: 6.1

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed as Compound per CAA Section 112
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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Issue Date: 2003-02

Mercury
MER8040

Section 1 - Chemical Product and Company Identification 44/57

Material Name: Mercury **CAS Number:** 7439-97-6
Chemical Formula: Hg
EINECS Number: 231-106-7
Synonyms: COLLOIDAL MERCURY; HYDRARGYRUM; KWIK; LIQUID SILVER; MERCURE; MERCURIO; MERCURY; MERCURY (ELEMENTAL); MERCURY METAL: COLLOIDAL MERCURY; MERCURY,METALLIC; METALLIC MERCURY; QUECKSILBER; QUICK SILVER; QUICKSILVER; QUICKSILVER SYNONYMS OF; RTEC
Derivation: Obtained by roasting cinnabar (mercury sulfide) and purified by distillation, or as a by-product of gold mining.
General Use: Used in agricultural poisons, anti-fouling paint, dental amalgams, mining amalgamation (to remove gold and other metals from ore), thermometers, barometers, dry cell batteries, chlorine and caustic soda production, electrical apparatus, and as a neutron absorber in nuclear power plants.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Mercury		ca 100% wt

OSHA PEL
Ceiling: 0.1 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 0.05 mg/m^3; STEL: 0.1 mg/m^3.

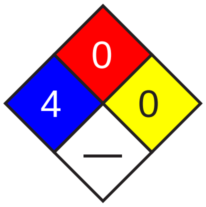
ACGIH TLV
TWA: 0.025 mg/m^3; skin.

NIOSH REL
TWA: 0.05 mg/m^3; Ceiling: 0.1 mg/m^3; skin, as Hg vapor.

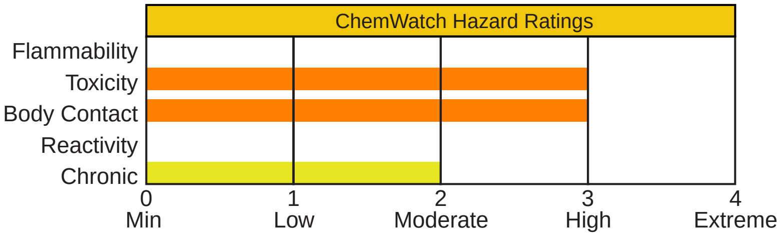
IDLH Level
10 mg/m^3; as Hg.

DFG (Germany) MAK
TWA: 0.1 mg/m^3; danger of sensitization of the skin, substances with systemic effects, onset of effect greater than 2 hours, half-life greater than shift length, strongly cumulative.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
4	Health
0	Flammability
0	Reactivity

ANSI Signal Word

Danger!

Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Mercury exists as a heavy, odorless, silver-white liquid metal. It is highly toxic by both acute and chronic exposure. Exposure can cause corrosion of the eyes, skin, and respiratory tract and may result in irreversible nervous system damage. It readily forms amalgamations with most metals except iron.

Potential Health Effects

Target Organs: Central nervous system, eyes, skin, respiratory system, liver, kidneys.
Primary Entry Routes: Inhalation, eye and skin contact/absorption.

Acute Effects The onset of signs and symptoms usually is prompt, but may be delayed up to 12 hr.

Systemic Effects by all routes: Nausea, vomiting, abdominal pain, diarrhea, excessive salivation, sweating, headache, giddiness, vertigo (dizziness), weakne ss, blurring or dimness of vision, miosis or mydiasis (dilatation of the pupils), tearing, bradycardia (slow heart beat), tachycardia (fast heart beat), cardiac irregularities (arrhythmias, compl ete heart block), loss of muscle coordination, slurred speech, muscle twitching (particularly tongue and eyelids), generalized profound weakness, confusion, disorientation, drowsiness, difficulty in breathing, excessive secretion of saliva and mucus, cyanosis, rales, high blood pressure, random jerky movements, incontinence, convulsions, coma, and death due to respiratory paralysis.

Inhalation: Exposure to high vapor concentrations can cause severe respiratory damage. Other symptoms include wakefulness, muscle weakness, anorexia, headache, ringing in the ear, headache, diarrhea, liver changes, fever, gingivitis, chest pain, difficulty breathing, cough, inflammation of the mouth (stomatitis), salivation, bronchitis, and pneumonitis. Acrodynia (pink or Swifts disease), characterized by redness and peeling of the skin on the toes and fingers, was commonly seen in children in the 1950s and is still *infrequently* seen in workers.

Eye: Irritation and corrosion.

Skin: Skin can become severely irritated if allowed to remain in contact with mercury. Skin absorption will occur at 2.2% of the rate of absorption through the lungs.

Ingestion: Mercury generally passes through the digestive tract uneventfully. However, large amounts may get caught up in the intestine and require surgical removal. If an abscess or other perforation is present along the digestive tract, absorption into the blood stream with subsequent mercury poisoning is possible.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Central nervous system disorders.

Chronic Effects: Chronic exposure appears more common than acute and is primarily associated with central nervous system damage which can be permanent (ex. paresthesia of the hands, lips, feet). Early signs of toxicity include weakness, fatigue, anorexia, weight loss, and gastrointestinal disturbances. If exposure levels are high, characteristic tremors of the fingers, eyelids, and lips occur with progression to generalized tremors of the entire body. Psychic disorders are noticeable and characterized by behavior and personality changes, increased excitability, memory loss, insomnia, and depression. In severe cases, delirium and hallucinations may occur. Kidney damage is observed with oliguria (decreased urine output) progressing to anuria (urine cessation) and may require dialysis. The cornea and lens of the eyes may take on a brownish discoloration and the extraocular muscles may be damaged. This syndrome has been termed *Asthenic-Vegetative Syndrome* or *Micromercurialism.* Chronic symptoms occur increasingly with exposures to 0.1 mg/m^3 or higher. *Mutation:* Aneuploidy and other chromosomal aberrations have been observed in the lymphocytes from whole blood cultures in workers exposed to mercury. *Reproductive:* Mercury has been detected in stillborn babies of women treated with mercury for syphilis. In a study of six men acutely exposed (occupationally) to mercury levels as high as 44 mg/m^3, all suffered impaired sexual function. Repeated skin contact may cause allergic dermatitis in some individuals.

Note: Spilled mercury will release sufficient vapor over time to produce chronic poisoning.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water and then wash exposed area with soap. For reddened or blistered skin, consult a physician.

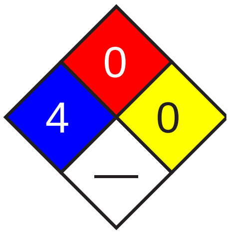
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. In general, mercury will pass through the digestive tract uneventfully.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI: *blood* (15 µg/L), *urine*: (35 µg/g creatinine). Extremely high urine levels of 0.5 to 0.85 mg Hg/L are indicative of polyneuropathy. 0.4 to 22 µg/L is reported to be the human lethal blood level. Obtain urinalysis including at a minimum: albumin, glucose, and a microscopic examination of centrifuged sediment. Use BAL or 2, 3-dimercaptosuccinic acid as chelators. *Do not* use calcium sodium EDTA because of nephrotoxicity. An electromyograph may determine extent of nerve dysfunction. It has been noted that exposure to mercury may predispose persons to development of carpal tunnel syndrome.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Nonflammable
LEL: None reported.
UEL: None reported.
Extinguishing Media: Use agents suitable for surrounding fire.
General Fire Hazards/Hazardous Combustion Products: Toxic mercury vapor and mercuric oxide.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



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Section 6 - Accidental Release Measures

Spill/Leak Procedures: Keep a mercury spill kit readily available in areas where mercury is used. Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind.
Small Spills: Small and Large Spills: Follow instructions on mercury spill kit. Most kits come with an aspiration-driven vacuum trap with a mercury "sweeper" (copper or copper-plated brush). Wash spill area with a dilute calcium sulfide or nitric acid solution. If spill cannot be taken up readily, dust the top of the spill with flowers of sulfur or preferably, calcium polysulfide. This will produce a surface coating of mercury sulfide which will reduce mercury vapor dispersion into the air.
Large Spills: No data found.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use appropriate PPE when working with mercury. *Do not* use on porous work surfaces (wood, unsealed concrete, etc.) to prevent spills from lodging in cracks.
Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.
Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat and incompatibles (Sec. 10). Store on non- porous floors and wash them regularly with a dilute calcium sulfide solution. Because mercury will form amalgamations with most metals except iron, metal shelves should be painted with a sufficiently thick coating to prevent this from happening.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Wherever possible, enclose processes to prevent mercury vapor dispersion into work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.
Administrative Controls: Consider pre-placement and periodic medical exams of exposed workers with emphasis on the skin, eyes, central nervous system, liver, and kidneys.
Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets made of butyl rubber, nitrile rubber, fluorocarbon rubber, neoprene rubber, polyvinyl chloride, chlorinated polyethylene, or polycarbonate to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For <= 0.5 mg/m^3, use any chemical cartridge respirator with cartridges providing protection against mercury and equipped with an ESLI (end of service life indicator), any SCBA, or any SAR (supplied-air respirator). For <= 1.25 mg/m^3, use any SAR operated in continuous-flow mode, any PAPR (powered, air-purifying respirator) with an ESLI. For <= 2.5 mg/m^3, use any SCBA or SAR with a full facepiece, any SAR with a tight-fitting facepiece and operated in continuous-flow mode, or any chemical cartridge respirator with a full facepiece, chemical cartridges providing protection against mercury, and equipped with an ESLI. For <=28 mg/m^3, use any SAR operated in pressure- demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA with full facepiece and operated in pressure-demand or other positive pressure mode. *Warning! Air- purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Silvery-white, odorless.
Physical State: Liquid metal
Vapor Pressure (kPa): 0.0018 mm Hg at 77 °F (25 °C)
Formula Weight: 200.59
Density: 13.534 g/cm^3 at 77 °F (25 °C)
Boiling Point: 674.09 °F (356.72 °C)
Freezing/Melting Point: -37.97 °F (-38.87 °C)
Viscosity: 15.5 mP at 77 °F (25 °C)
Surface Tension: 484 dyne/cm at 77 °F (25 °C)
Critical Temperature: 2664 °F (1462 °C)
Critical Pressure: 1587 atm
Water Solubility: 0.28 µmol/L at 77 °F (25 °C)
Other Solubilities: Soluble in boiling sulfuric acid, nitric acid (reacts); slightly in lipids, and 2.7 mg/L in pentane. Insoluble in alcohol, ether, cold sulfuric acid, hydrogen bromide, and hydrogen iodide.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Mercury does not tarnish at ordinary temperatures but when heated to near its boiling point, it slowly oxidizes to mercuric oxide. Hazardous polymerization does not occur. Exposure to high temperatures, metal surfaces or incompatibles.

Storage Incompatibilities: Mercury forms alloys (amalgamates) with most metals except iron. It is incompatible with oxidizers such as bromine, 3-bromopropyne, methylsilane + oxygen, chlorine, chlorine dioxide, nitric acid, or peroxyformic acid; tetracarbonyl nickel + oxygen, alkynes + silver perchlorate, ethylene oxide, acetylenic compounds (explosive), ammonia (explosive), boron phosphodiiodide, methyl azide, nitromethane, and ground sodium carbide.

Hazardous Decomposition Products: Thermal oxidative decomposition of mercury can produce mercuric oxide.

Section 11 - Toxicological Information

Acute Oral Effects:
Man, oral, TD$_{Lo}$: 43 mg/kg caused tremor and jaundice or other liver changes.
Acute Inhalation Effects:
Woman, inhalation, TC$_{Lo}$: 150 µg/m^3/46 days caused anorexia, diarrhea, and wakefulness.
Man, inhalation, TC$_{Lo}$: 44300 µg/m^3/8 hr caused muscle weakness, liver changes, and increased body temperature.
Acute Skin Effects:
Man, skin, TD$_{Lo}$: 129 mg/kg for 5 continuous hours caused ringing in the ears, headache, and allergic dermatitis.
Other Effects:
Rat, inhalation: 1 mg/m^3/ 24 hr for 5 continuous weeks caused proteinuria.
Rat, inhalation: 890 ng/m^3/24 hr for 16 weeks prior to mating had an effect on spermatogenesis.

See NIOSH, *RTECS* OV4550000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Mercury is expected to volatilize rapidly when deposited on soil surfaces. Once in the air, it can be transported long distances before being redeposited on soil or in water. In water, mercury appears to bind to particulates where it eventually becomes deposited on the bed sediment. In general, mercury entering the environment can be deposited and revolatilized several times.

Ecotoxicity: Catfish, LC$_{50}$ = 0.35 mg/L/96 hr; mollusk (*Modiolus carvalhoi*), LC$_{50}$ = 0.19 ppm/96 hr: tadpole (*Rana hexadactyla*), LC$_{50}$ = 0.051 ppm/96 hr. Mercury is transformed to methyl mercury by bacteria in the environment and undergoes bioaccumulation readily. BCF for freshwater fish = 63,000; for saltwater fish = 10,000; and for marine and freshwater invertebrates = 100,000.

Section 13 - Disposal Considerations

Disposal: Incineration is *not* an appropriate disposal method. Wastewater may be treated by addition of chlorine to oxidize the mercury to its ionic state. The water can then be passed through an absorbent (an activated charcoal concentrate with a sulfur coating or peanut shell charcoal) to collect the ionic mercury, followed by distillation to recover the mercury. Sodium borohydride, a reducing agent, can be used to precipitate mercury from waste solutions. Bioremediation, using *Pseudomonas putida*, has also been suggested. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Mercury
Hazard Class: 8
ID No.: UN2809
Packing Group: III
Label: Corrosive

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U151 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a), per CAA Section 112 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification

Material Name: Methanol

CAS Number: 67-56-1

Chemical Formula: CH_4O

Structural Chemical Formula: CH_3OH

EINECS Number: 200-659-6

Synonyms: ALCOHOL,METHYL; ALCOOL METHYLIQUE; ALCOOL METILICO; CARBINOL; X-CIDE 402 INDUSTRIAL BACTERICIDE; COAT-B1400; COLONIAL SPIRIT; COLONIAL SPIRITS; COLUMBIAN SPIRIT; COLUMBIAN SPIRITS; EPA PESTICIDE CHEMICAL CODE 053801; EUREKA PRODUCTS CRIOSINE DISINFECTANT; EUREKA PRODUCTS,CRIOSINE; FREERS ELM ARRESTER; IDEAL CONCENTRATED WOOD PRESERVATIVE; METANOL; METANOLO; METHANOL; METHYL ALCOHOL; METHYL HYDRATE; METHYL HYDROXIDE; METHYLALKOHOL; METHYLOL; METYLOWY ALKOHOL; MONOHYDROXYMETHANE; PMC REJEX-IT F-40ME; PYROLIGNEOUS SPIRIT; PYROXYLIC SPIRIT; PYROXYLIC SPIRITS; SURFLO-B17; WILBUR-ELLIS SMUT-GUARD; WOOD ALCOHOL; WOOD NAPHTHA; WOOD SPIRIT

Derivation: Prepared by wood pyrolysis; non-catalytic oxidation of hydrocarbons; as a by-product in the fisher-tropsch synthesis; or by reduction of carbon monoxide.

General Use: Used as an industrial solvent; starting material for organic synthesis; antifreeze for windshield washer fluid; in fuel antifreezes; gasoline octane booster; fuel for stoves; extractant for oils; denaturing ethanol; softening agent; food additive; in paint, varnish removers, and embalming fluids; in the manufacture of photographic film, celluloid, textile soap, wood stains, coated fabrics, shatterproof glass, paper coating, waterproofing formulations, artificial leather, dyes.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Methanol	67-56-1	ca 100% vol

Trace Impurities: (Grade A): Acetone and aldehydes < 30 ppm, acetic acid < 30 ppm

OSHA PEL
TWA: 200 ppm; 260 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 200 ppm; 260 mg/m^3;
STEL: 250 ppm; 325 mg/m^3.

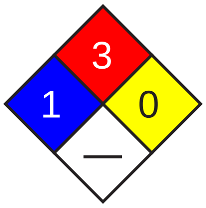
ACGIH TLV
TWA: 200 ppm, 262 mg/m^3;
STEL: 250 ppm, 328 mg/m^3; skin.

NIOSH REL
TWA: 200 ppm, 260 mg/m^3;
STEL: 250 ppm, 325 mg/m^3;
skin.

IDLH Level
6000 ppm.

DFG (Germany) MAK
TWA: 200 ppm, 270 mg/m^3; skin, ceiling, substances with systemic effects, onset of effects within 2 hours, half-life two hours to shift length.

Section 3 - Hazards Identification



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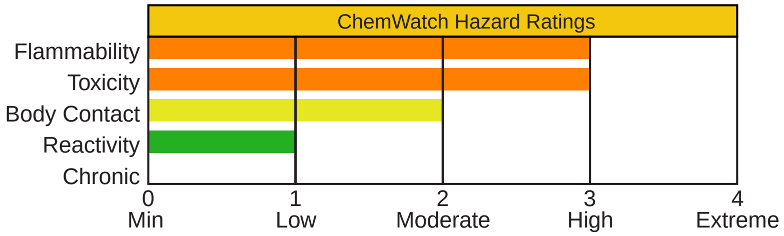


HMIS	
2	Health
3	Flammability
0	Reactivity

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Methanol is a colorless liquid with a slight alcohol odor when pure, or disagreeably pungent odor when crude. It is irritating to the eyes, skin, and respiratory tract. Exposure may result in headache, visual disturbance, blindness, and respiratory failure. Reproductive effects have been reported in animal testing. This flammable liquid is a moderate explosion hazard. When heated to decomposition, methanol emits carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Potential Health Effects

Target Organs: Eyes, skin, central nervous system (CNS), gastrointestinal (GI) tract, respiratory system

Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption

Acute Effects

Inhalation: Irritation, breathing difficulty, headache, drowsiness, vertigo, light-headedness, nausea, vomiting, acidosis (decreased blood alkalinity), visual disturbance, and at high concentrations, CNS damage, convulsions, circulatory collapse, respiratory failure, coma and blindness can result from inhalation of methanol vapor. Concentration >= 200 ppm may cause headache; 50,000 ppm can cause death within 1-2 hrs.

Eye: Contact with liquid may result in irritation, inflamed lids, light sensitization, and superficial lesions.

Skin: Contact may cause irritation, dermatitis, swelling, scaling, and systemic effects listed under inhalation.

Ingestion: GI irritation and systemic effects (see Inhalation). Symptoms may be delayed 18-48 hours. Fatal dose - 2 to 8 ounces.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Exposure to methanol vapors has caused conjunctivitis, headache, giddiness, insomnia, GI disturbance, impaired vision. CNS damage is also likely. Methanol is slowly eliminated from the body; exposure is considered cumulative over the short term.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation develops.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Follow emesis with rehydration, correction of acidosis, and folate to enhance formate oxidation. Consider IV administration of ethanol (if blood methanol >20 mg/dL) to show metabolic oxidation of methanol. Assay formic acid in urine, blood pH and plasma bicarbonate.

Section 5 - Fire-Fighting Measures

Flash Point: 54 °F (12 °C), Closed Cup

Burning Rate: 1.7 mm/min

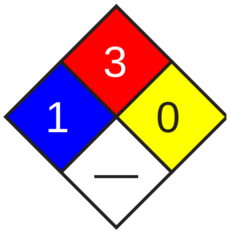
Autoignition Temperature: 867 °F (464 °C)

LEL: 6.0% v/v

UEL: 36% v/v

Flammability Classification: OSHA Class IB Flammable Liquid.

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, fog or alcohol-resistant foam. A water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources.



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General Fire Hazards/Hazardous Combustion Products: Heating methanol to decomposition can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes. Can form explosive mixtures in the air. The heavier-than-air vapors of methanol may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.

Fire-Fighting Instructions: *Do not* scatter material with any more water than needed to extinguish fire. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Isolate spill area for at least 330-660 feet (100-200 m) in all directions. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Ground all equipment used when handling this product. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors.

Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Use clean non-sparking tools to collect absorbed material.

Large Spills: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Ground all equipment. Use non-sparking tools.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec. 2). Wear protective gloves, goggles, and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations. Also 29 CFR 1910.106 for Class 1B Flammable Liquids.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Enclose operations and/or provide local explosion-proof exhaust ventilation at the site of chemical release. Where possible, transfer methanol from drums or other storage containers to process containers. Minimize sources of ignition in surrounding areas.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of butyl rubber, Teflon, Viton, Saranex, 4H, Responder, Trellchem HPS, or Tychem 10000 (Breakthrough Time (BT) >8 hr) to prevent skin contact. Natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl alcohol and CPF 3 may degrade after contact and are not recommended. Wear splash-proof chemical safety goggles, and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/ NIOSH-approved respirator. For concentrations <= 2000 ppm, use a supplied air respirator; <= 5000 ppm, supplied air (SA) respirator in continuous flow mode; <= 6000 ppm, SA respirator with tight-fitting face mask operated in continuous flow mode, or SCBA with full facepiece, or SA respirator with full facepiece; > IDLH/unknown/emergency, SCBA with full facepiece operated in pressure-demand or other positive-pressure mode, or SA respirator with full facepiece operated in pressure-demand or other positive-pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For escape, use an appropriate escape-type SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen- deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless; slight alcohol odor when pure, disagreeably pungent odor when crude.

Physical State: Liquid
Vapor Pressure (kPa): 127 mm Hg at 77 °F (25 °C)
Vapor Density (Air=1): 1.11
Bulk Density: 6.59 lbs/gal at 68 F (20 °C)
Formula Weight: 32.04

Density: 0.796 g/mL at 59 °F (15 °C)
Specific Gravity (H_2O=1, at 4 °C): 0.81 at 0 °C/4 °C
Refractive Index: 1.3292 at 68 °F (20 °C)
pH: Slightly acidic
Boiling Point: 148 °F (64.7 °C) at 760 mm Hg

Freezing/Melting Point: -144.04 °F (-97.8 °C)
Viscosity: 0.614 mPa sec
Surface Tension: 22.61 dynes/cm
Ionization Potential (eV): 10.84 eV

Water Solubility: Miscible
Other Solubilities: Ethanol, acetone, benzene, chloroform, DMSO, ether, ketones, most organic solvents.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Methanol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Vapor inhalation, oxidizers.

Storage Incompatibilities: Include beryllium dihydride, metals (potassium, magnesium), oxidants (barium perchlorate, bromine, chlorine, hydrogen peroxide, sodium hypochlorite, phosphorus trioxide), potassium tertbutoxide, carbon tetrachloride and metals, chloroform and heat, diethyl zinc, alkyl aluminum salts, acetyl bromide, chloroform and sodium hydroxide, cyanuric chloride, nitric acid, chromic anhydride, lead perchlorate.

Hazardous Decomposition Products: Thermal oxidative decomposition of methanol can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 5628 mg/kg.

Human, oral, LD_{Lo}: 428 mg/kg produced toxic effects: behavioral - headache; lungs, thorax, or respiration - other changes.

Human, oral, LD_{Lo}: 143 mg/kg produced optic nerve neuropathy, dyspnea, nausea or vomiting.

Acute Inhalation Effects:

Rat, inhalation, LC_{50}: 64000 ppm/4 hr.

Human, inhalation, TC_{Lo}: 300 ppm produced visual field changes, headache; lungs, thorax, or respiration - other changes.

Acute Skin Effects:

Rabbit, skin, LD_{50}: 15800 mg/kg.

Monkey, skin, LD_{Lo}: 393 mg/kg.

Irritation Effects:

Rabbit, standard Draize test: 100 mg/24 hr resulted in moderate irritation.

Rabbit, standard Draize test: 20 mg/24 hr resulted in moderate irritation.

Other Effects:

Rat, oral: 10 µmol/kg resulted in DNA damage.

Rat, inhalation: 50 mg/m^3/12 hr/13 weeks intermittently produced degenerative changes to brain and coverings; muscle contraction or spasticity.

Rat, inhalation: 2610 ppm/6 hr/4 weeks intermittently produced toxic effects: endocrine - changes in spleen weight.

Multiple Dose Toxicity Effects - Rat, oral: 12 g/kg/8 weeks intermittently produced toxic effects: behavioral - ataxia; behavioral - alteration of operant conditioning.

Human, lymphocyte: 300 mmol/L resulted in DNA inhibition.

Rat (female), oral: 7500 mg/kg, administered during gestational days 17-19 produced effects on newborn - behavioral.

Rat (female), oral: 35295 mg/kg administered during gestational days 1-15 produced effects on the fertility index; pre implantation mortality; and post-implantation mortality.

Rat (female), inhalation: 20000 ppm/7 hr, administered during gestational days 1-22 produced specific developmental abnormalities - musculoskeletal system; cardiovascular (circulatory) system; urogenital system.

Rat (male), oral: 200 ppm/20 hr, 78 weeks prior to mating produced paternal effects - testes, epididymis, sperm duct.

See NIOSH, *RTECS* PC1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Bioconcentration (BCF, estimated at 0.2) is not expected to be significant. Physical removal from air can occur via rainfall. Relatively rapid evaporation from dry surfaces is likely to occur. If released to the atmosphere, it degrades via reaction with photochemically produced hydroxyl radicals with an approximate half-life of 17.8 days. If released to water or soil, biodegradation is expected to occur. A low K_{oc} indicates little sorption and high mobility in the soil column.

Ecotoxicity: Trout, LC_{50}: 8,000 mg/L/48 hr; *Pimephales promelas* (fathead minnow) LC_{50}: 29.4 g/L/96 hr.

Henry's Law Constant: 4.55 x10^{-6} atm-m^3/mole at 77 °F (25 °C)

Octanol/Water Partition Coefficient: log K_{ow} = -0.77

Soil Sorption Partition Coefficient: K_{oc} = 0.44

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Methanol
Hazard Class: 3
ID No.: UN1230
Packing Group: II
Label: FLAMMABLE LIQUID

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U154 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification

Material Name: Methyl Bromide **CAS Number:** 74-83-9
Chemical Formula: CH_3Br
Structural Chemical Formula: CH_3Br
EINECS Number: 200-813-2
ACX Number: X1000021-0
Synonyms: BERCEMA; BROM-O-GAS; BROM-O-GAS METHYL BROMIDE SOIL FUMIGANT; BROM-METHAN; BROMOMETANO; BROMOMETHANE; BROM-O-SOL; BROMUR DI METILE; BROMURE DE METHYLE; BROMURO DI METILE; BROOMMETHAAN; CELFUME; CURAFUME; DAWSON 100; DETIA GAS EX-M; DOWFUME MC-2; DOWFUME MC-2R; DOWFUME MC-33; DOWFUME MC-2 FUMIGANT; DOWFUME MC-2 SOIL FUMIGANT; DREXEL PLANT BED GAS; EDCO; EMBAFUME; EPA PESTICIDE CHEMICAL CODE 053201; FUMIGANT-1; HALON 1001; HALTOX; ISCOBROME; KAYAFUME; M-B-C FUMIGANT; M-B-R 98; MB; MBC SOIL FUMIGANT; MBC-33 SOIL FUMIGANT; MBX; MEBR; METABROM; METAFUME; METHANE,BROMO-; METH-O-GAS; METHOGAS; METHYL BROMIDE; METHYL BROMIDE RODENT FUMIGANT (WITH CHLOROPICRIN); METHYL FUME; METHYLBROMID; METYLU BROMEK; MONOBROMOMETHANE; PESTMASTER; PESTMASTER SOIL FUMIGANT-1; PROFUME; R 40B1; ROTOX; SUPERIOR METHYL BROMIDE-2; TERABOL; TERR-O-CIDE II; TERR-O-GAS; TERR-O-GAS 100; TERR-O-GAS 67; TRI-BROM; ZYTOX
General Use: Highly toxic to insect pests and rodents. Widely used insect fumigant for soils, grain silos, mills, warehouses, vaults, ships and rail cars.
Used in organic synthesis, as a solvent and in fire extinguishing systems.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
methyl bromide	74-83-9	>99.5

OSHA PEL
Ceiling: 20 ppm, 80 mg/m^3; skin.

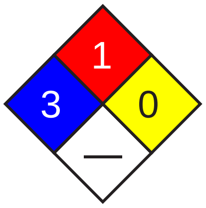
NIOSH REL

DFG (Germany) MAK
Skin.

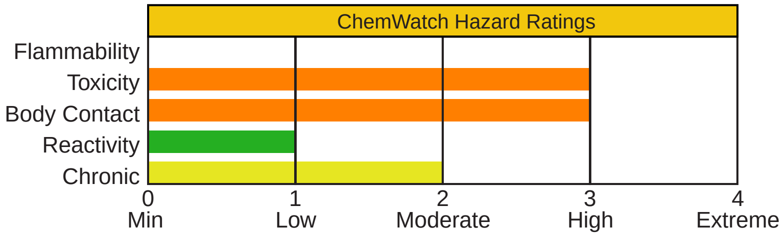
ACGIH TLV
TWA: 1 ppm; skin.

IDLH Level
250 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
1 Flammability
1 Reactivity

ANSI Signal Word

Danger!

Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas; odorless. Corrosive. Toxic. Other Acute Effects: headache, nausea, vomiting, liver/kidneys effects. Chronic Effects: CNS damage, speech difficulties, ataxia, confusion, hallucinations; acneform eruptions.

Potential Health Effects

Target Organs: central nervous system (CNS), liver, lungs, skin, eyes
Primary Entry Routes: inhalation, skin absorption/contact

Acute Effects

Inhalation: Reactions may not occur on exposure but response may be delayed with symptoms only appearing many hours later. The gas is extremely discomforting to the upper respiratory tract and lungs and may be toxic if inhaled and even fatal if exposure is prolonged.

Exposure may cause nausea, vomiting, headache, dizziness, visual disturbances, lethargy, faintness.

Severe exposure causes convulsions, muscular tremor, pulmonary congestion, cyanosis, delirium, coma and death following.

In humans pulmonary edema is the chief adverse effect of poisoning.

Other symptoms include muscle weakness and pain, loss of coordination and gait, an inability to focus, convulsions, hyperthermia, and coma.

Accidental overexposure of fumigation workers has produced paralysis of the extremities, delirium, clonic-tonic convulsions and even typical eleptiforme attacks. Some symptoms are persistent and recovery may take several months or may be incomplete with gross, permanent disability.

Methyl bromide concentrations may have been as high as 60000 ppm although severe poisoning has been reported where the injection of methyl bromide into greenhouse soil produced workplace concentrations of 30 to 300 ppm.

Milling of treated soils can produce ambient air exposures of 15 ppm as long as 9 days after treatment.

Single prolonged exposure at concentrations greater than 250 ppm to 500 ppm is fatal to rats and rabbits. In fatally poisoned mice, liver, kidney and lung changes were observed with the no-observed-effect level (NOEL) reported as 444 ppm.

Rats, guinea pigs showed no signs of intoxication when exposed to 64 ppm, 7 to 8 hours daily over a period of six months. In rabbits exposed to 65 ppm for 8 months, the severe neuromuscular toxicity which resulted subsided in 6 to 8 weeks following termination of exposure.

Primary target organs were the brain, kidneys, nasal cavity, heart, adrenal glands, liver and testes. Neuronal necrosis was apparent in the cerebral cortex, hippocampus, and thalamus of the brain of rats, whilst in mice, neuronal necrosis was primarily in the cerebellum. All mice exhibited nephrosis and this was the major cause of moribundity and death. Rats did not exhibit nephrosis.

Eye: The gas is discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The liquid is extremely discomforting to the eyes and is capable of causing severe damage with loss of sight.

Depression of the central nervous system is most outstanding effect of most halogenated aliphatic hydrocarbons.

Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin).

Skin: The gas is mildly discomforting to the skin and may cause transient staining of the skin and it is absorbed through the skin.

Toxic effects may result from skin absorption.

Absorption by skin may readily exceed vapor inhalation exposure.

Symptoms for skin absorption are the same as for inhalation.

Bare unprotected skin should not be exposed to this material.

The liquid is highly discomforting and may cause blisters or burns.

Liquid methyl bromide may penetrate through all articles of clothing and skin contact produces superficial burns with vesication.

Ingestion: Not normally a hazard due to physical form of product.

At normal temperatures methyl bromide gas is impossible to swallow.

Gavage of rats for 90 days produced squamous cell carcinomas of the forestomach at a dose of 50 mg/kg; 2 to 10 mg/kg produced a dose-related incidence of hyperplasia of the forestomach.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Chronic exposure in humans at low concentrations may produce neurological signs, ataxia, hepato- and nephrotoxicity and behavioral changes such as malaise, headache and visual disturbance.

In mice exposed at up to 100 ppm methyl bromide, 6 hours/day, 5 days/week for up to 103 weeks there was no evidence of carcinogenic activity but there was an increase in the incidence of several non-neoplastic lesions in the brain, heart, bone (sternum) and nose with most of the increase occurring after inhalation of 100 ppm for the animals lifetime. In addition there were signs of degenerative changes in the cerebellum and cerebrum as well as myocardial degeneration and cardiomyopathy.

Short-term tests and DNA binding (methylation) studies in rats given methyl bromide by inhalation and oral administration clearly demonstrate the potential for systemic genotoxicity. Conspicuously high levels of DNA alkylation were seen in the stomach and forestomach following exposure by both routes. Long-term inhalation studies in rats have failed to demonstrate carcinogenicity. These results indicate that the genotoxic potential is not powerful enough to increase tumor incidence in animals exposed by inhalation.

A special source of risk must be considered in humans which distinguishes them from other animals. In rat, for example, the half-life of methyl bromide is short because of rapid metabolism. The genetic disposition of humans is such that two groups are distinguished: the "conjugators" and "nonconjugators" are likely to experience different effects of methyl bromide related to their ability to metabolize the substance more or less quickly, in turn. This makes it difficult to know to what extent animal studies may be considered to apply to humans, especially in light of the clearly demonstrated genotoxic potential.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.

Quickly remove all contaminated clothing, including footwear.

Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Rinse mouth out with plenty of water.

Contact a Poison Control Center.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Onset of symptoms may be delayed from 2-48 hours. Keep under observation for at least 48 hours.

Should pulmonary edema develop, 100% oxygen should be administered and bed rest. Convulsions may require the administration of barbiturates and anti-convulsants.

Period of convalescence and rehabilitation may be lengthy.

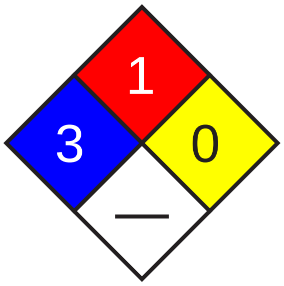
Methyl bromide is converted in vivo to bromide ion - the severity of some clinical signs correlate to blood bromide levels. Although methyl bromide is also metabolized to methanol, the quantities of methanol produced are insufficient to account for the toxicity of methyl bromide.

Such toxicity appears to reside with the intact molecule.

As methyl bromide is rapidly taken up through the skin, biological monitoring, for example, should determine the level of methylation of hemoglobin or albumin.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Nonflammable

Autoignition Temperature: 537 °C

LEL: 13.5% v/v

UEL: 14.5% v/v

Extinguishing Media: Water spray or fog. Use extinguishing media suitable for surrounding area.

General Fire Hazards/Hazardous Combustion Products: Not readily combustible; but burns at high temperatures. Vapor may be ignited by intense direct flame; sustained high energy spark or intense heat source Slight explosion hazard, in vapor form, when exposed to heat or flame.

In presence of moisture, the material is corrosive to aluminum, zinc and tin producing highly flammable hydrogen gas.

Heating may cause expansion or decomposition leading to violent rupture of containers.

Combustion/decomposition may produce acrid/toxic fumes of carbon monoxide (CO). Other decomposition products include hydrogen bromide.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Care: Contact with aluminum or magnesium and alloys of these metals leads to formation of metal alkyls which ignite spontaneously.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

Cool fire-exposed containers with water spray from a protected location.

Do not approach cylinders suspected to be hot.

If safe to do so, stop flow of gas.

If safe to do so, remove containers from path of fire.

Use water delivered as a fine spray to control the fire and cool adjacent area.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Clear area of personnel and move upwind and restrict access to area.

Contact fire department and tell them location and nature of hazard.

Wear full body protective clothing with breathing apparatus. May be washed to drain with large quantities of water.

Avoid breathing vapors and contact with skin and eyes.

Stop leak if safe to do so. Water spray or fog may be used to disperse / absorb vapor. Increase ventilation.

Do not exert excessive pressure on valve; do not attempt to operate damaged valve.

Remove leaking cylinders to a safe place if possible. Release pressure under safe, controlled conditions by opening the valve.

Large Spills: Clear area of personnel and move upwind and restrict access to area.

Contact fire department and tell them location and nature of hazard.

Wear full body protective clothing with breathing apparatus. May be washed to drain with large quantities of water.

Avoid breathing vapors and contact with skin and eyes.

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Increase ventilation.

Do not exert excessive pressure on valve; do not attempt to operate damaged valve.

Remove leaking cylinders to a safe place if possible. Release pressure under safe, controlled conditions by opening the valve.

Absorb liquid methyl bromide or water spray used for knock down onto sand / vermiculite, sodium bicarbonate mix; with a sand-soda mixture (90/10).

Collect residues and seal in labeled drums for disposal.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Atmosphere of any tank must be checked for safety before any entry.

Used in closed pressurized systems; fitted with temperature and pressure safety relief valves which are vented to allow safe dispersal.

Vented gas is more dense than air and may collect in pits, basements.

Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.

Avoid breathing mist and vapor. Avoid all personal contact.

Avoid sources of heat.

Wear personal protective equipment when handling.

Handle and open container with care.

When handling, DO NOT eat, drink or smoke.

Use in a well-ventilated area.

Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Cylinder fitted with valve protector cap.

Ensure the use of equipment rated for cylinder pressure.

Ensure the use of compatible materials of construction.

Cylinder valve must be closed when not in use or when empty.

Cylinder must be properly secured either in use or in storage.

WARNING: Suckback into cylinder may result in rupture.

Use back-flow preventive device in piping.

Check that containers are clearly labeled.

Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.

The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Fumigated areas must be well ventilated and atmosphere tested before entry.

Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Close fitting gas tight goggles.

Normally use full face air supplied breathing apparatus or Air Line hood.

Cannister type respirators are only suitable for minor exposure.

Hands/Feet: Barrier cream and Viton gloves or Elbow length PVC gloves or PVC gloves.

PVC boots.

Do not allow clothing wet with material to stay in contact with skin.

Avoid rubber gloves or leather gloves as these absorb methyl bromide and may cause serious burns.

Respiratory Protection:

Exposure Range >20 to <250 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 250 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properites

Other: Overalls, PVC apron or PVC protective clothing.
Ensure that there is ready access to eye wash unit.
Ensure there is ready access to an emergency shower.
Ensure that there is ready access to breathing apparatus.

Glove Selection Index:

BUTYL	Best selection
NATURAL RUBBER	Best selection
NEOPRENE	Best selection
PE	Best selection
SARANEX-23	Satisfactory; may degrade after 4 hours continuous immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Supplied as liquified gas in pressure cylinders. TOXIC GAS UNDER PRESSURE. Packed as liquid under pressure and remains liquid only under pressure. Sudden release of pressure or leakage may result in rapid vaporization with generation of large volume of gas.

Poisonous colorless gas. Sharp burning taste when impure. In high concentrations it has a chloroform-like odor. Non-corrosive when dry. Mildly corrosive when moist. Usually nonflammable, but ignites with high energy source. Burns in oxygen. Soluble in alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride and benzene. Liquid is highly volatile and is unstable in sunlight. Forms liquid hydrate below 4 °C.

Physical State: Liquefied gas
Odor Threshold: 80 to 4000 mg/m^3
Vapor Pressure (kPa): 191 at 20 °C
Vapor Density (Air=1): 3.27
Formula Weight: 94.95
Specific Gravity (H_2O=1, at 4 °C): 1.730

Evaporation Rate: Very fast
pH: Not applicable
Boiling Point: 3.55 °C (38 °F)
Freezing/Melting Point: -93.66 °C (-136.588 °F)
Volatile Component (% Vol): 100
Water Solubility: 13.4 g/Kg water at 25 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: High temperature.

Storage Incompatibilities: Segregate from aluminum and its alloys, magnesium and magnesium alloys as ignition may result.
Avoid contamination with strong oxidizing agents as ignition may result.
Avoid contact with: dimethyl sulfoxide, ethylene oxide.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 214 mg/kg
Inhalation (human) TC_{Lo}: 35 ppm
Inhalation (rat) LC_{50}: 302 ppm/8h
Dermal (human) TD_{Lo}: 35000 mg/m^3/40m-I
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

Irritation

Nil reported

See *RTECS* PA 4900000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Methyl bromide released to soil is expected to be primarily lost by volatilization. It may also leach due to its weak adsorption to soil. Hydrolysis to methanol and bromide ions and biodegradation may also occur in soil. Release to water is expected to result primarily in volatilization. Hydrolysis to methanol and bromide ions will occur with a half-life of 20-26.7 days. Bioconcentration is not expected to be significant. Release to the atmosphere will result in reaction with photochemically generated hydroxyl radicals with half-lives ranging from 0.29 years (25 °C and 2 x10^6 hydroxyl radicals/cc) to 1.6 years (-8 °C and 5 x10^5 hydroxyl radicals/cc). Direct photolysis is not expected to be important in the troposphere, but is expected to be the predominant fate in the stratosphere.

Ecotoxicity: LD_{50} Coleoptera 4.505 mg/l/24 hr; LC_{50} Menidia beryllina (tidewater silverside) 12 ppm/96 hr (static bioassay in synthetic seawater at 23 °C, mild aeration applied after 24 hr)

Henry's Law Constant: 6.24×10^{-3}
BCF: estimated at 4.7
Biochemical Oxygen Demand (BOD): none
Octanol/Water Partition Coefficient: log $K_{ow} = 1.19$
Soil Sorption Partition Coefficient: K_{oc} = estimated at 2.1

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options. Follow applicable federal, state, and local regulations.
Ensure damaged or non-returnable drums are gas-free before disposal.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Methyl bromide
ID: UN1062
Hazard Class: 2.3 - Poisonous gas
Packing Group:
Symbols:
Label Codes: 2.3 - Poison Gas
Special Provisions: 3, B14, T50
Packaging: **Exceptions:** None **Non-bulk:** 193 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U029 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 1000 lb
  - **TPQ:** 1000 lb
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification 61

Material Name: Methyl n-Butyl Ketone **CAS Number:** 591-78-6

Chemical Formula: $C_6H_{12}O$

Structural Chemical Formula: $CH_3COC_4H_9$

EINECS Number: 209-731-1

ACX Number: X1001528-8

Synonyms: BUTYL METHYL KETONE; N-BUTYL METHYL KETONE; 2-HEXANONE; HEXAN-2-ONE; HEXANONE-2; KETONE,BUTYL METHYL; MBK; METHYL BUTYL KETONE; METHYL N-BUTYL KETONE; MNBK; 2-OXOHEXANE; PROPYLACETONE

Derivation: Produced by reaction of acetyl chloride with butyl magnesium chloride or by catalyzed reaction of acetic acid and ethylene under pressure, followed by distillation.

General Use: Formerly used as a solvent for lacquers, thinners, nitrocellulose, resins, oils, fats, and waxes. Not currently produced in the United States, but potential exposure can occur through its presence as a byproduct in wood pulping, coal gassification, and oil-shale processing.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Methyl *n*-Butyl Ketone	591-78-6	ca% vol

OSHA PEL
TWA: 100 ppm; 410 mg/m^3.

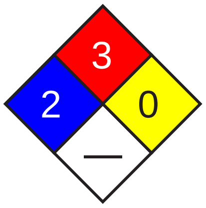
ACGIH TLV
TWA: 5 ppm; STEL: 10 ppm; skin.

NIOSH REL
TWA: 1 ppm (4 mg/m^3).

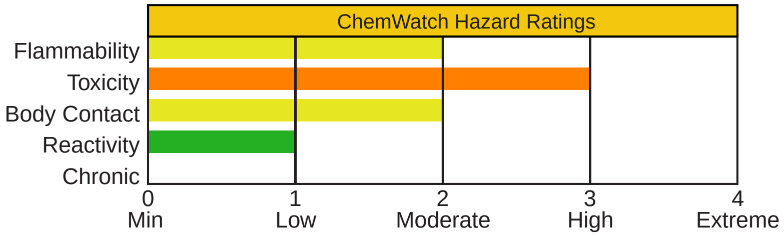
IDLH Level
1600 ppm.

DFG (Germany) MAK
TWA: 5 ppm; PEAK: 40 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; pungent, acetone-like odor. Irritating to eyes/skin. Other Acute Effects: varying degrees of CNS depression, nausea, headache, unconsciousness. Chronic Effects: nerve damage. Flammable. Capable of forming explosive mixtures with air.

Potential Health Effects

Target Organs: Eyes, skin, respiratory system, central and peripheral nervous systems.

Primary Entry Routes: Inhalation, eye and skin contact/absorption.

Acute Effects

Inhalation: Vapor inhalation can cause respiratory tract irritation and varying degrees of central nervous system depression. Symptoms include headache, nausea and vomiting, incoordination, and dizziness, with progression to narcosis (unconsciousness) and cardiorespiratory failure.

Eye: Irritation can occur from exposures to as low as 1000 ppm for 15 sec. to 1 min.

Skin: Methyl n-butyl ketone is easily absorbed through the skin (222 mg/hr through hands).

Ingestion: Central nervous system depression is likely.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Skin conditions such as dermatitis or any disorder that affects the peripheral nervous system.

Chronic Effects: Repeated skin contact can cause dermatitis. Repeated inhalation or skin absorption can lead to significant peripheral nerve damage due to metabolism to 2,5-hexanedione. Symptoms include muscle weakness, tingling, sensation loss, and incoordination. The degree of these effects vary depending on exposure duration and concentration and may progress slowly for several months after cessation of exposure. In general, chronic exposure appears to affect only the peripheral nervous system; however, some animal studies have demonstrated chronic damage to the central nervous system, including the optic nerves. Whereas peripheral nerves may regenerate after damage, nerves of the central nervous system do not.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing (*be aware*, clothing is now flammable - dispose of or clean with care). Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

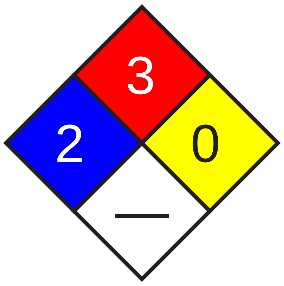
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not* induce vomiting if small amounts have been ingested because of the danger of aspiration into the lungs. However, if large amounts are ingested, vomiting may be indicated as potential systemic effects may outweigh danger of aspiration. Consult a physician.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: In chronic exposures, clinical biopsies and electromyographic studies may show axonal degeneration with enlarged axons containing masses of neurofilaments and thinning of the myelin sheath. MBK toxicity is potentiated by exposure to other solvents, especially those that increase liver microsomal activities.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: 77 °F (25 °C) CC; 83 °F (28.3 °C) OC

Burning Rate: 4.8 mm/min.

Autoignition Temperature: 795 °F (423 °C)

LEL: 1.22% v/v

UEL: 8% v/v

Flammability Classification: Class 1C Flammable Liquid

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, or alcohol-resistant foam. For large fires, use fog or alcohol-resistant foam. Water spray may be ineffective for fires as methyl *n*-butyl ketone may float on top of water and spread fire.

General Fire Hazards/Hazardous Combustion Products: Acrid smoke and carbon dioxide gas. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. Methyl *n*-butyl ketone presents a vapor explosion hazard indoors, outdoors, and in sewers.

Fire-Fighting Instructions: Apply cooling water to sides of fire-exposed containers until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned monitor nozzles or unmanned hose holders. If impossible, withdraw from area and let fire burn. Withdraw from area immediately if you hear any rising sound from venting safety device or notice any tank discoloration as a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. Use water spray to "knock-down" vapor. Cleanup personnel should protect against inhalation and skin/eye contact.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers.

Large Spills: Dike far ahead of liquid spill for later disposal or reclamation. Do not release into sewers or waterways. Damp mop any residue.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Do not use near heat or ignition sources. Use non-sparking tools to open containers. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using methyl *n*-butyl ketone, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around methyl *n*- butyl ketone. Inert atmospheres may be useful for process equipment. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the peripheral nervous system and skin. Advise employees of the health and fire hazards associated with handling methyl *n*-butyl ketone.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For <= 10 ppm, use any supplied-air respirator. For <= 25 ppm, use any supplied-air respirator operated in continuous-flow mode. For <= 50 ppm, use any SAR with a tight-fitting facepiece operated in continuous-flow mode or any SCBA or supplied-air respirator with a full facepiece. For <= 1600 ppm, use any supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air- purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove methyl *n*- butyl ketone from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless with a pungent odor.
Physical State: Liquid
Odor Threshold: 0.28 to 0.35 mg/m^3
Vapor Pressure (kPa): 11 mm Hg at 77 °F (25 °C)
Bulk Density: 6.75 lb/gal
Formula Weight: 100.16
Specific Gravity (H_2O=1, at 4 °C): 0.8113 at 68 °F (20 °C)
Evaporation Rate: Relative Evaporation Rate (BuAc = 1): 1
Refractive Index: 1.4024 at 68 °F (20 °C)
Boiling Point: 268 °F (128 °C)
Freezing/Melting Point: -70.6 °F (-57 °C)
Viscosity: 0.62 cP at 68 °F (20 °C)
Surface Tension: 25.49 dyne/cm at 68 °F (20 °C)
Ionization Potential (eV): 9.34 eV
Water Solubility: 1.4 wt% at 68 °F (20 °C)
Other Solubilities: Soluble in alcohol, acetone, and ether.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Methyl *n*-butyl ketone is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, ignition sources, and incompatibles.

Storage Incompatibilities: Strong oxidizers.

Hazardous Decomposition Products: Thermal oxidative decomposition of methyl *n*-butyl ketone can produce carbon dioxide.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 2590 mg/kg.
Guinea pig, oral, LD_{50}: 914 mg/kg.
Acute Inhalation Effects:
Rat, inhalation, LC_{50}: 8000 ppm.
Human, inhalation, TC_{Lo}: 1000 ppm caused headache and nausea or vomiting.
Acute Skin Effects:
Rabbit, skin, LD_{50}: 4800 mg/kg.
Irritation Effects:
Rabbit, skin: 500 mg/24 hr caused mild irritation.
Other Effects:
Rat, inhalation: 1000 ppm/6 hr administered from 1 to 21 days of pregnancy caused specific developmental abnormalities of the gastrointestinal and urogenital system.
Chicken, inhalation: 200 ppm/90 days, continuously caused peripheral nerve sensation changes (spastic paralysis with or without sensory change) and weight loss or decreased weight gain.

See *RTECS* MP1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, methyl *n*-butyl ketone is highly mobile and can leach to groundwater. Some may volatilize as well as undergo rapid biodegradation. In water, volatilization is expected to be rapid. Bioconcentration is not expected (BCF = 6). In the air, methyl *n*-butyl ketone reacts with photochemically-produced hydroxyl radicals with an estimated half-life of 2 days. Because it is soluble, washout via rain is expected. Highly mobile.
Ecotoxicity: Fathead minnow (*Pimephales promelas*), LC_{50} = 428 mg/L/96 hr at 77 °F (25 °C)
Octanol/Water Partition Coefficient: log K_{ow} = 1.38

Section 13 - Disposal Considerations

Disposal: Methyl *n*-butyl ketone can be subjected to incineration; addition of a more flammable solvent may facilitate easier burning. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Ketones, liquid, n.o.s.
ID: UN1224
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 3 - Flammable Liquid
Special Provisions: T11, TP1, TP8, TP27
Packaging: **Exceptions:** None **Non-bulk:** 201 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** E **Other:**

Shipping Name and Description: Ketones, liquid, n.o.s.
ID: UN1224
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T7, TP1, TP8, TP28
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Ketones, liquid, n.o.s.
ID: UN1224
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 3 - Flammable Liquid
Special Provisions: B1, IB3, T4, TP1, TP29
Packaging: **Exceptions:** 150 **Non-bulk:** 203 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Not listed
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

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Methyl Ethyl Ketone
BUT2330

Section 1 - Chemical Product and Company Identification 54

Material Name: Methyl Ethyl Ketone **CAS Number:** 78-93-3
Chemical Formula: C_4H_8O
Structural Chemical Formula: $CH_3COCH_2CH_3$
Synonyms: ACETONE,METHYL-; AETHYLMETHYLKETON; 2-BUTANONE; 3-BUTANONE; BUTANONE; BUTANONE 2; EPA PESTICIDE CHEMICAL CODE 044103; ETHYL METHYL CETONE; ETHYL METHYL KETONE; ETHYLMETHYLCETONE; ETHYLMETHYLKETON; KETONE,ETHYL METHYL; MEETCO; MEK; METHYL ACETONE; METHYL ETHYL KETONE; METILETILCETONA; METILETILCHETONE; METYLOETYLOKETON
General Use: As a solvent in lacquers, thinners, solvent cements, adhesives, glues, in paint removers, nail polish removers, nail polish and cleaning solvents.
In the manufacture of smokeless gunpowder and colorless synthetic resins.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
methyl ethyl ketone	78-93-3	>99

OSHA PEL
TWA: 200 ppm; 590 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 200 ppm; 590 mg/m^3;
STEL: 300 ppm; 885 mg/m^3.

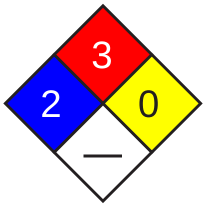
ACGIH TLV
TWA: 200 ppm, 590 mg/m^3;
STEL: 300 ppm, 885 mg/m^3.

NIOSH REL
TWA: 200 ppm, 590 mg/m^3;
STEL: 300 ppm, 885 mg/m^3.

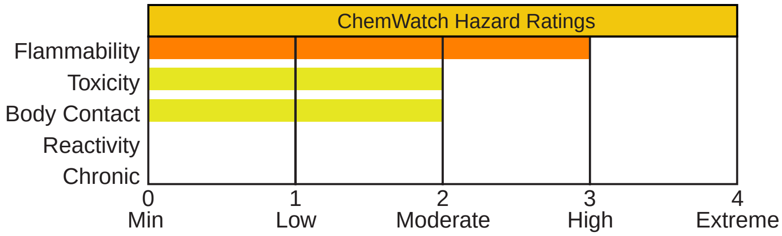
IDLH Level
3000 ppm.

DFG (Germany) MAK
TWA: 200 ppm, 600 mg/m^3;
PEAK: 200 ppm, 600 mg/m^3;
skin, ceiling, local irritant effects determine peak value.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② **Health**
③ **Flammability**
⓪ **Reactivity**

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; sweet mint odor. Irritating to eyes/respiratory tract. Also causes: corneal injury; inhalation may cause dizziness or vomiting. Chronic: dry skin, dermatitis. Flammable. Can form explosive mixtures in air.

Potential Health Effects

Target Organs: respiratory system, central nervous system (CNS), skin, eyes
Primary Entry Routes: inhalation, eyes, skin contact/absorption
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Inhalation of vapor may aggravate a pre-existing respiratory condition.

Easy odor recognition and irritant properties means that high vapor levels are readily detected and should be avoided by application of control measures; however odor fatigue may occur with loss of warning of exposure.

Exposure to ketone vapors may produce nose, throat and mucous membrane irritation. High concentrations of vapor may produce central nervous system depression characterized by headache, vertigo, loss of coordination, narcosis and cardiorespiratory failure. Some ketones produce neurological disorders (polyneuropathy) characterized by bilateral symmetrical paresthesia and muscle weakness primarily in the legs and arms.

Eye: The liquid is highly discomforting to the eyes if exposure is prolonged and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is highly discomforting to the eyes if exposure is prolonged.

The vapor when concentrated has pronounced eye irritation; this gives some warning of high vapor concentrations. If eye irritation occurs seek to reduce exposure with available control measures, or evacuate area.

Skin: The liquid is highly discomforting to the skin, it is absorbed by the skin and may cause drying of the skin, which may lead to dermatitis.

Toxic effects may result from skin absorption.

The material may accentuate any pre-existing skin condition.

Material on the skin evaporates rapidly and may cause tingling, chilling and even temporary numbness.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting if swallowed and toxic if swallowed in large quantity.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

The material is considered to have a low order of toxicity; however Methyl ethyl ketone is often used in combination with other solvents and the toxic effects of mix may be greater than either solvent alone.

Combinations of n-hexane with methyl ethyl ketone and also methyl n-butyl ketone with methyl ethyl ketone show increase in peripheral neuropathy, a progressive disorder of nerves of extremities.

Combinations with chloroform show increase in toxicity.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: -9 °C Closed Cup

Autoignition Temperature: 404 °C

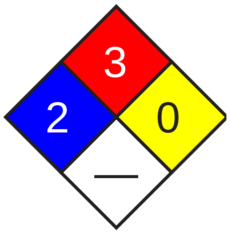
LEL: 1.4% v/v

UEL: 11.4% v/v

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.

Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly



Fire Diamond

flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result. Attacks, softens and may dissolve rubber, many plastics, paints and coatings.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. NIOSH-approved respirator (supplied air type) may be required in special circumstances. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves or Butyl rubber gloves.
Safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >200 to 1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1000 to <3000 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range 3000 to unlimited ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face; Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls or Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.

Glove Selection Index:

BUTYL	Best selection
PE/EVAL/PE	Best selection
TEFLON	Best selection
PVA	Satisfactory; may degrade after 4 hours continuous immersion
BUTYL/NEOPRENE	Satisfactory; may degrade after 4 hours continuous immersion
SARANEX-23	Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL	Poor to dangerous choice for other than short-term immersion
HYPALON	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
NATURAL+NEOPRENE	Poor to dangerous choice for other than short-term immersion
VITON/NEOPRENE	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Thin colorless highly flammable liquid. Penetrating, sharp smell. Very volatile and vapor is heavier than air. Mixes with alcohol, ether and hydrocarbon solvents, petrol, turps etc. Attacks, softens and may dissolve rubber, many plastics, paints and coatings.

Physical State: Liquid
Vapor Pressure (kPa): 9.5 at 20 °C
Vapor Density (Air=1): 2.4 at 20 °C
Formula Weight: 72.12
Specific Gravity (H_2O=1, at 4 °C): 0.81 at 20 °C
Water Solubility: 353 g/L water at 10 °C
Evaporation Rate: 5.7 Fast (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 79.6 °C (175 °F)
Freezing/Melting Point Range: -86.3 °C (-123.34 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers hypochlorites, e.g. pool chlorine, bleaches and. strong bases and chloroform.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 2737 mg/kg	Eye (human): 350 ppm -irritant
Inhalation (human) TC_{Lo}: 100 ppm/5 m	Eye (rabbit): 80 mg - irritant
Inhalation (rat) LD_{50}: 23500 mg/m^3/8 hr	Skin (rabbit): 402 mg/24 hr - mild
Dermal (rabbit) LD_{50}: 6480 mg/kg	Skin (rabbit): 13.78mg/24 hr open - mild

See NIOSH, *RTECS* EL 6475000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When discharged into water, it will be lost by evaporation (half-life 3-12 days) or be slowly biodegraded. When released to the atmosphere, it will photodegrade at a moderate rate (half-life 2.3 days or less). It would not be expected to bioconcentrate into aquatic organisms.

Ecotoxicity: LC_{50} Pimephales promelas (fathead minnow) 3220 mg/l/96 hr (confidence limit 3130-3320 mg/l) /Conditions of bioassay not specified; Toxicity Threshold (Cell Multiplication Inhibition Test) Scenedesmus quadricauda (green algae) 4300 mg/l /Conditions of bioassay not specified; Toxicity Threshold (Cell Multiplication Inhibition Test) Entosiphon sulcatum (protoza) 190 mg/l /Conditions of bioassay not specified

Henry's Law Constant: 2.4×10^{-5}

BCF: not significant

Biochemical Oxygen Demand (BOD): 214%, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 0.26$ to 0.29

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHYL METHYL KETONE (METHYL ETHYL KETONE)
Hazard Class: 3.1
ID No.: 1193
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information: METHYL ETHYL KETONE

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U159 Toxic Waste, Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

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Issue Date: 2002-02

Methyl Isobutyl Ketone
MET3360

Section 1 - Chemical Product and Company Identification 54

Material Name: Methyl Isobutyl Ketone **CAS Number:** 108-10-1
Chemical Formula: $C_6H_{12}O$
Structural Chemical Formula: $(CH_3)_2CHCH_2COCH_3$
Synonyms: EPA PESTICIDE CHEMICAL CODE 044105; HEXON; HEXONE; ISOBUTYL METHYL KETONE; ISOBUTYL-METHYLKETON; ISOPROPYL ACETONE; ISOPROPYLACETONE; KETONE,ISOBUTYL METHYL; METHYL ISOBUTYL KETONE; 4-METHYL 2-PENTANONE; METHYL-ISOBUTYL-CETONE; METHYLISOBUTYLKETON; 4-METHYL-2-OXOPENTANE; 4-METHYL-2-PENTANON; 4-METHYL-PENTAN-2-ON; 2-METHYL-4-PENTANONE; 4-METHYL-2-PENTANONE; 4-METHYLPENTANONE-2; 2-METHYLPROPYL METHYL KETONE; METILISOBUTILCHETONE; 4-METILPENTAN-2-ONE; METYLOIZOBUTYLOKETON; MIBK; MIK; 2-PENTANONE,4-METHYL-; SHELL MIBK
General Use: Used as a solvent for paints, varnishes, nitrocellulose, lacquers; manufacture of methyl amyl alcohol; extraction processes including extraction of uranium from fission products; organic synthesis; denaturant for alcohol.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
methyl isobutyl ketone	108-10-1	>99

OSHA PEL
TWA: 100 ppm; 410 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 50 ppm; 205 mg/m^3; STEL: 75 ppm; 300 mg/m^3.

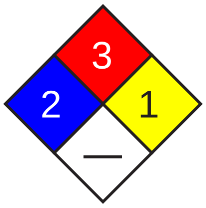
ACGIH TLV
TWA: 50 ppm, 205 mg/m^3; STEL: 75 ppm, 307 mg/m^3.

NIOSH REL
TWA: 50 ppm, 205 mg/m^3; STEL: 75 ppm, 300 mg/m^3.

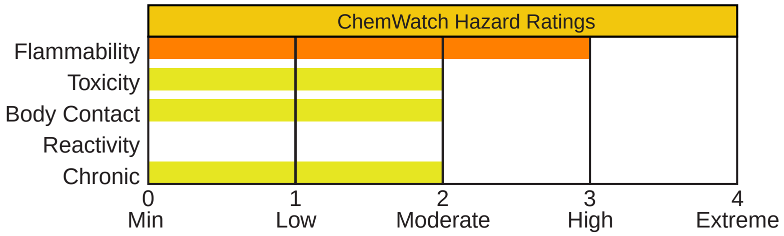
IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 20 ppm, 83 mg/m^3; PEAK: 40 ppm, 166 mg/m^3; skin, ceiling, local irritant effects determine peak value.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
3	Flammability
0	Reactivity

ANSI Signal Word

Warning!

Explosive

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; camphor-like odor. Irritating to eyes/skin/respiratory tract. Also causes: headache, excitability, visual disturbances, nausea, vomiting. Chronic: dermatitis. May cause reproductive effects. Flammable. Forms explosive peroxides in air.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, respiratory system, skin
Primary Entry Routes: inhalation, eye contact, skin contact, ingestion
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract. Inhalation hazard is increased at higher temperatures.

Exposure to ketone vapors may produce nose, throat and mucous membrane irritation. High concentrations of vapor may produce central nervous system depression characterized by headache, vertigo, loss of coordination, narcosis and cardiorespiratory failure. Some ketones produce neurological disorders (polyneuropathy) characterized by bilateral symmetrical paresthesia and muscle weakness primarily in the legs and arms.

Overexposure in humans may produce weakness, loss of appetite, headache, a burning sensation to the eyes, stomach-ache, nausea and vomiting. Sore throat, insomnia, somnolence, heartburn and intestinal pain have been reported by some workers. Tolerance is reported to be acquired over the workweek and lost during the weekend.

Rats, mice, dogs and monkeys that inhaled 100 or 200 ppm MIBK 24 hrs/day showed no outward adverse effects during 2 weeks of exposure. At 200 ppm rats showed increased absolute liver and kidney weights and increased organ-to-body weight ratios. Examination of the proximal tubules showed toxic nephrosis (hyaline droplet degeneration and occasional focal tubular necrosis) in rats exposed to 100 ppm. This damage was considered transient and reversible. Discriminatory behavior and memory in baboons was effected at exposures of 50 ppm for 7 days.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is discomforting to the eyes if exposure is prolonged.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

At concentrations of 100-200 ppm, the vapor may irritate the eyes and respiratory tract

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting and toxic if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Experiments with rats have shown nerve changes characteristic of neuropathy (disease of the peripheral nerves usually causing weakness and numbness).

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: 23.889 °C Open Cup

Autoignition Temperature: 460 °C

LEL: 1.4% v/v

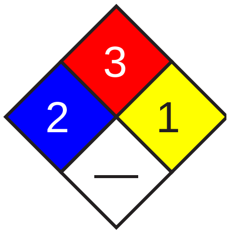
UEL: 7.5% v/v at 93 °C

Extinguishing Media: Alcohol stable foam; dry chemical powder; BCF (where regulations permit).

Carbon dioxide.

Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly



Fire Diamond

flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Metal safety cans.
Packing as supplied by manufacturer.
Plastic containers may only be used if approved for flammable liquid.
Check that containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. NIOSH-approved respirator (supplied air type) may be required in special circumstances. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves. Wear chemical protective gloves, eg. PVC.
Wear safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >100 to <500 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Eyewash unit.

Glove Selection Index:

BUTYL/NEOPRENE	Best selection
PE/EVAL/PE	Best selection
PVA	Best selection
TEFLON	Best selection
BUTYL	Satisfactory; may degrade after 4 hours continuous immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NATURAL+NEOPRENE	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid. Sharp mint-like odor. Mixes with alcohol, ether, acetone, and most organic solvents

Physical State: Liquid
Vapor Pressure (kPa): 1.33 at 30 °C
Vapor Density (Air=1): 3.5
Formula Weight: 100.16
Specific Gravity (H_2O=1, at 4 °C): 0.80
Water Solubility: 1.91% in water
Evaporation Rate: 1.62 (BuAc=1))

pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point Range: 116.8 °C (242 °F) at 760 mm Hg
Freezing/Melting Point Range: -84.7 °C (-120.46 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 2080 mg/kg	Eye (human): 200 ppm/15m
	Skin (rabbit): 500 mg/24h - mild
	Eye (rabbit): 40 mg - SEVERE
	Eye (rabbit): 500 mg/24h - mild

See NIOSH, *RTECS* SA 9275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it may be removed by direct photolysis on soil surfaces, volatilization, or aerobic biodegradation. This compound is also susceptible to extensive leaching and has been detected in landfill leachate. Chemical hydrolysis is not expected to be environmentally significant. If released to water, the primary removal mechanisms are expected to be volatilization (t1/2 15-33 hours) and direct photolysis. Aerobic biodegradation may be of minor importance. It is not expected to undergo chemical oxidation or chemical hydrolysis, bioaccumulate in aquatic organisms or adsorb significantly to suspended solids or sediments in water. In the atmosphere, it will be subject to direct photolysis (t1/2 15 hours in sunlight) and reaction with hydroxyl radical (t1/2 16-17 hours). In photochemical smog situations, it may also react with nitrogen oxides. Acetone is a major photooxidation product, and in the presence of nitrogen oxides, peroxyacetylnitrate (PAN) and methyl nitrate will also be formed.

Ecotoxicity: LC_{50} Pimephales promelas (fathead minnow) 505 mg/l 96 hr flow-through bioassay, wt 0.12 g, water hardness 45.5 mg/l $CaCO_3$, temp: 25 +/- 1 °C, pH 7.5, dissolved oxygen greater than 60% of saturation; LD_{50} Angelaius phoeniceus (Redwinged blackbird) oral 100 mg/kg; LC_{50} Carassius auratus (goldfish) 460 mg/l/24 hr /Conditions of bioassay not specified

Henry's Law Constant: estimated at 9.4×10^{-5}

BCF: estimated at 2 to 5

Biochemical Oxygen Demand (BOD): theoretical 1.8%, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 1.19$

Soil Sorption Partition Coefficient: K_{oc} = estimated at 19 to 106

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: METHYL ISOBUTYL KETONE
Hazard Class: 3.1
ID No.: 1245
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information: 4-METHYL-2-PENTANONE

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U161 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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Issue Date: 2003-02

Methylene Chloride
MET5440

Section 1 - Chemical Product and Company Identification 44/57

Material Name: Methylene Chloride **CAS Number:** 75-09-2
Chemical Formula: CH_2Cl_2
EINECS Number: 200-838-9
Synonyms: AEROTHENE MM; CHLORURE DE METHYLENE; DCM; DICHLOROMETHANE; METHANE DICHLORIDE; METHANE,DICHLORO-; METHYLENE BICHLORIDE; METHYLENE CHLORIDE; METHYLENE DICHLORIDE; METHYLENUM CHLORATUM; METYLENU CHLOREK; NARKOTIL; R 30; R30 (REFRIGERANT); SOLAESTHIN; SOLMETHINE
Derivation: Produced by chlorination of methane.
General Use: Used as a solvent for cellulose acetate, adhesives, food processing, and pharmaceuticals; in degreasing and cleaning fluids, paint and varnish removers, decaffeination of coffee, in propellant mixtures for aerosols; as a blowing agent in foams, dewaxing agent, component of fire extinguishing compound, chemical intermediate, low temperature heat-transfer medium, and as a fumigant. Formerly used as an anesthetic.

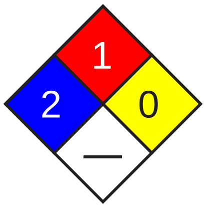
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Methylene chloride	75-09-2	ca < 100% vol

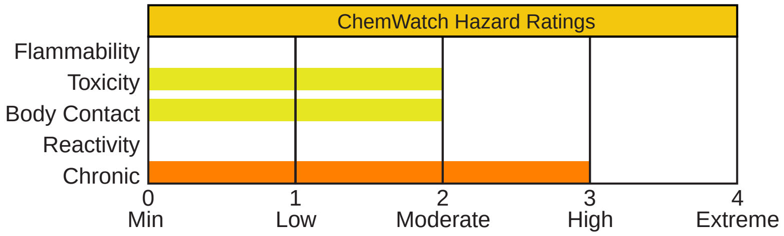
Trace Impurities: Stabilizers may be added such as: amines, 4-cresol, hydroquinone, methanol, 2-methyl-2-ene, 1-naphthol, nitromethane + 1,4-dioxane, phenol, resorcinol, and thymol.

OSHA PEL	NIOSH REL
TWA: 25 ppm; STEL: 125 ppm.	No data found.
ACGIH TLV	**IDLH Level**
TWA: 50 ppm, 174 mg/m^3.	2300 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
1 Flammability
0 Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Methylene chloride is a colorless, volatile liquid with a sweet odor. It is irritating to the eyes, skin, and respiratory tract. At high concentrations it can cause narcosis (unconsciousness). Methylene chloride is metabolized to carbon monoxide in the body which contributes to much of its toxicity. It can form flammable mixtures with air (forming toxic phosgene when burned) and becomes explosive when mixed with oxygen.

Potential Health Effects

Target Organs: Eyes, skin, central nervous system (CNS), cardiovascular system (CVS), blood.
Primary Entry Routes: Inhalation, skin and eye contact.

Acute Effects Methylene chloride will cross the placenta. The estimated lethal dose is 0.5 to 5 mL/kg. Although methylene chloride has a distinct sweetish odor, it is not recognized at levels low enough to protect from overexposure.

Inhalation: Symptoms include headache, giddiness, irritability, nausea, stupor, numbness and tingling of limbs, fatigue, anemia and polymorphonuclear leukocytosis, digestive disturbances, and neurasthenic disorders (emotional and psychic disorders characterized by easy fatigue, lack of motivation, feelings of inadequacy, and psychosomatic symptoms). Many symptoms are attributed to the metabolism of methylene chloride to carbon monoxide in the body. The carbon monoxide forms carboxyhemoglobin in the blood, which unlike hemoglobin, does not have the ability to carry oxygen. This lack of oxygen leads to CNS and CVS problems. However, CNS effects *have* been seen in persons without a significantly elevated blood carbon monoxide level.

Eye: Exposure to vapors produces irritation, tearing, and conjunctivitis. Direct contact with the liquid causes severe pain, but permanent damage does not occur.

Skin: Contact is irritating and can be painful (burns) if confined to skin (i.e. trapped under gloves or clothing). Methylene chloride can be absorbed through the skin to cause systemic effects.

Ingestion: Expected to cause gastrointestinal irritation, nausea, vomiting, and systemic effects (see inhalation).

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Medical Conditions Aggravated by Long-Term Exposure: Skin and cardiovascular disorders.

Chronic Effects: Repeated skin contact can cause dermatitis. Liver disease has been reported. *Case Reports*: 1 yr exposure caused toxic encephalopathy (toxicity of the brain) with audio and visual delusions and hallucinations; 3 yr exposure to 300 to 1000 ppm caused memory loss, intellectual impairment, and balance disturbances.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air, administer 100% humidified, supplemental oxygen and support breathing.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult an ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting with Ipecac syrup. If vomiting does not occur, the decision to perform gastric lavage should be made.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Lethal blood level = 280 mg/L. Biological monitoring: carbon monoxide in expired air (nonsmokers only). Recently, methylene chloride concentrations in urine have been found to correlate well to concentrations in air.

Section 5 - Fire-Fighting Measures

Flash Point: Methylene chloride does not have a flash point by standard tests. However, it does form flammable mixtures with air.

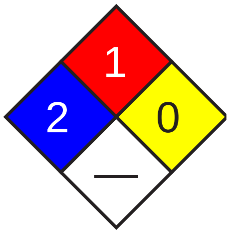
Autoignition Temperature: 1033 °F (556 °C)

LEL: 15.5% (in oxygen); LFL: 12% v/v

UEL: 66.4% (in oxygen); UFL: 19% v/v

Extinguishing Media: For small fires, use dry chemical or carbon dioxide. For large fires, use water spray, fog, or regular foam.

General Fire Hazards/Hazardous Combustion Products: Hydrogen chloride, carbon monoxide and phosgene. Creates an explosion hazard if allowed to enter a confined space. Container may explode in heat of fire.



Fire Diamond

Fire-Fighting Instructions: Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel need to protect against inhalation and skin/eye contact.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material.

Large Spills: Dike far ahead of spill for later reclamation or disposal. Do not release into sewers or waterways. Damp mop any residue.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Do not use near ignition sources. Wear appropriate PPE. Do not use plastic or rubber hose for unloading trucks or tank cars unless the materials have been tested and approved for methylene chloride service. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using methylene chloride, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10). To minimize decomposition, all storage containers should be galvanized or lined with a phenolic coating. Indoor storage tanks should have vents piped outdoors to prevent vapors from escaping into work areas. Prevent moisture from entering tanks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Do not use closed circuit rebreathing systems employing soda lime or other carbon dioxide absorber because of formation of toxic compounds capable of producing cranial nerve paralysis. To prevent static sparks, electrically ground and bond all equipment used with and around methylene chloride. Provide general or local exhaust ventilation systems to maintain airborne levels below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on skin, liver, CNS, CVS, and blood. A complete blood count should be performed and carboxyhemoglobin levels should be determined periodically. Any level above 5% should prompt investigation of employee and workplace to determine the cause (smokers will already have an increased level of carboxyhemoglobin and are at increased risk). Use less hazardous solvents where possible.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyvinyl alcohol and Viton laminated with Neoprene are suitable materials for PPE. Natural rubber, synthetic rubbers, and polyvinyl chloride *do not* provide protection against methylene chloride. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable concentration, use any SCBA or supplied-air respirator (with auxiliary SCBA) with a full facepiece and operated in pressure demand or other positive- pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove methylene chloride from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless; volatile with a sweet odor.

Physical State: Liquid

Odor Threshold: 205 to 307 ppm

Vapor Pressure (kPa): 350 mm Hg at 68 °F (20 °C); 440 mm Hg at 77 °F (25 °C)

Bulk Density: 11.07 lb/gal at 68 °F (20 °C)

Formula Weight: 84.9

Specific Gravity (H_2O=1, at 4 °C): 1.33 at 15 °C

Refractive Index: 1.4244 at 68 °F (20 °C)

Boiling Point: 104 °F (40 °C)

Freezing/Melting Point: -142 °F (-97 °C)

Viscosity: 0.430 cP at 68 °F (20 °C)

Surface Tension: 0.5 to 2.3 g/L (*in oxygen*)

Ionization Potential (eV): 11.32 eV

Critical Temperature: 473 °F (245 °C)

Critical Pressure: 60.9 atm

Water Solubility: 2%

Other Solubilities: Soluble in alcohol, acetone, chloroform, carbon tetrachloride, ether, and dimethylformamide.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Methylene chloride is stable at room temperature in closed containers under normal storage and handling conditions. Tends to carbonize when vapor contacts steel or metal chlorides at high temperatures 572 to 842 °F (300 to 450 °C). Hazardous polymerization does not occur. Exposure to heat, ignition sources, and incompatibles.

Storage Incompatibilities: Include aluminum, lithium, sodium, aluminum bromide, azides, dimethyl sulfoxide + perchloric acid, N-methyl-N-nitrosourea + potassium hydroxide, sodium-potassium alloy, potassium *t*-butoxide, dinitrogen pentoxide, dinitrogen tetraoxide, nitric acid, and oxidizers. Methylene chloride will attack some forms of plastic, rubber, and coatings. Corrodes iron, some stainless steel, copper, and nickel.

Hazardous Decomposition Products: Hydrogen chloride, carbon monoxide and phosgene.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 1600 mg/kg.
Human, oral, LD_{Lo}: 357 mg/kg caused somnolence, paresthesia, and convulsions or effect on seizure threshold.

Acute Inhalation Effects:
Human, inhalation, TC_{Lo}: 500 ppm/8 hr caused euphoria.

Irritation Effects:
Rabbit, eye: 162 mg caused moderate irritation.
Rabbit, skin: 810 mg/24 hr caused severe irritation.

Other Effects:
Rat, oral: 1275 mg/kg caused DNA damage.
Rat, inhalation: 8400 ppm/6 hr/13 weeks (intermittently) caused changes in liver weight.
Rat, inhalation: 3500 ppm/2 yr (intermittently) caused endocrine tumors.
Mutagenicity - Human, fibroblast: 5000 ppm/1 hr (continuously) caused DNA inhibition.
Human, inhalation, TC_{Lo}: 500 ppm/1 yr (intermittently) caused altered sleep time, somnolence, and change in heart rate.

See NIOSH, *RTECS* PA8050000, for additional data.

Section 12 - Ecological Information

Environmental Fate: In air, methylene chloride degrades by reaction with photochemically-produced hydroxyl radicals (half-life = a few months) but does not undergo *direct* photolysis. Degradation products include carbon monoxide, carbon dioxide, and phosgene. In water, it is removed primarily by evaporation (est. half-life = 3 to 5.6 hr under moderate mixing conditions). Some may biodegrade but it is not expected to adsorb to sediment or bioconcentrate. If released to soil most methylene chloride will rapidly evaporate. Some may leach through soil. Methylene chloride will adsorb to peat moss but not to sand.

Ecotoxicity: *Pimephales promelas* (fathead minnow), LC_{50} = 193 mg/L/96 hr; *Lepomis macrochirus* (bluegill), LC_{50} = 230 mg/L/24 hr; *Poecilia reticulata* (guppies), LC_{50} = 294 ppm/14 days. Cytotoxic to plants.

Octanol/Water Partition Coefficient: $\log K_{ow} = 1.25$

Section 13 - Disposal Considerations

Disposal: Pour on sand or earth at a safe distance/location from occupied areas and allow to evaporate (most is transformed to carbon monoxide). A good candidate for liquid injection, rotary kiln, or fluidized bed incineration. Investigate biodegradation: methylene chloride is reported to completely biodegrade under aerobic conditions with sewage seed or activated sludge between 6 hrs. and 7 days. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Dichloromethane
Hazard Class: 6.1
ID No.: UN1593
Packing Group: III
Label: Keep away from food

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U080 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)

SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification

Material Name: 2-Methylnaphthalene **CAS Number:** 91-57-6
Chemical Formula: $C_{11}H_{10}$
Structural Chemical Formula: $C_{10}H_7CH_3$
EINECS Number: 202-078-3
ACX Number: X1002705-9
Synonyms: 2-METHYLNAPHTHALENE; BETA-METHYLNAPHTHALENE; NAPHTHALENE,2-METHYL-; NAPHTHALENE,BETA-METHYL
Derivation: 2-Methylnaphthalene is derived from coal tar.
General Use: 2-Methylnaphthalene is used in organic synthesis, vitamin K production, and insecticides; as a pesticide adjuvant, a dye carrier, and as a chemical intermediate.

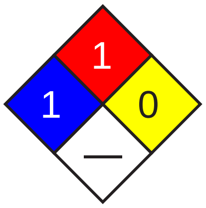
Section 2 - Composition / Information on Ingredients

Name	CAS	%
2-Methylnaphthalene	91-57-6	ca 95% wt (technical)

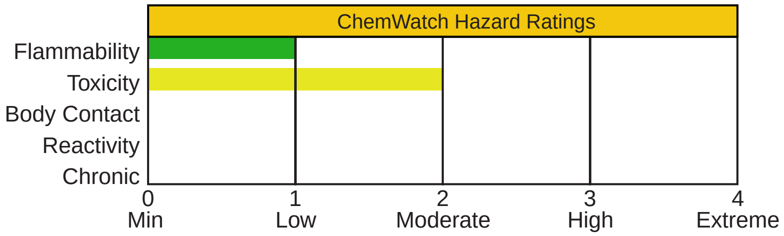
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
1 **Health**
1 **Flammability**
0 **Reactivity**

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White solid. Irritating to eyes/skin/respiratory tract. Harmful by ingestion. Chronic effects: human mutation effects. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, thorax and respiratory system
Primary Entry Routes: Ingestion, Inhalation, and skin/eye contact
Acute Effects
Inhalation: Causes upper respiratory system and mucous membrane irritation.
Eye: Contact causes eye irritation and possible corneal damage.
Skin: Contact causes skin irritation and skin photosensitization.
Ingestion: The toxic effects from ingestion of 2-methylnaphthalene have not been sufficiently investigated. However, naphthalene exposure causes facial flushing, fever, headache, restlessness, lethargy, nausea, vomiting, abdominal pain, anorexia, hemolysis, methemolglobinemia, hemoglobinuria, hyperkalemia, anemia, hepatocellular injury, and acute renal failure. Convulsion and coma may develop following severe exposures.
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Chronic Effects: None reported.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. If breathing is difficult, give oxygen.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Wash out mouth with water provided person is conscious. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Nausea, vomiting, abdominal pain, diarrhea, and anorexia may occur up to 48 hours following acute ingestion. Nausea may also occur after inhalation exposure. There is no specific antidote. Treatment is symptomatic and supportive. Consider GI decontamination with induced emesis or gastric lavage, followed by administration of activated charcoal. Hemolysis may require urinary alkalinization and transfusion; methemoglobinemia may require treatment with methylene or toluidine blue.

Section 5 - Fire-Fighting Measures

Flash Point: 207 °F (97 °C)

Autoignition Temperature: Data not found.

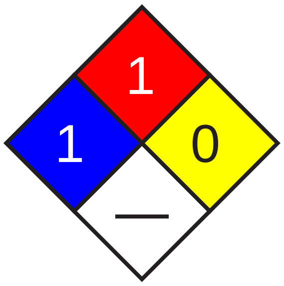
LEL: Data not found

UEL: Data not found

Extinguishing Media: Extinguish with water spray, carbon dioxide, dry chemical or appropriate foam.

General Fire Hazards/Hazardous Combustion Products: Acrid smoke, carbon monoxide, and carbon dioxide may be produced.

Fire-Fighting Instructions: Shut off all ignition sources. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, rubber boots, and heavy rubber gloves.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Cleanup personnel should protect against exposure (Sec. 8). Wear an SCBA, rubber boots and heavy rubber gloves.

Small Spills: If in solid form, *do not* sweep! Avoid raising dust. Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite. Wash spill site after material pickup is complete.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Wear personal protective clothing and equipment to prevent vapor inhalation and contact with skin or eyes (Sec. 8).

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from heat, light, ignition sources, and incompatibles.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose and exhaust ventilate operations to avoid vapor dispersion into the work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations below hazardous levels. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, rubber boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not protective eye devices. Appropriate eye protection must be worn instead of, or in conjunction with, contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air- purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White
Physical State: Solid; crystals.
Odor Threshold: Chemically pure 5.00 x10^{-2} ppm
Vapor Pressure (kPa): 6.81 x 10^{-2} mm Hg at 77 °F (25 °C)
Formula Weight: 142.21
Density: 1.0058 g/cm^3 at 20°/ 4°
Specific Gravity (H_2O=1, at 4 °C): 1.000
Refractive Index: 1.6015 at 77 °F (25 °C)
Boiling Point: 466 to 468 °F (241 to 242 °C)
Freezing/Melting Point: 93 to 97 °F (34 to 36 °C)
Ionization Potential (eV): 7.83 eV
Critical Temperature: 910 °F (488 °C)
Critical Pressure: 34.6 atm
Water Solubility: <1 mg/mL at 70 °F (21 °C)
Other Solubilities: Soluble in benzene and ether; at 70 °F (21 °C): >= 100 mg/mL 95% ethanol; >=100 mg/mL acetone; >=100mg/mL DMSO.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: 2-Methylnaphthalene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid contact with chemical incompatibles, heat, and sources of ignition.

Storage Incompatibilities: Include strong oxidizing agents.

Hazardous Decomposition Products: Thermal oxidative decomposition of 2-methylnaphthalene can produce acrid smoke and toxic fumes of carbon monoxide and carbon dioxide.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 1630 mg/kg.
Rat, oral: 5.00 mL/kg was lethal to all animals.

Other Effects:

Genetic Effects: Human, lymphocyte, 4 mmol/L induced cytogenetic analysis.
Human, lymphocyte, 250 µmol/L induced sister chromatid exchange.

Mouse, intraperitoneal, LD_{Lo}: 1 g/kg produced toxic effects: lung, thorax, or respiration - structural or functional change in trachea or bronchi; lung, thorax, or respiration - other changes.

Mouse, oral, 28500 mg/kg administered for 81 weeks continuously produced toxic effects: Tumorigenic - equivocal tumorigenic agent by RTECS criteria; lung, thorax ,or respiration - tumors.

See *RTECS* QJ9635000, for additional data.

Section 12 - Ecological Information

Environmental Fate: 2-Methylnaphthalene is a component of crude oil and a product of combustion which is produced and released to the environment during natural fires associated with lightning. Emissions from petroleum refining, coal tar distillation, and gasoline- and diesel-fueled engines are major contributors of 2-methlylnaphthalene to the environment. 2-Methylnephthalene should biodegrade rapidly in the environment where micro-organisms have acclimated to polycyclic aromatic hydrocarbons, and at a moderate rate in unacclimated soils and aquatic systems. Hydrolysis and bioconcentration of 2-methylnaphthalene should not be important fate processes in the environment. Photolysis is also likely to occur in air and on sunlit soil surfaces. 2-Methylnaphthalene is expected to exist entirely in the vapor phase in ambient air. Reactions with photochemically-produced hydroxyl radicals (half-life of 7.4 hours) and ozone (half-life of 28.7 days) in the atmosphere are likely to be important fate processes. A measured K_{oc} of 8500 indicates 2-methylnaphthalene will be immobile in soil. In aquatic systems, 2-methylnapthalene may partition from the water column to organic matter contained in sediments and suspended solids. A Henry's Law constant of 5.18×10^{-4} (calculated) suggests volatilization of 2-methylnaphthalene from environmental waters may be important. log K_{ow}: 3.86

Ecotoxicity: Moderately toxic to crustaceans and fish.

Henry's Law Constant: 5.18×10^{-4} (calculated)

BCF: 2.35×10^{4} (rainbow trout)

Soil Sorption Partition Coefficient: $K_{oc} = 8500$

Section 13 - Disposal Considerations

Disposal: Dissolve or mix 2-methylnaphthalene with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Not specifically listed.

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Not listed
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2003-02

Naphthalene
NAP1620

Section 1 - Chemical Product and Company Identification 50/57

Material Name: Naphthalene **CAS Number:** 91-20-3
Chemical Formula: $C_{10}H_8$
EINECS Number: 202-049-5
Synonyms: ALBOCARBON; CAMPHOR TAR; DEZODORATOR; FAULDING NAPHTHALENE FLAKES; MIGHTY 150; MIGHTY RD1; MOTH BALLS; MOTH FLAKES; MOTHBALLS; NAFTALEN; NAPHTHALENE; NAPHTHALIN; NAPHTHALINE; NAPHTHENE; TAR CAMPHOR; WHITE TAR
Derivation: From coal tar; from petroleum fractions after various catalytic processing operations.
General Use: Used as a moth repellent, an antiseptic, toilet bowl deodorant, heat transfer agent, fungicide, smokeless powder, cutting fluid, lubricant, wood preservative; an intermediate for naphthol, phthalic anhydride, chlorinated naphthalenes, Tertralin, Decalin, naphthyl and naphthol derivatives, and dyes; in synthetic resins, synthetic tanning, textile chemicals, scintillation counters, and emulsion breakers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Naphthalene	91-20-3	ca 100% wt.

Grade - By melting point, 165 °F (74 °C) min (crude) to greater than 174 °F (79 °C) (refined); scintillation 176-177 °F (80-81 °C)

OSHA PEL
TWA: 10 ppm; 50 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 10 ppm; 50 mg/m^3; STEL: 15 ppm; 75 mg/m^3.

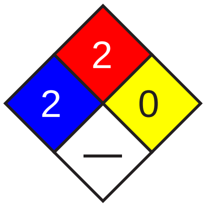
ACGIH TLV
TWA: 10 ppm, 52 mg/m^3; STEL: 15 ppm, 79 mg/m^3; skin.

NIOSH REL
TWA: 10 ppm, 50 mg/m^3; STEL: 15 ppm, 75 mg/m^3.

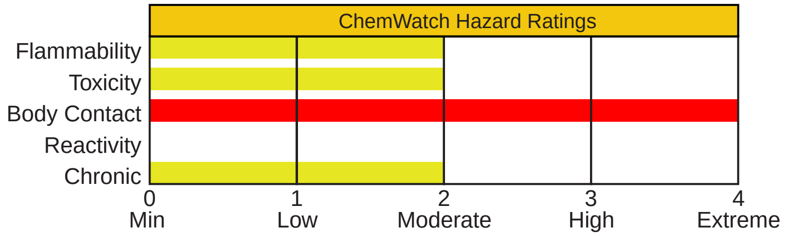
IDLH Level
250 ppm.

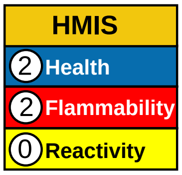
DFG (Germany) MAK
Skin

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Naphthalene is a white crystalline solid with a 'moth ball' or coal-tar odor. It is toxic by ingestion. Irritating to skin, eyes, and respiratory system. Naphthalene is a combustible solid. Dust may form explosive mixtures in air if subjected to an ignition source.

Potential Health Effects

Target Organs: Blood (red blood cell effects), eyes, skin, central nervous system (CNS), liver and kidneys
Primary Entry Routes: Inhalation, skin absorption, skin and/or eye contact
Acute Effects
Inhalation: Vapor inhalation causes headache, confusion, nausea, sometimes vomiting, loss of appetite, extensive sweating, dysuria (painful urination), hematuria (blood in the urine), and hemolysis (destruction of red blood cells).
Eye: Irritation, conjunctivitis, and corneal injury upon prolonged contact.
Skin: Irritation and hypersensitivity dermatitis.

Ingestion: Unlikely. However, ingestion causes irritation of the mouth and stomach, hemolytic anemia with hepatic and renal lesions and vesical congestion, kidney failure, hematuria, jaundice, depression of CNS, nausea, vomiting, abdominal pain, blue face, lips, or hands, rapid and difficult breathing, headache, confusion, excitement, malaise, fever, perspiration, urinary tract pain, dizziness, convulsions, coma, and death. Symptoms may appear 2 to 4 hours after exposure.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver and kidneys; individuals with a hereditary deficiency of the enzyme glucose-6-phosphate dehydrogenase in red blood cells are particularly susceptible to the hemolytic properties of naphthalene metabolites.

Chronic Effects: May cause optical neuritis, corneal injuries, cataracts, kidney damage. There are two reports of naphthalene crossing the placenta in humans.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. Contact a physician immediately if symptoms of systemic poisoning are present.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area thoroughly with soap and water. For reddened or blistered skin, consult a physician. Contact a physician immediately if symptoms of systemic poisoning are present.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Contact a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Obtain baseline CBC, electrolytes, liver and renal function rests, glucose-6-phosphatase dehydrogenase level, urinalysis, and benzidine dipstick to check for hemoglobinuria. Urinary metabolite, 1-naphthol or mercapturic acid, may help confirm the diagnosis.

Section 5 - Fire-Fighting Measures

Flash Point: 174 °F (79 °C) OC; 190 °F (88 °C) CC

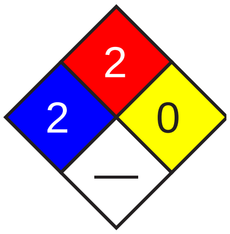
Autoignition Temperature: 979 °F (526 °C)

LEL: 0.9% v/v

UEL: 5.9% v/v

Flammability Classification: Combustible solid

Extinguishing Media: Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water or foam may cause frothing. Use water spray to keep fire-exposed containers cool.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Toxic vapors including carbon monoxide. Volatile solid that gives off flammable vapors when heated. Dust may explode in air if an ignition source is provided.

Fire-Fighting Instructions: Move containers from the fire area if it can be done without risk. Otherwise cool fire-exposed containers until well after the fire is extinguished. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Wear full protective clothing (see Sec. 8). Structural clothing is permeable, remain clear of smoke, water fall out, and water run off.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Stop leak if you can do it without risk. Use spark-proof tools and explosion proof equipment. Cleanup personnel should wear personal protective equipment to protect against exposure (see Sec. 8).

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: To avoid vapor inhalation use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Avoid skin and eye contact. Wear personal protective clothing and equipment to prevent any contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed, explosion-proof containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles (see Sec. 10). May be stored under nitrogen gas. Protect containers against physical damage. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor and dust dispersion into the work area. Ventilate at the site of chemical release. During the fractional distillation of naphthalene and in any operation entailing the heating or volatilization of naphthalene, enclosed apparatus should be employed. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with naphthalene. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the eyes, skin, liver, kidneys, CBC (RBC count, WBC count, differential count of a stained smear, hemoglobin, and hematocrit), and urinalysis including at a minimum specific gravity, albumin, glucose, and a microscopic examination on centrifuged sediment.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Teflon is recommended. *Do not* use butyl rubber, natural rubber, neoprene or polyvinyl chloride. Wear chemical dust-proof safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove naphthalene from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White volatile flakes, cakes, cubes, spheres, or powder; strong coal-tar or moth ball odor.

Physical State: Crystalline solid

Odor Threshold: 0.084 ppm to 0.3 ppm

Vapor Pressure (kPa): 0.05 mm Hg at 68 °F (20 °C); 1.0 mm Hg at 127 °F (53 °C)

Formula Weight: 128.2

Density: 1.145 g/cm^3 at 68 °F (20 °C)

Boiling Point: 424 °F (218 °C)

Freezing/Melting Point: 176 °F (80.2 °C)

Water Solubility: Insoluble [31.7 mg/L at 68 °F (20 °C)]

Other Solubilities: Benzene, absolute alcohol; very soluble in ether, chloroform, carbon disulfide, hydronaphthalenes, fixed and volatile oils

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Naphthalene is stable at room temperature in closed containers under normal storage and handling conditions. It volatilizes at room temperature. Hazardous polymerization cannot occur. Exposure to heat and ignition sources, incompatibles.

Storage Incompatibilities: Include aluminum chloride, benzoyl chloride, chromic acid, chromium trioxide, oxidizers. Explosive reaction with dinitrogen pentaoxide. Melted naphthalene will attack some forms of plastics.

Hazardous Decomposition Products: Thermal oxidative decomposition of naphthalene can produce toxic fumes including carbon monoxide.

Section 11 - Toxicological Information

Acute Oral Effects:\
Rat, oral, LD_{50}: 490 mg/kg.\
Mouse, oral, LD_{50}: 533 mg/kg.\
Human (child), oral, LD_{Lo}: 100 mg/kg.\
Acute Inhalation Effects:\
Rat, inhalation, LC_{50}: >340 mg/m^3 produced lacrimation and somnolence.\
Irritation Effects:\
Rabbit, eye, standard Draize test: 100 mg produced mild irritation.\
Rabbit, skin, open Draize test: 495 mg produced mild irritation.\
Other Effects:\
Rat, oral: 4500 mg/kg administered on gestational days 6-15 produced fetotoxicity and other developmental abnormalities. \
Man, unreported, LD_{Lo}: 74 mg/kg.\
Mouse, inhalation: 30 ppm/6 hr/2 yr administered intermittently produced toxic effects: tumorigenic - neoplastic by RTECS criteria; lungs, thorax, or respiration - tumors.\
Hamster, ovary: 15 mg/L induced sister chromatid exchange.

See NIOSH, *RTECS* QJ0525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, naphthalene rapidly photodegrades with a half-life of 3-8 hr. Volatilization, photolysis, adsorption, and biodegradation are important loss mechanisms for naphthalene discharged into water. Depending on local conditions, the half-lives range from a couple of days to a few months. If released on land, it is adsorbed moderately to soil, undergoes biodegradation; but in some cases biodegradation may still occur if conditions are aerobic. Bioconcentration occurs to a moderate extent, but is a temporary problem since depuration and metabolism readily proceed in aquatic organisms.

Ecotoxicity: *Oncorhynchus gorbuscha* (pink salmon): 1.37 ppm/96 hr at 39 °F (4 °C). *Pimephales promelas* (fathead minnow): 7.76 mg/L/24 hr.

Octanol/Water Partition Coefficient: log K_{ow} = 3.30

Section 13 - Disposal Considerations

Disposal: Consider rotary kiln or fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Naphthalene, crude or
Naphthalene, refined
Hazard Class: 4.1
ID No.: UN1334
Packing Group: III
Label: FLAMMABLE SOLID

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U165 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Issue Date: 2000-07

Nickel
MSDS 723
NIC1000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Nickel **CAS Number:** 7440-02-0
Chemical Formula: Ni
Structural Chemical Formula: Ni
Synonyms: ALCAN 756; C.I. 77775; CARBONYL NICKEL POWDER; EL12; FIBREX; FIBREX P; NI 0901-S; NI 4303-S; NI 4303T; NI-4303T; NI 270; NI 0901-S (HARSHAW); NICHEL; NICKEL; NICKEL 200; NICKEL 201; NICKEL 205; NICKEL 207; NICKEL 270; NICKEL CATALYST SYNONYMS OF OTHER NICKEL COMPOUNDS VARY DEPENDING UPON THE SPECIFIC COMPOUND; NICKEL (DUST); NICKEL METAL: ELEMENTAL NICKEL; NICKEL PARTICLES; NICKEL SPONGE; NICKEL,METAL; NICKLE CATALYST,WET; NP-2; NP 2; PULVERIZED NICKEL; RANEY ALLOY; RANEY NICKEL; RCH 55/5
General Use: Used in the manufacture of Monel metal, stainless steels, and nickel -chrome resistance wire; nickel-plating; various alloys such as new silver, Chinese silver, German silver; for coins, electrotypes, storage batteries. Used for magnets, lightning-rod tips, electrical contacts and electrodes, spark plugs, machinery parts; catalyst for hydrogenation of oils and other organic substances; in alloys for electronic and space applications.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
nickel	7440-02-0	> 99

OSHA PEL
TWA: 1 mg/m^3; as Ni.

OSHA PEL Vacated 1989 Limits
TWA: 1 mg/m^3; Insoluble as Ni.
Other Values: soluble as Ni mg/m^3; 0.1.

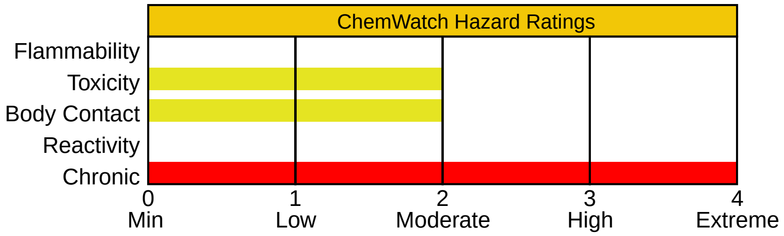
ACGIH TLV
TWA: 1 mg/m^3; as Ni.

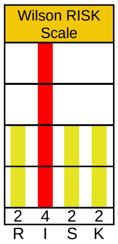
NIOSH REL
TWA: 1 mg/m^3; as Ni soluble & insoluble.

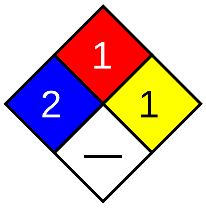
IDLH Level
10 mg/m^3; as Ni.

Section 3 - Hazards Identification

HMIS
2 Health
1 Flammability
1 Reactivity







Fire Diamond

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Silvery-white metal powder. Irritating. Also causes: exposure to fume: metal fume fever, asthma, noninfectious pneumonia, vomiting, abdominal pain; direct contact: nickel itch. Possible cancer hazard. Chronic: sensitization, perforation of nasal septum.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, ingestion
Target Organs: nasal cavities, lungs, skin

Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.

Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Regular exposure to nickel fume, as the oxide, may result in "metal fume fever" a sometimes debilitating upper respiratory tract condition resembling influenza.

Symptoms include malaise, fever, weakness, nausea and may appear quickly if operations occur in closed or poorly ventilated areas.

Pulmonary edema, pulmonary fibrosis and asthma has been reported in welders using nickel alloys; levels of exposure are generally not available and case reports are often confounded by mixed exposures to other agents.

Inhalation of freshly formed metal oxide particles sized below 1.5 microns and generally between 0.02 to 0.05 microns may result in "metal fume fever". Symptoms may be delayed for up to 12 hours and begin with the sudden onset of thirst, and a sweet, metallic or foul taste in the mouth.

Other symptoms include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalized feeling of malaise. Mild to severe headache, nausea, occasional vomiting, fever or chills, exaggerated mental activity, profuse sweating, diarrhea, excessive urination and prostration may also occur. Tolerance to the fumes develops rapidly, but is quickly lost. All symptoms usually subside within 24-36 hours following removal from exposure.

Eye: The dust may produce eye discomfort and abrasive eye inflammation.

Skin: The material may be mildly discomforting to the skin.

Nickel dusts, fumes and salts are potent contact allergens and sensitizers producing a dermatitis known as "nickel" rash.

In the absence of properly designed ventilation systems or where respiratory protective devises are inadequate, up to 10% of exposed workers are expected to be symptomatic.

Ingestion: The material may be mildly discomforting to the gastrointestinal tract if swallowed in large quantity.

The potential to generate small quantities of nickel chloride in the stomach may produce a low order toxic effect.

Nickel salts cause vomiting, following ingestion, as a result of astringent and irritant effects. In common with other irritant-emetics the lethal dose varies widely. Absorption is generally poor and systemic poisoning is rare.

Systemic effects include increased blood sugar levels (hyperglycemia), capillary damage (especially in the brain and adrenals), kidney damage, heart damage (myocardial weakness) and central nervous system depression.

Carcinogenicity: NTP - Class 2A, Reasonably anticipated to be a carcinogen, limited evidence of carcinogenicity from studies in humans; IARC - Group 1, Carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Not listed; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems.

The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

The most common toxic reaction to nickel is skin sensitization which may produce a chronic eczema called "nickel itch". The first symptom is itching which occurs up to 7 days prior to the appearance of skin eruption.

The primary skin eruption is erythematous or follicular and may be followed by superficial discrete ulcers (which discharge and become crusted), or eczema. In the chronic stages, pigmented or depigmented plaques may be formed. Recovery from the dermatitis usually occurs within 7 days but may take several weeks.

Nickel dusts and several specific compounds are carcinogenic in animals following inhalation or parenteral administration (but not by ingestion or skin contact). Increases in lung and nasal cavity cancers have been observed amongst nickel workers in smelters and refineries.

Respiratory cancer risks primarily relate to chronic exposure to soluble nickels at concentrations in excess of 1 mg Ni/m^3 and exposure to the less soluble forms at concentrations greater than 10 mg Ni/m^3. Metallic nickel does not appear to pose such a threat.

When injected intramuscularly, nickel induced incidences of fibrosarcomas in rats and hamsters of both sexes, local sarcomas in rats of both sexes and local tumors with some metastases to pre-vertebral lymph nodes in female rats.

When injected intrapleurally, nickel powder induced round cell and spindle cell tumors at the site of injection in female rats.

Inhalation of nickel dusts induced lymphosarcomas in female mice and anaplastic intraalveolar carcinomas in male and female guinea pigs.

Subdermal implantation of nickel pellets induced sarcomas surrounding the pellet in rats of both sexes whilst intramedullar injection into the femur of rats produced neoplasms at or near the site of injection, including fibrosarcomas (neurogenic in origin).

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

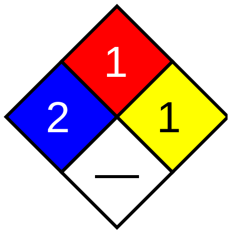
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. Seek medical attention if irritation or discomfort persist.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.
* Preplacement and periodic medical examinations of workers exposed to nickel are recommended. Preplacement examination should evaluate any history of skin allergies or asthma, other exposures to nickel, smoking history, condition of nasal cavity and lungs. Periodic examinations should include chest X-rays.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Not available; probably combustible
LEL: Not applicable
UEL: Not applicable

Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.

General Fire Hazards/Hazardous Combustion Products: Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high.
Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.
When heated with sulfur reacts with incandescence.
If involved in fire, may produce toxic fumes of nickel carbonyl and nickel.

Fire Incompatibility: Avoid reaction with nitric acid and other strong acids, oxidizing agents and sulfur compounds.
Nickel dust reacts violently with titanium, ammonium nitrate, potassium perchlorate and hydrazoic acid.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective clothing, impervious gloves and safety glasses.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place in suitable containers for disposal.

Large Spills: Clear area of personnel and move upwind.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.
Use dry clean-up procedures and avoid generating dust.
Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash spill area with large quantities of water.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.

Always wash hands with soap and water after handling.
Avoid physical damage to containers. Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.

Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Glass container.
Plastic drum.
Plastic bag.
Polyethylene or polypropylene container.
Metal drum.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Metal dusts must be collected at the source of generation as they are potentially explosive.
1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.
2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

Special ventilation requirements apply for processes which result in the generation of barium, chromium, lead, or nickel fume and in those processes which generate ozone.

The use of mechanical ventilation by local exhaust systems is required as a minimum in all circumstances (including outdoor work).

In confined spaces always check that oxygen has not been depleted by excessive rusting of steel or snowflake corrosion of aluminum. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

Personal Protective Clothing/Equipment

Eyes: Safety glasses. Chemical goggles.
Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Impervious gloves; rubber gloves.
Neoprene gloves.
Safety footwear.
Rubber boots.

Respiratory Protection:
Exposure Range >1 to <10 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 10 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: odor threshold unknown

Other: Overalls. Barrier cream. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Lustrous silver-white, hard, ferromagnetic metal. Soluble in dilute nitric acid; slightly soluble in hydrochloric acid and sulfuric acid. Insoluble in ammonia. Mohs' hardness:3.8
Welding flux grades typical sieve analysis (cumulative retention %):- 200 um 0, 150 um 2, 100 um 12, 75 um 60, 63 um 80, 43 um 98.

Physical State: Solid
Vapor Pressure (kPa): 0.13 at 1810 °C
Formula Weight: 58.71
Specific Gravity (H_2O=1, at 4 °C): 8.9
Water Solubility: Insoluble in water
Evaporation Rate: Non-volatile

pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point Range: 2730 °C (4946 °F)
Freezing/Melting Point Range: 1455 °C (2651 °F)
Volatile Component (% Vol): Nil at 38 °C

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid reaction with oxidizing agents. Reacts with acids producing flammable/explosive hydrogen (H_2) gas.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 5000 mg/kg	

See NIOSH, *RTECS* QR 5950000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NONE
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.............................1999-11 **Review Date:** 2000-07

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di-sec-Octyl Phthalate
DIE8100

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: di-sec-Octyl Phthalate **CAS Number:** 117-81-7
Chemical Formula: $C_{24}H_{38}O_4$
Structural Chemical Formula: $C_6H_4[COOCH_2CH(C_2H_5)(CH_2)_3]_2$
EINECS Number: 204-211-0
ACX Number: X1003752-2
Synonyms: BEHP; 1,2-BENZENEDICARBOXYLIC ACID,BIS(2-ETHYLHEXYL) ESTER; 1,2-BENZENEDICARBOXYLIC ACID,BIS(ETHYLHEXYL) ESTER; BIS(2-ETHYLHEXYL) 1,2-BENZENEDICARBOXYLATE; BIS(2-ETHYLHEXYL)-1,2-BENZENEDICARBOXYLATE; BIS-(2-ETHYLHEXYL)-1,2-BENZENEDICARBOXYLATE; BIS-(2-ETHYLHEXYL)ESTER KYSELINY FTALOVE; BIS(2-ETHYLHEXYL)ESTER PHTHALIC ACID; BIS(2-ETHYLHEXYL)PHTHALATE; BIS-(2-ETHYLHEXYL)PHTHALATE; BISOFLEX 81; BISOFLEX DOP; COMPOUND 889; DAF 68; DEHP; DI(2-ETHYLHEXYL) PHTHALATE; DI(ETHYLHEXYL) PHTHALATE; DIETHYLHEXYL PHTHALATE; DI(2-ETHYLHEXYL)ORTHOPHTHALATE; DI(2-ETHYLHEXYL)PHTHALATE; DI-2-ETHYLHEXYLPHTHALATE; DI-SEC-OCTYL PHTHALATE; DIOCTYL PHTHALATE; DOF; DOP; ERGOPLAST FDO; ERGOPLAST FDO-S; 2-ETHYLHEXYL PHTHALATE; ETHYLHEXYL PHTHALATE; EVIPLAST 80; EVIPLAST 81; FLEXIMEL; FLEXOL DOP; FLEXOL PLASTICIZER DOP; GOOD-RITE GP 264; HATCOL DOP; HERCOFLEX 260; JAYFLEX DOP; KODAFLEX DOP; MOLLAN O; NUOPLAZ DOP; OCTOIL; OCTYL PHTHALATE; PALATINOL AH; PHTHALIC ACID DIOCTYL ESTER; PHTHALIC ACID,BIS(2-ETHYLHEXYL) ESTER; PITTSBURGH PX-138; PLATINOL AH; PLATINOL DOP; RC PLASTICIZER DOP; REOMOL D 79P; REOMOL DOP; SICOL 150; STAFLEX DOP; TRUFLEX DOP; VESTINOL AH; VINICIZER 80; WITCIZER 312
General Use: Used as a plasticizer for resins, elastomers, vinyl products, films for packaging, containers and electrical cables.
High purity grades used as electrical insulating (dielectric) fluid.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
di-sec-octyl phthalate	117-81-7	>99

OSHA PEL
TWA: 5 mg/m^3.

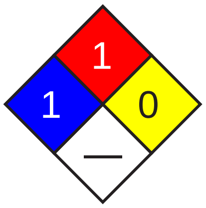
ACGIH TLV
TWA: 5 mg/m^3.

NIOSH REL
TWA: 5 mg/m^3; STEL: 10 mg/m^3.

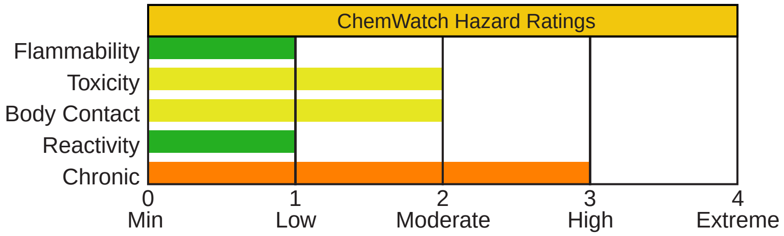
IDLH Level
5000 mg/m^3.

DFG (Germany) MAK
TWA: 10 mg/m^3; PEAK: 80 mg/m^3.

Section 3 - Hazards Identification



Fire Diamond



HMIS
0 Health
1 Flammability
0 Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Light colored liquid; slight odor. Mildly irritating to eyes/skin/respiratory tract. Also causes: conjunctivitis, keratitis, bronchial irritation, eczema, staggering, abdominal cramps, nausea, diarrhea, CNS depression. Possible cancer hazard.

Potential Health Effects

Target Organs: eyes, upper respiratory system, skin, central nervous system (CNS)

Primary Entry Routes: inhalation, ingestion

Acute Effects

Inhalation: Not normally a hazard due to nonvolatile nature of product. Inhalation hazard is increased at higher temperatures.

The mist is discomforting to the upper respiratory tract.

Inhalation of concentrated mists can cause coughing, sneezing, severe irritation, dizziness, headache and nausea.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration. The mist is moderately discomforting to the eyes.

The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is mildly discomforting to the skin if exposure is prolonged and may cause drying of the skin, which may lead to dermatitis.

Irritation and skin reactions are possible with sensitive skin.

The material may accentuate any pre-existing dermatitis condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is discomforting and is regarded as harmful if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Phthalates (aromatic dicarboxylic acid esters), in general, exhibit low toxicity, partly because of poor absorption but mainly as a result of rapid metabolism in which the esters are saponified to phthalic acid (which is rapidly excreted) and the parent alcohol (which is subsequently metabolized). The pathology of these compounds seems to be related to the released alcohol and its biological effects. Testicular atrophy produced in rats during feeding studies depends on the length and structure of the alcohol; in general the lower molecular weight esters produce the more severe effects.

The toxicity of phthalic acid isomers decreases in the order o-phthalic acid, isophthalic acid and terephthalic acid.

Phthalic acid is not metabolized but is excreted, unchanged, in the urine and feces.

Terephthalic acid appears to potentiate the biological effects of substances such as antibiotics, thiamine and sulfonamides.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: Oral studies of 90-days to 2-years in rat, 1-year in guinea pig and up to 1-year in dog have shown a no-effect level of about 60 mg/kg/day. Higher doses produced growth retardation and increased weights of livers and kidneys.

Rats and mice fed on diets containing 6000-12000 (rats) and 3000-6000 (mice) mg/kg body weight for 103 weeks showed an increased incidence of hepatocellular carcinomas in female rats and male and female mice, and an increased incidence of either hepatocellular carcinomas or neoplastic nodules in male rats. About 35% of the hepatocellular carcinomas in mice had metastasised to the lungs.

The substance can cause testicular damage in rats (dietary and gavage studies) with a no-effect level in 0.3% to 0.5% in the diet. Inhalation or dermal exposures did not produce testicular effects. When the substance was fed to pregnant rats (5 mL/kg) it produced slight effects on embryonic and fetal development with skeletal abnormalities more common.

A Russian study describes exposure by workers to mixed phthalates (and other plasticizers) - pain, numbness and spasms in the upper and lower extremities were related to duration of exposures. Symptoms usually developed after the sixth or seventh year of work. Neurological studies revealed the development of polyneuritis in about 30% of the workers involved in this study. About 30% of the workforce showed depression of the vestibular receptors. Because the study described mixed exposures it is difficult to determine what, if any, unique role was played by the phthalates.

Increased incidences of anovulatory reproductive cycles and low estrogen concentrations were reported among Russian women working with phthalate plasticizers; the abnormal cycles were associated with spontaneous abortion. The specific phthalates implicated, dose levels and other data were not reported.

It has been alleged that the phthalates mimic or interfere with sex hormones. Phthalates are added as plasticizers in plastics (including food packaging) and are used as ingredients in paints, inks and adhesives. Their potential for entering the human body is marked. They have been added to a list of chemicals (including alkyl phenolics, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and dioxins) which are implicated in reducing sperm counts and fertility in males a phenomenon which has apparently arisen since the mid 1960s.

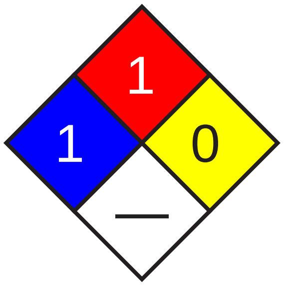
Although the human fetus is "bathed" in naturally occurring estrogens during pregnancy it is suggested that it has developed a protective mechanism against natural estrogens but is not safe from synthetic variants. These tend to accumulate in body fats which sets them apart from the natural product. During early pregnancy, fats are broken down and may flood the body with concentrated pollutants.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
Eye Contact: Immediately hold eyes open and flush continuously with running water for at least 15 minutes. Ensure irrigation under eyelids.
Seek medical attention without delay.
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: 215 °C Open Cup
Autoignition Temperature: 391 °C
LEL: 0.3% v/v
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Combustible. Slight fire hazard when exposed to heat or flame.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit acrid smoke.
Mists containing combustible materials may be explosive.
Hot organic vapors or mist are capable of sudden spontaneous combustion when mixed with air even at temperatures below their published autoignition temperatures. The temperature of ignition decreases with increasing vapor volume and vapor/air contact times and is influenced by pressure change.
Ignition may occur under elevated-temperature process conditions especially in processes performed under vacuum subjected to sudden ingress of air or in processes performed at elevated pressure, where sudden escape of vapors or mists to the atmosphere occurs.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Wipe up. Place in a suitable labeled container for waste disposal.
Large Spills: Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
Shut off all possible sources of ignition and increase ventilation.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.

Absorb or cover spill with sand, earth, inert material or vermiculite.
Recover liquid and place in labeled, sealable container for recycling.
Collect residues and seal in labeled drums for disposal.
Wash spill area with detergent and water.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use in a well-ventilated area.
Avoid generating and breathing mist and vapor.
Avoid contact with incompatible materials.
Avoid prolonged and repeated skin contact.
Avoid smoking, bare lights or ignition sources.
Avoid physical damage to containers.
Keep containers securely sealed when not in use.
Wear personal protective equipment when handling.
When handling, DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: None under normal operating conditions. OTHERWISE: General exhaust is adequate under normal operating conditions.
If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.
If mist is present, use air supplied breathing apparatus.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream and Nitrile rubber gloves or Neoprene rubber gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >5 to 50 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to 500 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >500 to <5000 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 5000 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)

Other: Overalls. Eyewash unit.

Glove Selection Index:

BUTYL	Best selection
VITON	Best selection
NITRILE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Light-colored, odorless and oily liquid. Mixes with mineral oil and most organic solvents.

Physical State: Liquid	**pH:** Not applicable
Vapor Pressure (kPa): 0.17 at 200 °C	**pH (1% Solution):** Not applicable.
Vapor Density (Air=1): 13.45	**Boiling Point:** 230 °C (446 °F) at 5 mm Hg
Formula Weight: 390.54	**Freezing/Melting Point:** -50 °C (-58 °F)
Specific Gravity (H_2O=1, at 4 °C): 0.99 at 20 °C	**Water Solubility:** < 0.01% at 25 °C

Evaporation Rate: Very Slow

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Hazardous polymerization will not occur. Stable under normal storage conditions.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 30000 mg/kg
Oral (human) TD_{Lo}: 143 mg/kg
Oral (mouse) LD_{50}: 1500 mg/kg
Oral (rabbit) LD_{50}: 34000 mg/kg
Dermal (rabbit) LD_{50}: 25000 mg/kg
Intraperitoneal (rabbit) LD_{50}: >31 mL/kg
Oral (guinea pig) LD_{50}: 26000 mg/kg
Dermal (g.pig) LD_{50}: 10000 mg/kg

Gastrointestinal changes, respiratory system changes, somnolence, hemorrhage, necrotic changes in GI tract, lowered blood pressure, liver, endocrine tumors, feto toxicity, paternal effects, maternal effects, specific developmental abnormalities (hepatobiliary system, musculoskeletal system, cardiovascular system, urogenital system, central nervous system, eye/ear), fetolethality recorded.

NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

Irritation

Skin (rabbit): 500 mg/24 hr mild
Eye (rabbit): 500 mg/24 hr mild

See *RTECS* TI 0350000, for additional data.

Section 12 - Ecological Information

Environmental Fate: In water it will biodegrade (half-life 2-3 wk), adsorb to sediments and bioconcentrate in aquatic organisms. Atmospheric material will be carried long distances and be removed by rain.

Ecotoxicity: LC_{50} Gammarus pseudolimnaeus more than 32 mg/l/96 hr at 21 °C; juvenile /static bioassay; LC_{50} Ictalurus punctatus (channel catfish) more than 100 mg/l/96 hr at 20 °C; wt 1.5 g /static bioassay; EC_{50} Gymnodinium breve growth rate 3.1% vol/vol/96 hr /Conditions of bioassay not specified; LC_{50} Oncorhynchus kisutch (coho salmon) more than 100 mg/l/96 hr at 16 °C; wt 1.5 g /static bioassay; LC_{50} Daphnia magna: 1,000-5,000 ug/l/48 hr /Conditions of bioassay not specified; LC_{50} Chironomus plumosus (Midge): > 18,000 ug/l/48 hr /Conditions of bioassay not specified

Henry's Law Constant: 1×10^{-4}

BCF: fish 2

Biochemical Oxygen Demand (BOD): acclimated < 1 lb/lb, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 4.89$

Soil Sorption Partition Coefficient: $K_{oc} = 4$ to 5

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: None

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U028 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium Publishing Corp.
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Amsterdam, NY 12010
(518) 842-4111

Polychlorinated Biphenyls (PCBs)
POL2140

Issue Date: 2002-02

Section 1 - Chemical Product and Company Identification 54

Material Name: Polychlorinated Biphenyls (PCBs) **CAS Number:** 1336-36-3
Chemical Formula: Unspecified or Variable
Structural Chemical Formula: $(C_{12}H_{10-x})Cl_x$
Synonyms: AROCLOR; AROCLOR 1221; AROCLOR 1232; AROCLOR 1242; AROCLOR 1248; AROCLOR 1254; AROCLOR 1260; AROCLOR 1262; AROCLOR 1268; AROCLOR 2565; AROCLOR 4465; AROCLOR 5442; 1,1'-BIPHENYL,CHLORO DERIVS; BIPHENYL,POLYCHLORO-; CHLOPHEN; CHLOREXTOL; CHLORINATED BIPHENYL; CHLORINATED DIPHENYL; CHLORINATED DIPHENYLENE; CHLORO 1,1-BIPHENYL; CHLORO 1,1-BIPHENYL-; CHLORO BIPHENYL; CLOPHEN; CLOPHEN A 60; DYKANOL; EPA PESTICIDE CHEMICAL CODE 017801; FENCLOR; FENCLOR 42; INERTEEN; KANECHLOR; KANECHLOR 300; KANECHLOR 400; MONTAR; MONTER; NOFLAMOL; PCB; PCBS; PHENOCHLOR; PHENOCLOR; POLYCHLORINATED BIPHENYL; POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS (PCB'S); POLYCHLOROBIPHENYL; PYRALENE; PYRANOL; SANTOTHERM; SANTOTHERM FR; SOVOL; THERMINOL; THERMINOL FR-1
General Use: Used as dielectric fluids in transformers and capacitors. Prior to 1972, were used as hydraulic and other industrial fluids (e.g., in vacuum pumps, as lubricants and cutting oils), in paints, inks and fire retardants.
Also used in heat transfer systems; gas-transmission turbines; carbonless reproducing paper; adhesives; as plasticizer in epoxy paints; fluorescent light ballasts; wax extenders; coolants; dedusting agents; pesticide extenders; surface treatment and coatings; sealants; caulking material.
This is one of a group of once widely used industrial chemicals whose high stability contributed both to their commercial usefulness and the long term deleterious environmental health effects. Consequently their use has been phased out. Their manufacture in the U.S.A. was discontinued in 1977.

Section 2 - Composition / Information on Ingredients

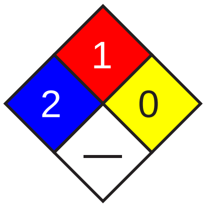
Name	CAS	%
polychlorinated biphenyls (PCB's)	1336-36-3	100

OSHA PEL
No data found.

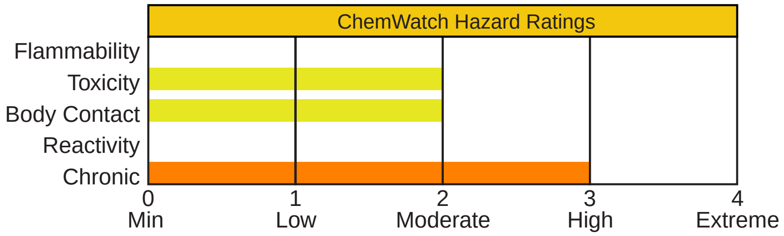
NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



Fire Diamond



HMIS
- ② Health
- ① Flammability
- ⓪ Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Oily liquid, white crystalline solid, or hard resin. Severely irritating. Suspect cancer hazard. Chronic: chloracne, GI disturbances, neurological symptoms, liver enlargement, menstrual changes, bronchitis. Possible reproductive and teratogenic effects.

Potential Health Effects

Target Organs: skin, liver, eyes, mucous membranes, respiratory system
Primary Entry Routes: inhalation, skin contact, ingestion

Acute Effects

Inhalation: Not normally a hazard due to nonvolatile nature of product. Inhalation of vapor is more likely at higher than normal temperatures.

The vapor/mist is discomforting and may be extremely toxic if inhaled.

Eye: The vapor/liquid is moderately discomforting and may be harmful to the eyes.

Skin: The liquid is harmful to the skin, it is rapidly absorbed and is capable of causing skin reactions.

Exposure to material may result in a dermatitis, described as chloracne, a persistent acneiform characterized by comedones (white-, and black- heads), keratin cysts, and inflammed papules with hyperpigmentation and an anatomical distribution frequently involving the skin under the eyes and behind the ears. It occurs after acute or chronic exposure to a variety of chlorinated aromatic compounds by skin contact, ingestion or inhalation and may appear within days and months following the first exposure. Other dermatological alterations including hypertrichosis (the growth of excess hair), an increased incidence of actinic or solar elastosis (the degeneration of elastic tissue within muscles or loss of dermal elasticity produced by the effects of sunlight), and Peyrone's disease (a rare progressive scarring of the penile membrane).

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Digestion may lead to nausea, vomiting, abdominal pain, anorexia, jaundice and liver damage, coma and death.

Headache, dizziness, lethargy, depression, nervousness, loss of libido, muscle, joint pains may be found.

Symptoms appear after a latent period of 5 to 6 months.

PCB's may appear in breast milk of exposed mothers and in newborn infants.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: People occupationally exposed to PCB's have relatively high PCB residue levels in blood plasma. Symptoms include chloracne dermatitis and degreasing the skin, pigmentation of skin and nails, excessive eye discharge, swelling of eyelids, transient visual disturbances, distinctive hair follicles, edema of the face and hands.

In common with other polyhalogenated aromatic hydrocarbons, the chlorinated biphenyls exhibit dioxin-like behavior. Polyhalogenated aromatic hydrocarbons (PHAHs) comprise two major groups.

The first group represented by the halogenated derivatives of dibenzodioxins (the chlorinated form is PCDD), dibenzofurans (PCDF) and biphenyls (PCB) exert their toxic effect (as hepatoxicants, reproductive toxicants, immunotoxicants and procarcinogens) by interaction with a cytostolic protein known as the Ah receptor. In guinea pigs the Ah receptor is active in a mechanism which "pumps" PHAH into the cell whilst in humans the reverse appears to true. This, in part, may account for species differences often cited in the literature. This receptor exhibits an affinity for the planar members of this group and carries these to the cellular nucleus where they bind, reversibly, to specific genomes on DNA.

This results in the regulation of the production of certain proteins which elicit the toxic response. The potency of the effect is dependent on the strength of the original interaction with the Ah receptor and is influenced by the degree of substitution by the halogen and the position of such substitutions on the parent compound.

The most potent molecule is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) while the coplanar PCBs (including mono-ortho coplanars) possess approximately 1% of this potency. Nevertheless, all are said to exhibit "dioxin-like" behavior and in environmental and health assessments it has been the practice to assign each a TCDD-equivalence value.

The most subtle and important biological effects of the PHAHs are the effects on endocrine hormones and vitamin homeostasis. TCDD mimics the effect of thyroxin (a key metamorphosis signal during maturation) and may disrupt patterns of embryonic development at critical stages. Individuals from exposed wildlife populations have been observed to have altered sexual development, sexual dysfunction as adults and immune system suppression.

Immunotoxic effects of the PHAHs (including the brominated congener, PBB) have been the subject of several studies. No clear pattern emerges in human studies however with T-cell numbers and function (a blood marker for immunological response) increasing in some and decreasing in others.

Three incidences have occurred which have introduced abnormally high levels of dioxin or dioxin-like congeners to humans. The explosion at a trichlorophenol-manufacturing plant in Seveso, Italy distributed TCDD across a large area of the country-side, whilst rice-oil contaminated with heat-transfer PCBs (and dioxin-like contaminants) has been consumed by two groups, on separate occasions (one in Yusho, Japan and another in Yu-cheng, Taiwan). The only symptom which can unequivocally be related to all these exposures is the development of chloracne, a disfiguring skin condition, following each incident. Contaminated oil poisonings also produced eye-discharge, swelling of eyelids and visual disturbances. The Babies born up to 3 years after maternal exposure (so-called "Yusho-babies") were characteristically brown skinned, colored gums and nails and (frequently) produced eye-discharges. Delays in intellectual development have been noted. It has been estimated that Yu-cheng patients consumed an average level of 0.06 mg/kg body weight/day total PCB and 0.0002 mg/kg/day of PCDF before the onset of symptoms after 3 months. When the oil was withdrawn after 6 months they had consumed 1 gm total PCB containing 3.8 mg PCDF.

Preliminary data from the Yusho cohort suggests a six-fold excess of liver cancer mortality in males and a three-fold excess in women.

Recent findings from Seveso indicate that the biological effects of low level exposure (BELLEs), experienced by a cohort located at a great distance from the plant, may be hormetic, i.e. may be protective AGAINST the development of cancer.

TCDD induces carcinogenic effects in the laboratory in all species, strains and sexes tested. These effects are dose-related and occur in many organs.

Exposures as low as 0.001 ug/kg body weight/day produce carcinoma.

Several studies implicate PCBs in the development of liver cancer in workers as well as multi-site cancers in animals.

The second major group of PHAH consists of the non-planar PCB congeners which possess two or more ortho-substituted halogens. These have been shown to produce neurotoxic effects which are thought to reduce the concentration of the brain neurotransmitter, dopamine, by inhibiting certain enzyme-mediated processes.

The specific effect elicited by both classes of PHAH seems to depend on the as much on the developmental status of the organism at the time of the exposure as on the level of exposure over a lifetime.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

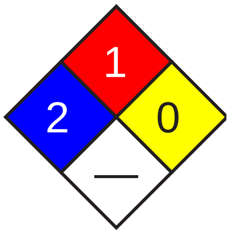
Ingestion: Contact a Poison Control Center. DO NOT induce vomiting. Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink. Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically. If large amounts are ingested, gastric lavage is suggested. For splash in the eyes, a petrolatum-based ophthalmic ointment may be applied to the eye to relieve the irritating effects of PCBs.
If electrical equipment arcs over, PCB dielectric fluids may decompose to produce hydrogen chloride (HCl), a respiratory irritant. [Monsanto] Preplacement and annual medical examinations of workers, with emphasis on liver function, skin condition, reproductive history, is recommended.

Section 5 - Fire-Fighting Measures

Flash Point: > 141 °C
Autoignition Temperature: 240 °C
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Foam.Alcohol stable foam.
Dry chemical powder.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Noncombustible liquid.
POLLUTANT -contain spillage.
Decomposes on heating and produces acrid black soot and toxic fumes of aldehydes, hydrogen chloride (HCl), chlorides and extremely toxic polychlorinated dibenzofuran (PCDF), polychlorinated dibenzodioxin (PCDD).

Fire Incompatibility: Reacts vigorously with chlorine (Cl2).

Fire-Fighting Instructions: POLLUTANT -contain spillage. Noncombustible.
Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Cool fire-exposed containers with water spray from a protected location.
Avoid spraying water onto liquid pools.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: POLLUTANT -contain spillage. Clean up all spills immediately.
Environmental hazard - contain spillage.
Avoid breathing vapors and contact with skin and eyes.
Wear protective clothing, impervious gloves and safety glasses.
Contain spill with sand, earth or vermiculite.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: POLLUTANT -contain spillage. Clear area of personnel.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect residues and seal in labeled drums for disposal.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If equipment is grossly contaminated, decontaminate and destroy.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Do not allow clothing wet with material to stay in contact with skin Use good occupational work practices. Observe manufacturer's storing and handling recommendations.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Avoid all personal contact, including inhalation.
Wear protective clothing and gloves when handling containers.
Avoid physical damage to containers.
Use in a well-ventilated area and Use only in completely enclosed system.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Metal can or metal drum or Steel drum with plastic liner.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Provide adequate ventilation in warehouse or closed storage areas.
If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; chemical goggles.
Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Impervious gloves or Viton gloves or Polyethylene gloves or PVC gloves.
Protective footwear.

Other: Impervious protective clothing. Overalls. Impervious apron.
Eyewash unit.
Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to yellow-green, mobile oily to viscous liquid, or sticky to hard resin, or white crystalline solid, depending on degree of chlorination. Slightly soluble in glycerol and glycols. Soluble in organic solvents and lipids. Viscosity range: 71 - 2500 Saybolt unit sec. at 38 °C. PCBs are resistant to chemical and biological degradation and because of their solubility in fats and oils they tend to be concentrated in living organisms. The highly chlorinated PCBs are retained in animal's bodies longer and seems to delay the excretion of the lower chlorinated PCB's. They have become widely dispersed in the world-wide environment and in the food-chain since their introduction in 1929. They are now recognized internationally to be a major environmental pollutant, their persistence causing ecological damage via water pollution. Consequently loss of PCBs to the environment is to be avoided at all costs.

Physical State: Liquid
Vapor Pressure (kPa): Negligible
Formula Weight: 188.66 - 395
Specific Gravity (H_2O=1, at 4 °C): 1.18 - 1.8
Water Solubility: Solubility in water extremely low
Evaporation Rate: Non Vol. at 38 °C

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 340 °C (644 °F) to 375 °C (707 °F)
Decomposition Temperature (°C): 375-550

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers. Segregate from chlorine.
Avoid contamination of water, foodstuffs, feed or seed.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (human) LD_{Lo}: 500 mg/kg	Nil reported
Oral (rat) LD_{50}: 3980 mg/kg	

See NIOSH, *RTECS* TQ1350000, for additional data.

Section 12 - Ecological Information

Environmental Fate: PCBs are mixtures of different congeners of chlorobiphenyl and the relative importance of the environmental fate mechanisms generally depends on the degree of chlorination. In general, the persistence of PCBs increases with an increase in the degree of chlorination. Mono-, di- and trichlorinated biphenyls (Aroclor 1221 and 1232) biodegrade relatively rapidly, tetrachlorinated biphenyls (Aroclors 1016 and 1242) biodegrade slowly, and higher chlorinated biphenyls (Aroclors 1248, 1254, and 1260) are resistant to biodegradation. Although biodegradation of higher chlorinated congeners may occur very slowly on an environmental basis, no other degradation mechanisms have been shown to be important in natural water and soil systems; therefore, biodegradation may be the ultimate degradation process in water and soil.

If released to soil, PCBs experience tight adsorption with adsorption generally increasing with the degree of chlorination. PCBs will generally not leach significantly in aqueous soil systems; the higher chlorinated congeners will have a lower tendency to leach than the lower chlorinated congeners. In the presence of organic solvents PCBs may leach quite rapidly through soil. Vapor loss from soil surfaces appears to be an important fate mechanism with the rate of volatilization decreasing with increasing chlorination. Although the volatilization rate may be low, the total loss by volatilization over time may be significant because of persistence and stability. Enrichment of the low Cl PCBs occurs in the vapor phase relative to the original Aroclor; the residue will be enriched in the PCBs containing high Cl content.

If released to water, adsorption to sediment and suspended matter will be an important fate process; PCB concentrations in sediment and suspended matter have been shown to be greater than in the associated water column. Although adsorption can immobilize PCBs (especially the higher chlorinated congeners) for relatively long periods of time, eventual resolution into the water column has been shown to occur. The PCB composition in the water will be enriched in the lower chlorinated PCBs because of their greater water solubility, and the least water soluble PCBs (highest Cl content) will remain adsorbed. In the absence of adsorption, PCBs volatilize relatively rapidly from water. However, strong PCB adsorption to sediment significantly competes with volatilization, with the higher chlorinated PCBs having longer half-lives than the lower chlorinated PCBs. Although the resulting volatilization rate may be low, the total loss by volatilization over time may be significant because of persistence and stability. PCBs have been shown to bioconcentrate significantly in aquatic organisms. If released to the atmosphere, PCBs will primarily exist in the vapor-phase; the tendency to become associated with the particulate-phase will increase as the degree of chlorination of the PCB increases. The dominant atmospheric transformation process is probably the vapor-phase reaction with hydroxyl radicals which has estimated half-lives ranging from 12.9 days for monochlorobiphenyl to 1.31 years for heptachlorobiphenyl. Physical removal from the atmosphere, which is very important environmentally, is accomplished by wet and dry deposition.

Ecotoxicity: Aquatic toxicity: 0.278 ppm/96 hr/bluegill/TLm/fresh water 0.005 ppm/336-1080 hr/pinfish/TLm/salt water; Waterfowl toxicity: LD_{50} 2000 ppm (mallard duck); Food chain concentration potential: High

Henry's Law Constant: 5 $x10^{-5}$

BCF: bioconcentrate in tissue

Biochemical Oxygen Demand (BOD): very low

Soil Sorption Partition Coefficient: K_{oc} = 510 to 1.33 $x10^{4}$

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.

Follow applicable federal, state, and local regulations.

Due to their environmental persistence and potential health hazards, PCBs cannot be disposed of in landfills or dumped at sea. The only environmentally acceptable method for the disposal of PCBs is by high temperature incineration.

All wastes and residues containing PCB's (e.g., wiping cloths, absorbent material, used disposable protective gloves, contaminated clothing, etc.) should be collected, placed in proper containers, labelled and disposed of in accordance with applicable regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: POLYCHLORINATED BIPHENYLS

Hazard Class: 9

ID No.: 2315

Packing Group: II

Label: Miscellaneous Dangerous Goods[9]

Additional Shipping Information: PCB'S

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed

CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per CWA Section 307(a) 1 lb (0.454 kg)

SARA 40 CFR 372.65: Listed

SARA EHS 40 CFR 355: Not listed

TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

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Issue Date: 2000-07

Perchloroethylene
MSDS 313
TET2750

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Perchloroethylene **CAS Number:** 127-18-4
Chemical Formula: C_2Cl_4
Structural Chemical Formula: $Cl_2C{=}CCl_2$
Synonyms: ANKILOSTIN; ANTISAL 1; ANTISOL 1; CARBON BICHLORIDE; CARBON DICHLORIDE; CZTEROCHLOROETYLEN; DIDAKENE; DILATIN PT; DOW-PER; ENT 1,860; EPA PESTICIDE CHEMICAL CODE 078501; ETHENE,TETRACHLORO-; ETHYLENE TETRACHLORIDE; ETHYLENE,TETRACHLORO-; FEDAL-UN; NEMA; PCE; PER; PERAWIN; PERC; PERCHLOORETHYLEEN,PER; PERCHLOR; PERCHLORAETHYLEN,PER; PERCHLORETHYLENE; PERCHLORETHYLENE,PER; PERCHLOROETHYLENE; PERCLENE; PERCLENE D; PERCLOROETILENE; PERCOSOLV; PERCOSOLVE; PERK; PERKLONE; PERSEC; TETLEN; TETRACAP; TETRACHLOORETHEEN; TETRACHLORAETHEN; TETRACHLORETHYLENE; TETRACHLOROETHENE; 1,1,2,2-TETRACHLOROETHYLENE; TETRACHLOROETHYLENE; TETRACLOROETENE; TETRAGUER; TETRALENO; TETRALEX; TETRAVEC; TETROGUER; TETROPIL
General Use: Used as a drycleaning solvent, a vapor-degreasing solvent; a drying agent for metals and certain other solids. Used also as a heat transfer medium and in the manufacture of fluorocarbons.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
perchloroethylene	127-18-4	100

OSHA PEL
TWA: 100 ppm; STEL: 200 ppm; from Table Z-2. Other Values: 300 mg/m^3; 5 min peak 3hr ppm.

OSHA PEL Vacated 1989 Limits
TWA: 25 ppm; 170 mg/m^3.

ACGIH TLV
TWA: 25 ppm; 170 mg/m^3; STEL: 100 ppm; 6850 mg/m^3.

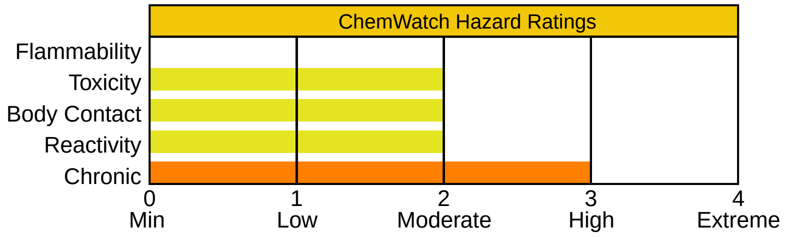
NIOSH REL
No data found.

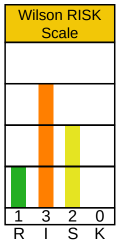
IDLH Level
150 ppm.

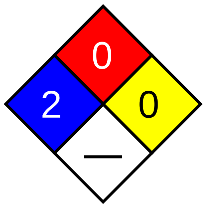
DFG (Germany) MAK
TWA: 50 ppm; 345 mg/m^3.

Section 3 - Hazards Identification

HMIS	
2	Health
0	Flammability
0	Reactivity







Fire Diamond

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; ether-like odor. Irritating to eyes/skin/respiratory tract. Also causes: headache, dizziness, CNS depression, incoordination, slurred speech. Chronic: liver/kidney damage; possible cancer hazard based on animal studies.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact

Target Organs: liver, kidneys, eyes, upper respiratory system, skin, central nervous system (CNS)

Acute Effects

Inhalation: Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.

The vapor is highly discomforting to the upper respiratory tract and lungs.

Inhalation hazard is increased at higher temperatures.

Anesthetic and narcotic effects (with dulling of senses and odor fatigue) are a consequence of exposure to chlorinated solvents.

Individual response varies widely; odor may not be considered objectionable at levels which quickly induce central nervous system effects.

High vapor concentrations may give a feeling of euphoria. This may result in reduced responses, followed by rapid onset of unconsciousness, possible respiratory arrest and death.

Accidental high level exposure has produced lightheadedness, unconsciousness and liver and kidney damage in workers. In at least two cases such exposures were fatal. Subjects exposed to 106 ppm in laboratory studies experienced slight eye irritation; dizziness and sleepiness were reported at 216 ppm; at exposures of 280 ppm or 600 ppm for 10 minutes there was a loss of motor coordination. In another study subjects exposed for 7 hours at 101 ppm complained of eye irritation and subjective symptoms such headache, drowsiness and sleepiness.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration Eye contact may cause lachrymation (tears) and burning sensation.

The vapor is highly discomforting to the eyes.

The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is highly discomforting to the skin if exposure is prolonged and may cause drying of the skin, which may lead to dermatitis.

Toxic effects may result from skin absorption.

Absorption by skin may readily exceed vapor inhalation exposure.

Symptoms for skin absorption are the same as for inhalation.

Bare unprotected skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).

This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.

Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Industrial experience shows localized skin irritation. Prolonged dermal contact can cause chemical burns and blistering.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting and toxic if swallowed and may be fatal if swallowed in large quantity.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

When used in the treatment of hookworm (4.5 to 6.5 gm orally) the only adverse effect is inebriation. Transient hepatotoxicity in patients given single oral doses of up to 5 mL have been recorded.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Workers inhaling 232 to 385 ppm for 8 hours/day, 5 days/week for 2 to 6 years have shown abnormal hepatic function, including cirrhosis, with lightheadedness, headache, malaise and dizziness.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

Avoid giving milk or oils.

Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

For acute or short-term repeated exposures to perchloroethylene:

Tetrachloroethylene/perchlorethylene is well absorbed through the lungs with peak levels more important than duration in determining blood concentration.

Lungs excrete most of the absorbed tetrachloroethylene in an unchanged state; about 3% is converted by the liver to form trichloracetic acid and subsequently excreted by the kidney. Exhaled material has a biological half-life of 65 hours.

INHALATION:

The treatment of acute inhalation exposures is supportive with initial attention directed to evaluation/support of ventilation and circulation.

As with all hydrocarbons care must be taken to reduce the risk of aspiration by proper positioning and medical observation.

INGESTION:

1.The ingestion level at which emesis should be induced is difficult to predict in the absence of extensive human studies.

2.The role of charcoal and cathartics remains uncertain.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker who has been exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Perchloroethylene in end-exhaled air	10 ppm	Prior to last shift of work-week	
Perchloroethylene in Blood	1 mg/L	Prior to last shift of work-week	
Trichloroacetic acid in urine	7 mg/L	End of work-week	NS,SQ

NS: Non-specific determinant; also seen after exposure to other materials

SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.

Section 5 - Fire-Fighting Measures

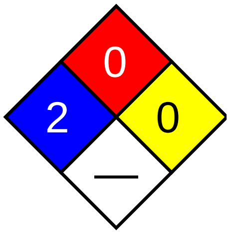
Flash Point: Nonflammable

Autoignition Temperature: 490 °C

LEL: 1.8% v/v

UEL: 11.5% v/v at 740 mm Hg 160 °C

Extinguishing Media: Use extinguishing media suitable for surrounding area.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Nonflammable liquid. However vapor will burn when in contact with high temperature flame. Ignition ceases on removal of flame.

May form a flammable/explosive mixture in an oxygen enriched atmosphere. Heating may cause expansion/vaporization with violent rupture of containers. Decomposes on heating and produces corrosive fumes of hydrochloric acid, carbon monoxide and small amounts of toxic phosgene.

Fire Incompatibility: Avoid mixing with strong alkalis or powdered metals, particularly zinc as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.

Use fire fighting procedures suitable for surrounding area.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately.
Wear protective neoprene gloves and chemical goggles.
If risk of overexposure exists, wear NIOSH-approved respirator.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
DO NOT discharge into sewer or waterways.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Minor hazard. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Check that containers are clearly labeled. Glass container.
Heavy gauge metal packages/heavy gauge metal drums.
Avoid storage with zinc, galvanized or diecast metal (including bungs).
DO NOT use aluminum or galvanized containers.
Packaging as recommended by manufacturer.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
If inhalation risk exists, wear NIOSH-approved organic-vapor respirator or air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. Full face shield.
Hands/Feet: Neoprene gloves; Viton gloves.
PVA gloves.
PVC gloves.
Protective footwear.
Respiratory Protection:
Exposure Range >100 to <150 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 150 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties
Other: Overalls. Eyewash unit. Ensure there is ready access to an emergency shower.

Glove Selection Index:

PE/EVAL/PE	A
VITON/CHLOROBUTYL	A
VITON/NITRILE	A
VITON	A
PVA	A
CPE	A
NITRILE	B
TEFLON	B
NITRILE+PVC	C
SARANEX-23 2-PLY	C
SARANEX-23	C
PVC	C
BUTYL	C
NEOPRENE	C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless liquid, with a chloroform-like odor. Extremely stable, resists hydrolysis. Miscible with alcohol, ether and oils.

Physical State: Liquid
Vapor Pressure (kPa): 2.11 at 22 °C
Vapor Density (Air=1): 5.83
Formula Weight: 165.82
Specific Gravity (H_2O=1, at 4 °C): 1.63 at 15 °C
Water Solubility: 0.02% by weight
Evaporation Rate: 0.09 Ether=1

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 121 °C (250 °F) at 760 mm Hg
Freezing/Melting Point Range: -19 °C (-2.2 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable and hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents. Segregate from strong alkalis.
Haloalkenes are highly reactive. Some of the more lightly substituted lower members are highly flammable; many members of the group are peroxidizable and polymerizable.
The presenceof 0.5% trichloroethylene as an impurity caused generation of dichloroacetylene during unheated drying over solid sodium hydroxide.
Subsequent fractional distillation produced an explosion.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (rat) LD_{50}: 2629 mg/kg
Inhalation (man) LD_{Lo}: 2857 mg/kg
Inhalation (human) TC_{Lo}: 96 ppm/7 hrs
Inhalation (man) TC_{Lo}: 280 ppm/2 hrs
Inhalation (man) TC_{Lo}: 600 ppm/10 min
Inhalation (rat) LC_{Lo}: 34200 mg/m^3/8 hr

IRRITATION
Skin (rabbit): 810 mg/24h -SEVERE
Eye (rabbit): 162 mg -mild

See NIOSH, *RTECS* KX 3850000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If it is released to soil, it will be subject to evaporation into the atmosphere and to leaching to the groundwater. Biodegradation may be an important process in anaerobic soils based on laboratory tests with methanogenic columns. Slow biodegradation may occur in groundwater where acclimated populations of microorganisms exist. If released to water, it will be subject to rapid volatilization with estimated half-lives ranging from <1 day to several weeks. It will not be expected to significantly biodegrade, bioconcentrate in aquatic organisms or significantly adsorb to sediment. It will not be expected to significantly hydrolyze in soil or water under normal environmental conditions. If released to the atmosphere, it will exist mainly in the gas-phase and it will be subject to photooxidation with estimates of degradation time scales ranging from an approximate half-life of 2 months to complete degradation in an hour. Some in the atmosphere may be subject to washout in rain based on the solubility in water.

Ecotoxicity: LC_{50} Tanytarsus dissimilis (midge) 30, 840 ug/l/48 hr, static bioassay; LC_{50} Poecilia reticulata (guppy) 18 ppm/7 days /Conditions of bioassay not specified; LC_{50} Daphnia magna (water flea) 18 mg/l/48 hr, static bioassay, at 22 °C; LC_{50} Salmo gairdneri (rainbow trout) 5 mg/l/96 hr, static bioassay at 12 °C

Henry's Law Constant: 2.87×10^{-2}

BCF: fathead minnow 38.9

Biochemical Oxygen Demand (BOD): none

Octanol/Water Partition Coefficient: $\log K_{ow} = 3.40$

Soil Sorption Partition Coefficient: $K_{oc} = 209$

Section 13 - Disposal Considerations

Disposal: Reclaim solvent at an approved site.
Allow absorbed spillage to evaporate in an open top container, away from habitation.
Incinerate residue at an approved site.
Used containers should be left upside down with bungs out.
Return containers to drum reconditioner or recycler.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: TETRACHLOROETHYLENE
Hazard Class: 6.1(b)
ID No.: 1897
Packing Group: III
Label: Harmful[6]

Additional Shipping Information: PERCHLOROETHYLENE

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U210 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001; per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.............................1999-11 **Review Date:** 2000-07

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Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Phenanthrene
PHE1330

Section 1 - Chemical Product and Company Identification 61

Material Name: Phenanthrene **CAS Number:** 85-01-8
Chemical Formula: $C_{14}H_{10}$
Structural Chemical Formula: $(C_6H_4CH)_2$
EINECS Number: 201-581-5
ACX Number: X1001897-8
Synonyms: COAL TAR PITCH VOLATILES: PHENANTHRENE; PHENANTHREN; PHENANTHRENE; PHENANTRIN
Derivation: A polynuclear aromatic hydrocarbon found as a component of coal tar pitch volatiles (products of bituminous coal distillation). Produced from toluene, bibenzil, 9-methyl fluorene or stilbene by passage through red hot tubes or by diene synthesis of 1-vinyl naphthalene and maleic anhydride.
General Use: Used in the manufacture of dyestuffs and explosives; in biological research or drug synthesis.

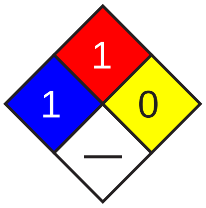
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Phenanthrene	85-01-8	ca 100 % wt

OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



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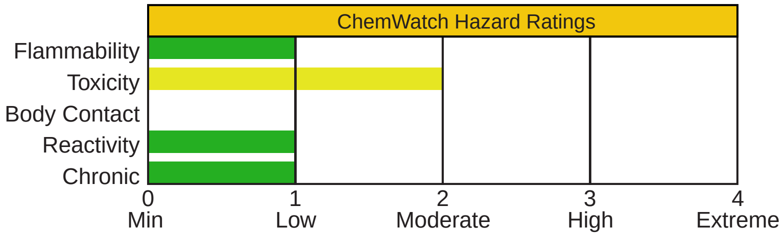


HMIS	
1	Health
1	Flammability
0	Reactivity

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Shiny crystals; faint, aromatic odor. Acute Effects: skin photosensitization. Combustible. Reacts dangerously with oxidizers.

Potential Health Effects

Target Organs: Skin.
Primary Entry Routes: Skin contact.
Acute Effects
Inhalation: Effects not reported.
Eye: Effects not reported.
Skin: Can cause photosensitization of the skin.
Ingestion: Effects not reported.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: Skin disorders.
Chronic Effects: None reported.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse exposed area with flooding amounts of water to remove loose material and then move quickly to a soap and water wash. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 340 °F (171 °C), Open Cup

LEL: Not reported.

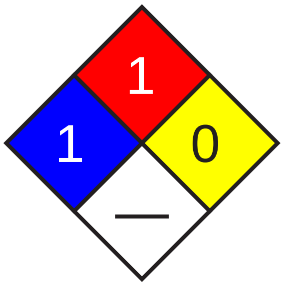
UEL: Not reported.

Flammability Classification: Class IIIB Combustible liquid

Extinguishing Media: Use dry chemical or carbon dioxide; water spray or foam may cause frothing.

General Fire Hazards/Hazardous Combustion Products: Carbon oxides (CO_x) and acrid smoke

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against skin contact.

Small Spills: To avoid dust generation, *do not* sweep! Carefully scoop up or vacuum (with appropriate filter). Damp mop residue.

Large Spills: Flush large spill to containment area for later disposal. Do not release into sewers or waterways. Mop up any residue.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use nonsparking tools to open containers. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from heat, ignition sources, and strong oxidizers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around phenanthrene. Provide general or local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. The following respirator recommendation is for *coal-tar pitch volatiles*: For any detectable concentration, use a SCBA or supplied-air respirator (with auxiliary SCBA) with a full facepiece and operated in pressure-demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, shiny crystals with a faint, aromatic odor.

Physical State: Solid

Odor Threshold: 0.055 to 0.06 mg/m^3

Vapor Pressure (kPa): 1 mm Hg at 244.76 °F (118.2 °C); 400 mm Hg at 586.4 (308 °C)

Formula Weight: 178.22

Density: 1.179 g/L at 77 °F (25 °C)

Refractive Index: 1.59427

Boiling Point: 644 °F (340 °C)

Freezing/Melting Point: 213 °F (101 °C)

Water Solubility: 1.6 mg/L at 59 °F (15 °C)

Other Solubilities: 1 g in: 2.4 mL toluene, 2.4 mL carbon tetrachloride, 2 mL benzene, 1 mL carbon disulfide, 25 mL absolute alcohol, 60 mL cold 95% alcohol, 10 mL boiling 95% alcohol and 3.3 mL anhydrous ether. Also soluble in glacial acetic acid, chloroform, and hot pyridine.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Phenanthrene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Phenanthrene dust generation and exposure to heat ignition sources, or oxidizers.

Storage Incompatibilities: Strong oxidizers.

Hazardous Decomposition Products: Thermal oxidative decomposition of phenanthrene can produce carbon oxide(s).

Section 11 - Toxicological Information

Acute Oral Effects:

Mouse, oral, LD_{50}: 700 mg/kg.

Other Effects:

Tumorgenicity, mouse, skin: 71 mg/kg produced tumors at site of application.
Genetic Effects - Rat, liver cell: 3 mmol/L caused DNA damage.
Human, lymphocyte: 100 µmol/L caused mutation.

See *RTECS* SF7175000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, some phenanthrene may biodegrade but the majority will bind to the soil without much leaching to groundwater. Volatilization is not expected to be significant. In water, it will adhere to particulates and sediment. Photolysis may occur near the surface producing toxic substances. Photolysis/photooxidation half-life = 8.4 hr. In the air, it will react with photochemically generated hydroxyl radicals (half-life = 1.67 days). Phenanthrene absorbs strongly to soil and sediment in water.

Ecotoxicity: *Neanhes arenaceodentata*, TL_m = 0.6 ppm/96 hr, sea water at 71.6 °F (22 °C)

Octanol/Water Partition Coefficient: log K_{ow} = 4.57

Section 13 - Disposal Considerations

Disposal: For treatment of phenanthrene contaminated water, the particulate bound portion can be removed by sedimentation, flocculation, and filtration. Chlorination is not recommended as it has been shown to produce mutagenic substances. The dissolved portion requires oxidation for partial removal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a) 5000 lb (2268 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium Publishing Corp.
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Amsterdam, NY 12010
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Issue Date: 2002-02

Phenol
PHE3200

Section 1 - Chemical Product and Company Identification 54

Material Name: Phenol **CAS Number:** 108-95-2
Chemical Formula: C_6H_6O
Structural Chemical Formula: C_6H_5OH
Synonyms: ACIDE CARBOLIQUE; BAKER'S P AND S LIQUID AND OINTMENT; BENZENOL; CARBOLIC ACID; CARBOLSAURE; FENOL; FENOLO; HYDROXYBENZENE; IZAL; MONOHYDROXYBENZENE; MONOPHENOL; OXYBENZENE; PHENIC ACID; PHENOL; PHENOL ALCOHOL; PHENOLE; PHENOL,MOLTEN; PHENYL ALCOHOL; PHENYL HYDRATE; PHENYL HYDROXIDE; PHENYLIC ACID; PHENYLIC ALCOHOL
General Use: Used as a general disinfectant, either in solution or mixed with slaked lime, etc., for toilets, stables, cesspools, floors, drains, etc.; for the manufacture of colorless or light-colored artificial resins.
Also used in many medicinal and industrial compounds and dyes; as a reagent in chemical analysis.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
phenol	108-95-2	>99

OSHA PEL
TWA: 5 ppm; 19 mg/m^3; skin.

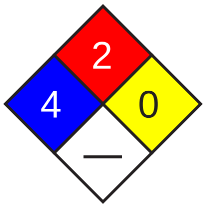
ACGIH TLV
TWA: 5 ppm, 19 mg/m^3; skin.

NIOSH REL
TWA: 5 ppm, 19 mg/m^3; Ceiling: 15.6 ppm; 60 mg/m^3; 15-minute, skin.

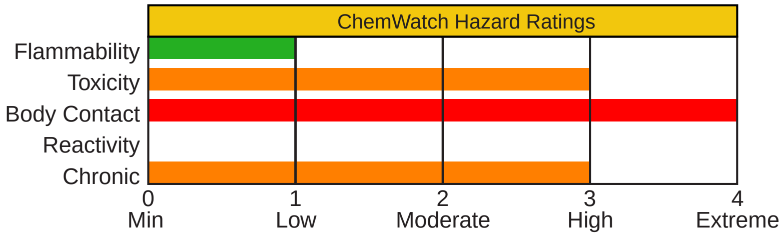
IDLH Level
250 ppm.

DFG (Germany) MAK
Skin

Section 3 - Hazards Identification



Fire Diamond



HMIS
③ Health
② Flammability
⓪ Reactivity

ANSI Signal Word
Danger!


Poison


Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, crystalline solid; medicinal odor. Poison! Corrosive, causes severe burns to the eyes (blindness)/skin/respiratory tract. Also causes: severe neurological effects (shock and coma), liver and kidney damage. Absorbed through the skin. Combustible.

Potential Health Effects

Target Organs: liver, kidneys, nervous system, skin
Primary Entry Routes: skin absorption, eye contact, ingestion, inhalation
Acute Effects
Inhalation: The vapor is extremely discomforting to the upper respiratory tract, may cause severe mucous membrane damage and may be harmful if inhaled.
Pulmonary absorption may lead to systemic toxicity affecting the cardiovascular and central nervous system.
Inhalation of phenol and some of its derivatives may produce profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis, hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema with pneumonia. Respiratory failure and kidney damage may follow.
Inhalation of the vapor causes a sore throat, coughing, shortness of breath and labored breathing.

Systemic effects include paleness, weakness, headache, sweating, ringing of the ears, shock, cyanosis, excitement, dark colored urine, frothing of the nose and mouth.

Pulmonary inflammation and pneumonia, inflammation and necrosis of the myocardium, hepatic centro-lobular necrosis, renal proximal tube swelling and edema and globular degeneration and hind-limb paralysis was observed in guinea-pigs exposed 29 times for 7 hours/day, five days/week to concentrations ranging from 26 to 52 ppm.

Eye: The material is highly corrosive to the eyes and is capable of causing severe burns and capable of causing severe damage with loss of sight.

The vapor from heated material is highly discomforting to the eyes.

The vapor when concentrated has pronounced eye irritation; this gives some warning of high vapor concentrations. If eye irritation occurs seek to reduce exposure with available control measures, or evacuate area.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Some phenol derivatives may produce mild to severe eye irritation with redness, pain and blurred vision. Permanent eye injury may occur; recovery may also be complete or partial.

Skin: The solid/dust is corrosive to the skin, may cause blisters or burns or severe burns and is it is rapidly absorbed by the skin.

Toxic effects may result from skin absorption.

Phenol and some of its derivatives may produce mild to severe skin irritation on repeated or prolonged contact, producing second and third degree chemical burns. Rapid cutaneous absorption may lead to systemic toxicity affecting the cardiovascular and central nervous system.

Absorption through the skin may result in profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis (following the formation of methemoglobin), hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema followed by pneumonia. Respiratory failure and kidney damage may follow.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).

This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.

Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Contact with the skin causes a white, wrinkled discoloration followed by a severe burn or systemic poisoning if not promptly and properly removed.

Intense burning and pain from skin contact may be delayed. Extreme dangers are posed by percutaneous absorption.

In one case a 32 year old male who spilled a solution of phenol over his scalp, face, neck, shoulders and back, died 10 minutes later.

There was coagulation necrosis of the skin, left eye and acute dermatitis veneta with acute passive congestion of the lungs, liver, spleen, kidneys.

Skin absorption occurs at low vapor pressure, without apparent discomfort and proceeds with the same efficiency as absorption by inhalation.

Damage to the lungs has been described following percutaneous absorption.

Methemoglobinemia and hemolytic anemia are frequently documented.

Ingestion: The material is corrosive to the gastrointestinal tract, may cause severe mucous membrane damage and may be fatal if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and diarrhea.

Ingestion of phenol causes blotches on the lips and in the mouth.

Some phenol derivatives may produce mild to severe damage within the gastrointestinal tract. Phenolic groups with ortho and para positions free from substitution are reactive; this is because the ortho and para positions on the aromatic ring are highly activated by the phenolic hydroxyl group and are therefore readily substituted.

Severe phenol ingestions cause hypotension, coma, ventricular dysrhythmias, seizures and white coagulative chemical burns.

Absorption may result in profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis (following the formation of methemoglobin), hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema followed by pneumonia.

Respiratory failure and kidney damage may follow. Phenol does not uncouple oxidative phosphorylation like dinitrophenol and pentachlorophenol and thus does not cause a heat exhaustion-like syndrome.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Prolonged exposure to some derivatives of phenol may produce dermatitis, anorexia, weight loss, weakness, muscle aches and pain, liver damage, dark urine, ochronosis, skin eruptions, diarrhea, nervous disorders with headache, salivation, fainting, increased skin and scleral pigmentation, vertigo and mental disorders. Liver and kidney damage may also ensue. Chronic phenol toxicity was first noted in medical personnel in the late 1800s when 5 and 10% phenol was used as a skin disinfectant. The term carbolic (phenol) marasmus was given to this syndrome.

Chronic phenol poisoning is very rarely reported, but symptoms include vomiting, difficulty in swallowing, diarrhea, lack of appetite, headache, fainting, dizziness, dark urine, mental disturbances, and possibly skin rash. Death due to liver and kidney damage may occur.

Repeated exposure of animals to phenol vapor at concentrations ranging from 26 to 52 ppm has produced respiratory, cardiovascular, hepatic, renal and neurologic toxicity.

Administration of phenol in the drinking water of mice (2500 ppm for 103 weeks) produced an increased incidence of leukemia and lymphomas.

Phenol has been studied in initiation/promotion protocols with a number of polycyclic hydrocarbons and has been shown to have promoting activity in the two-stage skin model.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: If spilled on skin remove contaminated clothing, swab repeatedly with glycerin, PEG (polyethylene glycol), or PEG/ methylated spirit mixture or if necessary with methylated spirit alone.

Contamination of skin with phenol and some of its derivatives may produce rapid collapse and death. After skin contamination, keep patient under observation for at least 24-48 hours. Phenol-decontaminating fluid is more effective than water in removing phenol from the skin and retarding absorption; olive oil or vegetable oil may also be used; do not use mineral oil. Alcohols (methylated spirit, for example) may enhance absorption and their use alone may be ill-advised; some authorities, however, continue to advise the use of such treatment. Rapid water dilution of phenol burns may increase systemic absorption by decreasing the extent of the coagulum and thus allowing greater absorption.

Transport to hospital (or doctor).

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: * Provide preplacement and annual medical examinations for employees exposed to phenol.

Persons with a history of convulsive disorders or abnormalities of the skin, respiratory tract, liver or kidneys would be expected to be at increased risk from exposure. Examination of the liver, kidneys and respiratory tract should be stressed. A urinalysis should be performed including at a minimum, specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

For acute or short-term repeated exposures to phenols/ cresols:

1.Phenol is absorbed rapidly through lungs and skin. Massive skin contact may result in collapse and death.

2.Ingestion may result in ulceration of upper respiratory tract; perforation of esophagus and/or stomach, with attendant complications, may occur. Esophageal stricture may occur.

3.An initial excitory phase may present. Convulsions may appear as long as 18 hours after ingestion. Hypotension and ventricular tachycardia that require vasopressor and antiarrhythmic therapy, respectively, can occur.

4.Respiratory arrest, ventricular dysrhythmias, seizures and metabolic acidosis may complicate severe phenol exposures so the initial attention should be directed towards stabilization of breathing and circulation with ventilation, intubation, intravenous lines, fluids and cardiac monitoring as indicated.

5.Vegetable oils retard absorption; do NOT use paraffin oils or alcohols. Gastric lavage, with endotracheal intubation, should be repeated until phenol odor is no longer detectable; follow with vegetable oil. A saline cathartic should then be given. ALTERNATELY: Activated charcoal (1g/kg) may be given. A cathartic should be given after oral activated charcoal.

6.Severe poisoning may require slow intravenous injection of methylene blue to treat methemoglobinemia.

7.Renal failure may require hemodialysis.

8.Most absorbed phenol is biotransformed by the liver to ethereal and glucoronide sulfates and is eliminated almost completely after 24 hours

BIOLOGICAL EXPOSURE INDEX - BEI

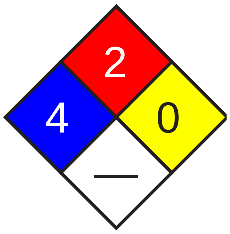
These represent the determinants observed in specimens collected from a healthy worker who has been exposed to the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Total phenol in blood	250 mg/gm creatinine	End of shift	B, NS

B: Background levels occur in specimens collected from subjects NOT exposed

NS: Non-specific determinant; also seen after exposure to other materials.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 79 °C Closed Cup
Autoignition Temperature: 715 °C
LEL: 1.7% v/v
UEL: 8.6% v/v
Extinguishing Media: Carbon dioxide; dry chemical powder.
Alcohol stable foam.
General Fire Hazards/Hazardous Combustion Products: Combustible. Moderate fire hazard when exposed to heat, flame or oxidizers.
Vapor may readily form an explosive mixture with air.
Decomposes on heating and produces toxic fumes of carbon monoxide (CO), carbon dioxide (CO_2).
Fire Incompatibility: Avoid reaction with strong oxidizing agents and halogens.
Reaction with calcium hypochlorite is exothermic and produces toxic fumes which may ignite. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium and zinc.
Do not heat phenol above 60 °C.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Use water delivered as a fine spray to control the fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: POLLUTANT -contain spillageEnvironmental hazard - contain spillage.
Wear protective clothing, impervious gloves and safety glasses.
Avoid breathing vapors and contact with skin and eyes.
Use dry clean-up procedures and avoid generating dust.
Place spilled material in clean, dry, sealable, labeled container.
Wash area down with large quantity of water and prevent runoff into drains.
Large Spills: POLLUTANT -contain spillageEnvironmental hazard - contain spillage.
Clear area of personnel and move upwind.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
If contamination of drains or waterways occurs, advise emergency services.
Shut off all possible sources of ignition and increase ventilation.
Stop leak if safe to do so.
Use dry clean-up procedures and avoid generating dust.
Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Use in a well-ventilated area.
Wear personal protective equipment when handling.
Avoid contact with incompatible materials.
Avoid smoking, bare lights or ignition sources.
Vapor may travel a considerable distance to source of ignition.
Avoid thermal shock.
Avoid physical damage to containers.
Handle and open container with care.
When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.
Recommended Storage Methods: Polylined drum. Stainless steel.

Steel drum.
Check that containers are clearly labeled.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Neoprene gloves; PVC gloves.
Rubber boots.

Respiratory Protection:
Exposure Range >5 to 50 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to <250 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range 250 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)

Other: Acid-resistant overalls.
PVC apron.
Hard hat with brim.
Ensure there is ready access to a safety shower.
Eyewash unit.

Glove Selection Index:

BUTYL	Best selection
BUTYL/NEOPRENE	Best selection
NATURAL+NEOPRENE	Best selection
NEOPRENE/NATURAL	Best selection
PE/EVAL/PE	Best selection
VITON	Best selection
VITON/NEOPRENE	Best selection
NEOPRENE	Best selection
TEFLON	Best selection
NATURAL RUBBER	Satisfactory; may degrade after 4 hours continuous immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
NAT+NEOPR+NITRILE	Poor to dangerous choice for other than short-term immersion
PVA	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: White, crystalline solid with a characteristic sharp medicinal, sweet, tangy odor, which is detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities, or if it is exposed to heat or light. Soluble in benzene. Very soluble in alcohol, chloroform, ether, glycerol, carbon disulfide, petrolatum, volatile and fixed oils, aqueous alkali hydroxides.

Physical State: Divided solid
Vapor Pressure (kPa): 101.33 at 181 °C
Vapor Density (Air=1): 3.24
Formula Weight: 94.11
Specific Gravity (H_2O=1, at 4 °C): 1.06 at 20 °C
Water Solubility: 1 g/15 ml water
Boiling Point Range: 181.8 °C (359 °F) at 760 mm Hg
Freezing/Melting Point Range: 40.9 °C (105.62 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from strong oxidizers, halogens, calcium hypochlorite, and metals such as aluminum, lead, zinc, magnesium.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 317 mg/kg	Skin (rabbit): 500 mg/24hr - SEVERE
Oral (human) LD_{Lo}: 140 mg/kg	Skin (rabbit): 500 mg open -SEVERE
Inhalation (rat) LC_{50}: 316 mg/m^3	Eye (rabbit): 5 mg - SEVERE
Dermal (rabbit) LD_{50}: 850 mg/kg	Eye (rabbit): 100 mg rinse - mild

See NIOSH, *RTECS* SJ 3325000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the environment, the primary removal mechanism is biodegradation which is generally rapid (days). Since it is a benchmark chemical for biodegradability studies, there is a large body of information on its degradation which concludes that it rapidly degrades in sewage, soil, fresh water and seawater. Acclimation of resident populations of microorganisms is rapid. Under anaerobic conditions degradation is slower and microbial adaptation periods longer. If released to soil, it will readily leach and biodegrade. The biodegradation in soil is generally rapid with half-lives of under 5 days even in subsurface soils. Biodegradation is sufficiently rapid that most groundwater is generally free of this pollutant. The exception would be in the cases of spills where high concentrations destroy degrading microbial populations. Biodegradation is also the primary removal process when released into water (half-lives are of the order of hours to days) although sensitized photolysis may also be important. In one study using estuarine water, the combination of biodegradation and photolysis resulted in a half-life in summer and winter of 39 and 94 hr, respectively. Since the pKa is 9.994, it will be partially dissociated at higher pHs in water and moist soils and its transport and reactivity may be pH-dependent. It does not bioconcentrate in aquatic organisms. In the atmosphere, it occurs as a vapor and reacts with photochemically-produced hydroxyl radicals resulting in a half-life of approximately 15 hours. During the nighttime, it reacts with nitrate radicals with a resulting half-life of 12 minutes. It has also been shown to be readily removed from the atmosphere by rain.

Ecotoxicity: LC_{50} Crangon crangon 5600 mg/l 3 min, 20 mg/l 1 hr, 80 mg/l 3 hr, 40 mg/l 6-24 hr, 30 mg/l 48-72 hr, 25 mg/l 96 hr in sea water at 15 °C /Conditions of bioassay not specified; LC_{50} Rainbow trout 5.6-11.3 mg/l/24 hr in a static bioassay; LC_{50} Ophicephalus punctatus 46.0 mg/l/48 hr in a static bioassay; TLm Mercenaria mercenaria (hard clam) egg 5.263 x10^4 ppb/48 hr in a static bioassay; Algae: Microcystis aeruginosa inhibition of cell multiplication noted at 4.6 mg/l /Conditions of bioassay not specified; Protozoa: Vorticella campanula perturbation level 3 mg/l /Conditions of bioassay not specified ; Arthropoda: LD_0 Daphnia magna 16 mg/l /Conditions of bioassay not specified; Arthropoda: TLm Daphnia magna (young) 17/7 mg/l 25-50 hr /Conditions of bioassay not specified ; TLm Roach 15 mg/l/24 hr /Conditions of bioassay not specified

Henry's Law Constant: 3.33 x10^{-7}

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): 200%, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 1.46$

Soil Sorption Partition Coefficient: K_{oc} = 1 to 3

Section 13 - Disposal Considerations

Disposal: Follow applicable federal, state, and local regulations.
Incinerate contaminated waste at an approved site.
Phenol may be recovered by charcoal absorption, solvent extraction or steam stripping. A concentration of 1% by weight is required for economical recovery.
Recycle containers wherever possible, otherwise dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: PHENOL, SOLID
Hazard Class: 6.1(a)
ID No.: 1671
Packing Group: II
Label: Poison[6]

Additional Shipping Information: CARBOLIC ACID, SOLID

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U188 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed

SARA EHS 40 CFR 355: Listed
RQ: 1000 lb
TPQ: 500/10000 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Propylene Dichloride
DIC6700

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

Material Name: Propylene Dichloride **CAS Number:** 78-87-5
Chemical Formula: $C_3H_6Cl_2$
Structural Chemical Formula: $CH_3CHClCH_2Cl$
EINECS Number: 201-152-2
ACX Number: X1003358-4
Synonyms: BICHLORURE DE PROPYLENE; 1,2-DICHLOROPROPANE; ALPHA,BETA-DICHLOROPROPANE; DICHLORO-1,2-PROPANE; DWUCHLOROPROPAN; ENT 15,406; PROPANE,1,2-DICHLORO-; PROPYLENE CHLORIDE; ALPHA,BETA-PROPYLENE DICHLORIDE; PROPYLENE DICHLORIDE; PROPYLENEDICHLORIDE
Derivation: Produced by chlorination of propylene or by reacting propyl chloride with antimony pentachloride.
General Use: As a solvent for paint removers, degreasers, and dry cleaning; lead scavenging agent for gasoline; chemical intermediate; and as an insecticide for peach trees, grains, soil (fumigant D-D) and livestock; and in scouring compounds.

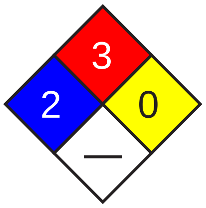
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Propylene dichloride	78-87-5	ca 99 to 99.5% wt

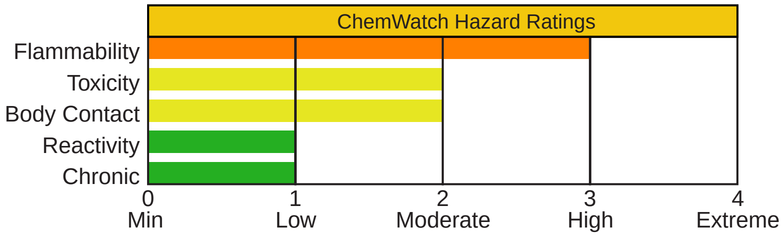
Trace Impurities: water (0.05% max); oxygen compounds (0.1% max)

OSHA PEL TWA: 75 ppm; 350 mg/m^3.	**NIOSH REL**
ACGIH TLV TWA: 75 ppm; STEL: 110 ppm.	**IDLH Level** 400 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tractOther Acute Effects: CNS depressant at high concentrations, repeated skin contact can cause dermatitis, liver/heart/kidney damage. Chronic Effects: liver/heart/kidney damage. Highly flammable.

Potential Health Effects

Target Organs: Eyes, skin, respiratory tract, liver, kidneys, heart, blood.
Primary Entry Routes: Inhalation, ingestion, skin and eye contact.
Acute Effects
Inhalation: Symptoms include irritation, destruction of the upper and lower respiratory tract epithelium, bloody nose, pulmonary edema (fluid in lungs), emphysema, bronchopneumonia, and tachycardia (excessively rapid heart beat). Symptoms similar to those via ingestion also occur. Reportedly, short-term exposure to 400 to 500 ppm did not cause adverse effects.
Eye: Irritation. A splash into the eye of one person caused corneal epithelium damage which healed promptly.

Skin: Irritation (may be severe). Some workers developed *allergic* dermatitis after exposure to a mixture having 7 to 13% propylene dichloride. However, *contact* dermatitis is more common and occurs from chronic exposure (defatting action).

Ingestion: Symptoms include vomiting, abdominal pain, fever, anorexia, black and blue marks (due to ruptured blood vessels), bloody urine, oliguria (reduced urinary excretion), night sweats, shock, delirium, cardiovascular collapse, liver and kidney damage, and hemolytic anemia (red blood cell breakage).

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Medical Conditions Aggravated by Long-Term Exposure: Liver, kidney, heart, skin, or blood disorders.

Chronic Effects: Repeated skin contact can cause contact dermatitis. Chronic inhalation or ingestion can cause liver and kidney problems (just as acute exposure can).

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove person to fresh air, support breathing and administer 100% humidified, supplemental oxygen as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

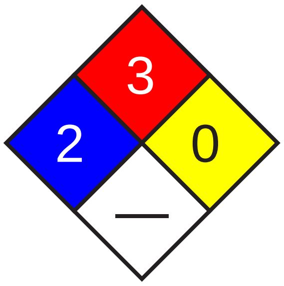
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Monitor patient for respiratory distress or kidney or liver problems. Effects may be delayed. *Do not* administer adrenergic amines or atropine. Analysis of blood or urine is useless after symptoms appear because 80 to 90% of propylene dichloride will be metabolized by that time.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: 60.8 °F (16 °C), Closed Cup

Burning Rate: 3.2 mm/min.

Autoignition Temperature: 1035 °F (557 °C)

LEL: 3.4% v/v

UEL: 14.5% v/v

Flammability Classification: Class 1B Flammable Liquid

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, fog, or regular foam.

General Fire Hazards/Hazardous Combustion Products: Includes hydrogen chloride, phosgene, and chlorine gas. Vapors may travel to ignition source and flash back. Container may explode in heat of fire. Propylene dichloride poses a vapor explosion hazard indoors, outdoors, and in sewers.

Fire-Fighting Instructions: Apply cooling water to sides of containers until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles and unmanned hose holders; if impossible, withdraw and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against contamination.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers.

Large Spills: Dike far ahead of spill for later disposal. *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use nonsparking tools to open containers.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using propylene dichloride, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: *Do not* store in aluminum or aluminum alloy containers because of corrosion. Store in a cool, dry, well- ventilated area away from ignition sources and incompatibles (Sec. 10). Outside or detached storage is preferred. If inside, store in a standard flammable liquids cabinet.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Do not use aluminum transfer lines because of corrosion. Install Class 1, Group D electrical equipment. Provide general or local exhaust ventilation systems to maintain airborne levels below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement or periodic medical exams of exposed workers with emphasis on the skin, kidneys, liver, heart, respiratory system, and blood.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyvinyl alcohol, fluorocarbon rubber, and Teflon are suitable materials for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable concentration, use any SCBA or SAR (with auxiliary SCBA) with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove propylene dichloride from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless with a sickly sweet, chloroform-like odor.

Physical State: Liquid
Odor Threshold: 50 ppm
Vapor Pressure (kPa): 50 mm Hg at 77 °F (25 °C)
Bulk Density: 9.6 lb/gal at 68 °F (20 °C)
Formula Weight: 112.99
Density: 1.1583 at 68 °F (20 °C)
Evaporation Rate: > 1 (BuAc = 1)
Refractive Index: 1.4068 at 68 °F (20 °C)

Boiling Point: 206.24 °F (96.8 °C)
Freezing/Melting Point: -148 °F (-100 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Ionization Potential (eV): 10.87 eV
Water Solubility: 0.26% by wt. at 68 °F (20 °C)
Other Solubilities: Soluble in benzene, chloroform, ethanol, ethyl ether, and most organic solvents.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Propylene dichloride is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, ignition sources, and incompatibles.

Storage Incompatibilities: Includes strong acids, oxidizers, and active metals. It reacts with aluminum to form aluminum chloride and this reaction, when confined, leads to a violent explosion.

Hazardous Decomposition Products: Thermal oxidative decomposition of propylene dichloride can produce hydrogen chloride, chlorine, and phosgene gas.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 1947 mg/kg.
Dog, oral, LD_{Lo}: 5 g/kg.
Acute Inhalation Effects:
Mouse, inhalation, TC_{Lo}: 1000 ppm/2 hr.
Irritation Effects:
Rabbit: 500 mg caused mild irritation.
Other Effects:
Tumorgenicity, mouse, oral: 130 g/kg/2 yr (intermittently) produced skin and appendage tumors.
Reproductive Effects - Hamster, ovary cell: 113 mg/L caused sister chromatid exchange.
Mouse, lymphocyte: 11600 µg/L caused mutation.

See *RTECS* TX9625000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, propylene dichloride will volatilize rapidly. In water, it will volatilize with a half-life of ~ 6 hr from a river and ~10 days from a lake. In the air, it reacts with photochemically-produced hydroxyl radicals with a half-life of > 23 days.

Ecotoxicity: Shrimp, TL_m: > 100 ppm/48 hr; fathead minnow, LC_{50}: 127 mg/L/96 hr; sheepshead minnow, TL_m: 7.3 ppm/96 hr.

Section 13 - Disposal Considerations

Disposal: Evaporate small quantities in a fume hood. Large quantities can be incinerated (permit-approved facility only). Incinerator should be equipped with an effluent gas scrubber capable of handling chlorine, hydrogen chloride, and phosgene. Biodegradation may be possible. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Triple rinse containers and dispose of rinse water as above.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: 1,2-Dichloropropane
ID: UN1279
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, N36, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U083 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Pyrene
PYR1640

Section 1 - Chemical Product and Company Identification 61

Material Name: Pyrene **CAS Number:** 129-00-0
Chemical Formula: $C_{16}H_{10}$
EINECS Number: 204-927-3
ACX Number: X1001901-7
Synonyms: BENZO(DEF)PHENANTHRENE; BENZO(D,E,F)PHENANTHRENE; COAL TAR PITCH VOLATILES:PYRENE; PYREN; BETA-PYRENE; PYRENE; PYRENE
General Use: Laboratory reference standard.
Occurs in coal tar or in destructive hydrogenation of hard coals.

Section 2 - Composition / Information on Ingredients

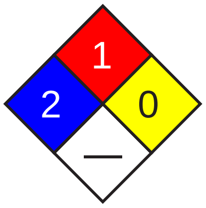
Name	CAS	%
pyrene	129-00-0	>98

OSHA PEL
TWA: 0.2 mg/m^3; as particulate polycyclical aromatic hydrocarbon.

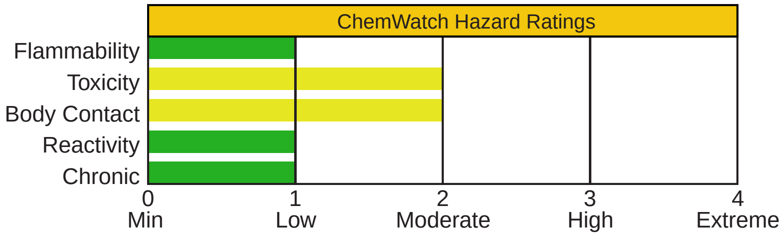
NIOSH REL
TWA: 0.1 mg/m^3, cyclohexane-extractable fraction; as particulate polycyclic aromatic hydrocarbon.

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
1 Flammability
0 Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless solid. Irritating to eyes/skin/respiratory tract. Also causes: conjunctival irritation, dermal irritation, ingestion may irritate and burn esophagus/gastrointestinal tract.

Potential Health Effects

Target Organs: skin, eyes, respiratory system
Primary Entry Routes: inhalation, ingestion, skin contact
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract and may be fatal if inhaled.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Animal inhalation studies have demonstrated hepatic, pulmonary and intragastric pathologic changes. The levels of neutrophil, leukocyte and erythrocytes decreased.
Eye: The dust may be discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
Skin: The material may be mildly discomforting to the skin.
Open cuts, abraded or irritated skin should not be exposed to this material.
Toxic effects may result from skin absorption.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Skin application resulted in hyperemia (blood engorgement), weight loss and hematopoietic (blood cell development) changes. Contact dermatitis was also evident.

Ingestion: The solid/dust is discomforting to the gastrointestinal tract and harmful if swallowed.

Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic exposure to pyrene results increase in blood leukocytes (leukocytosis).

The so-called polycyclic aromatic hydrocarbons (PAHs) comprise a large family; some members occur in coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified, in animal studies, as amongst the most highly active carcinogens.

Rodent species are sensitive to some PAHs with skin application producing cancerous growths. Injection produces soft tissue tumors (sarcomas) in rats and mice.

Administration of PAHs to Rhesus monkey on the other hand has not yet proved successful in yielding tumors and there is inadequate date to support the proposition that individual PAHs produce cancer in humans. There are however a number of epidemiology and mortality studies that show increased incidence of cancer in humans exposed to mixtures of PAHs. Evidence exists of lung and genito-urinary cancer mortality amongst coke-oven workers and skin tumors in workers exposed to creosote. Exposures to other chemical mixtures containing PAHs such as cigarette smoke, coal tar, coal tar pitch and bitumens, have been associated with increased incidences of lung cancer in humans. Anthracene, the basic unit on which most PAHs are built, is not carcinogenic whereas benz[a]anthracene appears to have weak carcinogenicity. Additions of other benzene rings to select positions on the benz[a]anthracene skeleton results in agents with powerful carcinogenicity (e.g. dibenz[a,h]anthracene and benz[a]pyrene). Further substitution of methyl groups in position on the rings enhances carcinogenicity (7,12 dimethylbenz[a]anthracene is one of the most powerful PAH carcinogens known). Biotransformation to produce soluble metabolites suitable for excretion appears to transform some PAHs to reactive electrophiles (as epoxides) which bind to DNA. Initiation of carcinogenesis is thought to rely upon such interactions.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water.

Consider drinking water to remove dust from throat.

Lay patient down. Keep warm and rested.

Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.

Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.

Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.

Note: DO NOT INDUCE VOMITING in an unconscious person.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Not available; probably combustible

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.

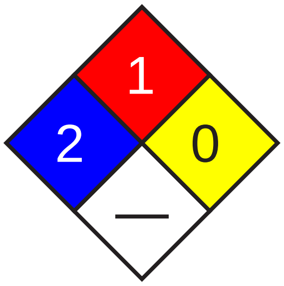
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Solid which exhibits difficult combustion or is difficult to ignite.

Avoid generating dust, particularly clouds of dust in a confined or unventilated space.

Dust may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion.

Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport. Build-up of electrostatic charge may be prevented by bonding and grounding.



Fire Diamond

Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective clothing, gloves, safety glasses and dust respirator.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up. Place in clean drum then flush area with water.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain or absorb spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid smoking, bare lights or ignition sources. When handling, DO NOT eat, drink or smoke. Avoid contact with incompatible materials.
Keep containers securely sealed when not in used. Avoid physical damage to containers. Always wash hands with soap and water after handling. Working clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing/handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Glass container; plastic container.
Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe. Eyewash unit. Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless crystalline solid when pure. Contamination by tetracene results in slight yellowing. Solid and solutions have slight blue fluorescence.

Physical State: Divided solid
Vapor Pressure (kPa): Negligible
Formula Weight: 202.24
Specific Gravity (H_2O=1, at 4 °C): 1.271
pH: Not applicable
pH (1% Solution): Not applicable

Boiling Point: 393 °C (739 °F) at 760 mm Hg
Freezing/Melting Point: 156 °C (312.8 °F)
Volatile Component (% Vol): Negligible
Water Solubility: 0.135 mg/L (+ or - 0005 mg/L) in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 2700 mg/kg
Inhalation (rat) LC_{50}: 170 mg/m^3
Oral (mouse) LD_{50}: 800 mg/kg
Intraperitoneal (mouse) LD_{50}: 514 mg/kg
Conjunctival irritation, excitement and muscle contraction recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

Irritation

Skin (rabbit): 500 mg/24h - mild

See *RTECS* UR 2450000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Although environmental concentrations are highest near sources, its presence in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long distance transport. When released to air it may be subject to direct photolysis, although adsorption to particulates apparently can retard this process. Half-lives for reaction of vapor phase with atmospheric pollutants are: O3, 0.67 days, NO2, 14 days; estimated half-life for reaction with photochemically produced hydroxyl radicals is 1.12 days. If released to water, it will adsorb very strongly to sediments and particulate matter, bioconcentrate in aquatic organisms slightly to moderately, but will not hydrolyze. It may be subject to significant biodegradation, and direct photolysis may be important near the surface of waters. Evaporation may be important with a half-life of 4.8 to 39.2 days predicted for evaporation from a river 1 m deep, flowing at 1 m/sec with a wind velocity of 3 m/sec; half-life for evaporation from a model pond was 1176 days. Adsorption to sediments and particulates will limit evaporation. If released to soil it will be expected to adsorb very strongly to the soil and will not be expected to appreciably leach to the groundwater, although its presence in groundwater illustrates that it can be transported there. It will not be expected to hydrolyze or significantly evaporate from soils and surfaces. It may be subject to appreciable biodegradation in soils.
Ecotoxicity: TL_m (Median threshold limit) Mosquito fish 0.0026 mg/l/96 hr at 24-27 °C in a static bioassay
Henry's Law Constant: calculated at 5.42 x10^{-5}
BCF: rainbow trout 72
Octanol/Water Partition Coefficient: log K_{ow} = 4.88
Soil Sorption Partition Coefficient: K_{oc} = soils 57 to 764

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging: **Exceptions:** 153 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a)
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 5000 lb
  - **TPQ:** 1000/10000 lb
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

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(518) 377-8854

Material Safety Data Sheet Collection

Silver **MSDS No. 181**

Date of Preparation: 4/86 Revision: A, 6/94

Section 1 - Chemical Product and Company Identification 44

Product/Chemical Name: Silver
Chemical Formula: Ag
CAS No.: 7440-22-4
Synonyms: argentum
Derivation: Occurs naturally in sea water (0.01 ppm) and the earth's crust (0.1 ppm). Silver containing ores include argentite, stephanite, polybasite, proustite, pyrargyrite, and cerargyrite. Extraction of silver is essentially as a by-product of copper, lead, or zinc extraction and this accounts for 3/4 of its production. The two main production methods are *slime melting* from electrolytic refining of copper and the *Parkes process* from lead and zinc ores.
General Use: Used in the manufacture of jewelry, tableware, ornaments, mirrors, electrical contacts, batteries, solder; in photography, dental amalgams; as a sterilant, for water purification, and as a coating for the inside of light bulbs (sandwiched between two layers of titanium oxide).
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Silver, ca 100 % wt. 97.5 % silver + 2.5 % copper = *sterling* silver.

OSHA PEL
8-hr TWA: 0.01 mg/m^3

ACGIH TLV
TWA: 0.1 mg/m^3

NIOSH REL
10-hr TWA: 0.01 mg/m^3

DFG (Germany) MAK
TWA: 0.01 mg/m^3 (total dust)
Category III: Substances with systemic effects
Onset of Effect: > 2 hr
Half-life: > shift length (strongly cumulative)

Peak Exposure Limit:
0.1 mg/m^3, 30 min. average value, 1/shift

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Silver exists as a hard, brilliant white, malleable metal. It is noncombustible as a solid, but the finely divided powder is flammable. Silver has no known function in man and appears to have low toxicity other than a localized or general bluish-gray pigmentation of the mucous membranes, eyes, and skin due to deposition of silver particles over a period of time. The condition called *argyria* appears to be more of a cosmetic problem than a toxicological concern.

Wilson Risk Scale	
R	1
I	4
S	1
K	0

HMIS	
H	1*
F	0
R	0

*Chronic effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, skin and eye contact.
Target Organs: Skin, eyes (especially the conjunctiva), and mucous membranes.
Acute Effects
Inhalation: Heavy exposure of a worker to heated metallic silver vapor for 4 hr caused lung damage and pulmonary edema (fluid in lungs). Diffuse pulmonary fibrosis is also possible.
Eye and Skin: Effects are generally chronic.
Carcinogenicity: IARC, NTP, and OSHA do not list silver as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Chronic Effects: The main effect associated with exposure to silver is argyria, a bluish-gray pigmentation of the eyes, skin, and mucous membranes caused by deposition of silver particles. This effect can be either local or generalized. It appears that localized deposition occurs by penetration of fine, metallic particles and that generalized argyria occurs from inhalation or ingestion of silver salts. It is estimated that a gradual intake of 1 to 5g silver will lead to generalized argyria. Generalized argyria appears to be darker in areas exposed to the light. Silver deposition in the respiratory tract may result in a mild chronic bronchitis. Silver polishers exposed for long periods to silver and polishing dusts have developed increased lung densities (shown by x-ray). Argyria of the eyes is not accompanied by vision loss although there may be some difficulty adapting to the dark. There is some evidence for skin absorption; amalgam tattoos (accidental implantation of dental amalgams) caused fatigue, headache, sinusitis, and weight loss. Repeated skin contact may cause allergic contact dermatitis in some individuals.
Other: The reason that silver toxicity rarely occurs beyond argyria is due to rapid binding to various proteins and precipitation of silver chloride. Tissue damage only occurs when this binding ability is altered by a heavy dose. Kidney, liver, and neurologic damage has been associated with silver, but these cases are not well documented.

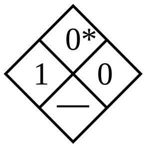
Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin Contact: *Quickly* remove contaminated clothing. Rinse away loose material and move quickly to a soap and water wash.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Silver deposited in tissues is relatively inert and does not respond well to chelation therapy. There is no known treatment for argyria. Background serum levels of silver vary widely: 0.004 mcg/g to 0.03 mcg/g of blood. Discoloration of Descemet's membrane is the most sensitive indicator of chronic exposure to silver. Background excretion is 8 to 28 nmol/L. In one study, the urinary enzyme, N-acetyl-ß-D glucosaminidase was significantly elevated and correlated with blood silver concentrations and age. It may be an indicator of exposure.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible as the solid.
Autoignition Temperature: None reported.
LEL: None reported.
UEL: None reported.
Extinguishing Media: Use agents suitable for surrounding fire.
Unusual Fire or Explosion Hazards: None reported.
Hazardous Combustion Products: Silver fumes.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.
* Flammable when in highly divided powder form.

Genium



Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, isolate and ventilate area. Cleanup personnel should protect against inhalation and skin/eye contact with dusts.
Spills: Carefully scoop up spill and place in sealed containers for reclamation.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Wear appropriate PPE to avoid inhalation or skin/eye contact with silver dusts.
Storage Requirements: Store in a cool, dry, well-ventilated area away from incompatibles (Sec. 10).

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: No special controls needed.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin, eyes, and mucous membranes (for presence of argyria).
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For ≤ 0.25 mg/m^3, use any supplied-air respirator (SAR) operated in continuous-flow mode or any powered, air-purifying respirator with a high-efficiency particulate filter. Use eye protection when necessary. For ≤ 0.5 mg/m^3, use any high-efficiency particulate filter respirator with a full facepiece, any SCBA with a full facepiece, or any SAR with a full facepiece. For ≤ 20 mg/m^3, use any SCBA or SAR (with auxiliary SCBA) with a full facepiece and operated in pressure demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment: Wear protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove silver from your shoes and clean personal protective equipment. *Do not* shake dust off contaminated clothing; vacuum with a HEPA filter.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using silver, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: Hard, brilliant white, lustrous, ductile, malleable metal; odorless.
Vapor Pressure: 0 mm Hg at 77 ˚F (25 ˚C), 100 mm Hg at 3389 ˚F (1865 ˚C)
Atomic Weight: 107.868
Density: 10.5 g/mL
Thermal Conductivity: 101 cal/cm/sec/ ˚C
Water Solubility: Insoluble
Other Solubilities: Insoluble in most cold acids except dilute nitric acid. Reacts with hot, concentrated sulfuric acid. Soluble in fused alkali hydroxides in the presence of air, fused alkali peroxides, and in alkali cyanides in presence of air or oxygen.
Boiling Point: 4013 ˚F (2212 ˚C)
Melting Point: 1763 ˚F (961 ˚C)

Section 10 - Stability and Reactivity

Stability: Silver is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization does not occur.
Chemical Incompatibilities: Include acetylene and acetylenic compounds (forms explosive silver acetylides), aziridine, bromine azide, 3-bromopropyne, carboxylic acids, copper + ethylene glycol, electrolytes + zinc, ethanol + nitric acid, ethylene oxide, ethyl hydroperoxide, iodoform, ethyleneimine, peroxomonosulfuric acid, and peroxyformic acid. Silver is flammable by chemical reaction with ammonia, chlorine trifluoride, ethylene imine, hydrogen peroxide, oxalic acid, and tartaric acid. It turns black (tarnishes) on contact with ozone, sulfur, or hydrogen sulfide.
Conditions to Avoid: Contact with incompatibles.
Hazardous Decomposition Products: Silver fumes will be given off when heated.

Section 11- Toxicological Information

Toxicity Data:*

Carcinogenicity: Rat, multiple routes: 330 mg/kg/43 weeks (intermittently) caused tumors at site of application.

* See NIOSH, *RTECS* (VW3500000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Sticklebacks, LD_{50} = 0.004 mg/L/168 hr; sticklebacks, LD_{50} = 0.1 mg/L/24 hr. Although silver accumulates in body tissue it does not appear to bioaccumulate through the food chain (no magnification at higher trophic levels).
Environmental Degradation: In water, silver will undergo absorption by manganese dioxide and precipitation with halides.

Section 13 - Disposal Considerations

Disposal: Return silver and silver-containing solutions from photography and x-rays to supplier for reclamation. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101): Not listed

Shipping Name: Environmentally hazardous substances, solid, n.o.s.*
Shipping Symbols: —
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9
Special Provisions (172.102): 8, B54, N50

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: None
b) Cargo Aircraft Only: None

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: —

* Classified as a hazardous substance when silver is in a quantity, in one package, which equals or exceeds the RQ of 1000 lb (454 kg)

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste Classification (40 CFR 261.24): D011, Characteristic of Toxicity (regulatory level = 5 mg/L)
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per CWA, Sec. 307(a)
CERCLA Reportable Quantity (RQ), 1000 lb (454 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

Section 16 - Other Information

References: 73, 103, 124, 132, 136, 148, 149, 167, 176, 187, 189
Prepared By .... M Gannon, BA
Industrial Hygiene Review .... RE Langford, PhD, CIH
Medical Review .... T Thoburn, MD, MPH
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Section 1 - Chemical Product and Company Identification 54

Material Name: Styrene **CAS Number:** 100-42-5
Chemical Formula: C_8H_8
Structural Chemical Formula: $C_6H_5CH=CH_2$
Synonyms: BENZENE,ETHENYL-; BENZENE,VINYL-; CINNAMENE; CINNAMENOL; CINNAMOL; DIAREX HF 77; ETHENYL BENZENE; ETHENYLBENZENE; ETHYLENE,PHENYL-; PHENETHYLENE; PHENYLETHENE; PHENYLETHYLENE; STIROLO; STYREEN; STYREN; STYRENE; STYRENE MONOMER; STYRENE MONOMER,INHIBITED; STYRENE,MONOMER; STYROL; STYROLE; STYROLENE; STYRON; STYROPOL; STYROPOR; VINYL BENZENE; VINYLBENZEN; VINYLBENZENE; VINYLBENZOL
General Use: Widely used in polymer manufacture: polystyrene; SBR, ABS, SAN resins and rubber modified polystyrene for plastics; styrene-butadiene rubber latex.
Styrene polyesters for GRP, FRP molding resins; styrene copolymer resins for coatings; chemical intermediate.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
styrene	100-42-5	>99

OSHA PEL
TWA: 100 ppm; Ceiling: 200 ppm, 600 ppm, 5-minute maximum peak in any 3 hours.

OSHA PEL Vacated 1989 Limits
TWA: 50 ppm; 215 mg/m^3; STEL: 100 ppm; 425 mg/m^3.

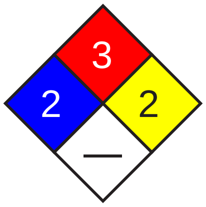
ACGIH TLV
TWA: 20 ppm; 85 mg/m^3; STEL: 40 ppm; 170 mg/m^3.

NIOSH REL
TWA: 50 ppm, 215 mg/m^3; STEL: 100 ppm, 425 mg/m^3.

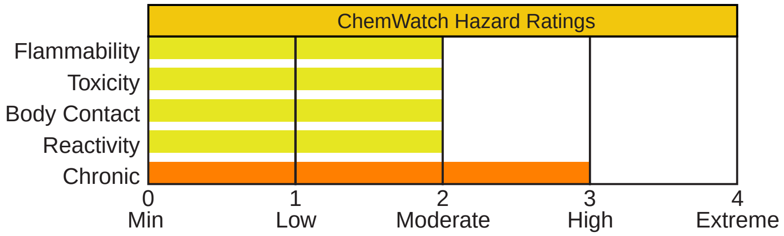
IDLH Level
700 ppm.

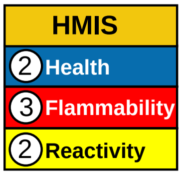
DFG (Germany) MAK
TWA: 20 ppm, 86 mg/m^3; PEAK: 40 ppm, 172 mg/m^3; ceiling, substances with systemic effects, onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless-yellow, oily liquid; sweet odor. Irritating. Also causes: difficulty breathing, dizziness. Chronic: dermatitis, nervous system disorders, blood/liver damage, reproductive/teratogenic effects (animal studies). Possible cancer hazard. Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, respiratory system, skin
Primary Entry Routes: inhalation, skin contact/absorption
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract if inhaled and may be harmful if exposure is prolonged.
Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high vapor concentrations may be chest and nasal irritation with coughing, sneezing, headache and even nausea.

If exposure to highly concentrated vapor atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma, and unless resuscitated, death.

Central nervous system (CNS) depression is seen at styrene exposures exceeding 50 ppm, whilst headache, fatigue, nausea and dizziness are reported consistently at exposures of 100 ppm.

Evidence exists that 5% to 10% reductions in sensory nerve conduction occur at 100 ppm and that slowed reaction times occur after exposure to 50 ppm.

Exposure at 376 ppm produces unpleasant subjective symptoms and signs of neurological impairment.

High vapor concentrations may have toxic and anesthetic effects, which may lead to unconsciousness or death.

Exposure at 1000 ppm can rapidly lead to unconsciousness.

Exposure at 10000 ppm may cause death in less than one hour.

Simple reaction times were increased and coordination decreased amongst volunteers inhaling 350 ppm (via mouth tube) for 30 minutes. Controlled inhalation studies with 300 ppm (via mouth tube) for 1 hour found reduced ocular tracking abilities but no changes in balance or coordination.

Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is highly discomforting to the eyes if exposure is prolonged.

The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

The vapor when concentrated has pronounced eye irritation; this gives some warning of high vapor concentrations. If eye irritation occurs seek to reduce exposure with available control measures, or evacuate area.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is highly discomforting to the skin if exposure is prolonged and may cause drying of the skin, which may lead to dermatitis.

Toxic effects may result from skin absorption.

Bare unprotected skin should not be exposed to this material.

The material may accentuate any pre-existing dermatitis condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is extremely discomforting and moderately toxic if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Neuro-optic pathways have been shown to be particularly vulnerable to organic solvent exposure and studies support the proposition that styrene exposure can induce a dose dependent color vision loss.

Chromosomal abnormalities (micronuclei, chromosome gaps or breaks, nuclear bridges and unscheduled DNA synthesis in peripheral lymphocytes) have been recorded in workers exposed to styrene. Such aberrations however are not always apparent in epidemilogical studies and the status of styrene as DNA effector is equivocal.

Deaths due to cancers among workers exposed to styrene is statistically unremarkable.

The dominant first metabolite of styrene is styrene-7,8-oxide which binds covalently to DNA and shows activity in various in-vitro and in-vivo assays for genetic effects where it induces dose-related responses of chromosomal damage at low concentrations. Styrene-7,8-oxide is detected in the blood of workers exposed to styrene. Adducts in hemoglobin and DNA, DNA single-strand breaks/ alkali-labile sites as well as significant increases in the frequency of chromosomal damage has been found in workers exposed to styrene in the reinforced plastics industry.

Exposure to styrene may aggravate C.N.S. disorders, chronic respiratory disease, skin disease, kidney disease and liver disease.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Quickly but gently, wipe material off skin with a dry, clean cloth.

Immediately remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to styrene:

INHALATION:

1. Severe exposures should have cardiac monitoring to detect arrhythmia.
2. Catecholamines, especially epinephrine (adrenalin) should be used cautiously (if at all).
3. Aminophylline and inhaled & beta-two selective bronchodilators (e.g. salbutamol) are the drugs of choice for treatment of bronchospasm.

INGESTION:

1. Ipecac syrup should be given for ingestions exceeding 3 mL (styrene)/kg.
2. For patients at risk of aspiration because of obtundation, intubation should precede lavage.
3. Pneumonitis is a significant risk. Watch the patient closely in an upright (alert patient) or left lateral head-down position (obtunded patient) to reduce aspiration potential.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker who has been exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Mandelic acid in Urine	800 mg/gm creatinine	End of shift	NS
	300 mg/gm creatinine	Prior to next shift	NS
Phenylglyoxylic acid in urine	240 mg/gm creatinine	End of shift	B,NS
	100 mg/gm creatinine	Prior to next shift	
Styrene in venous Blood	0.55 mg/L	End of shift	SQ
	0.02 mg/L	Prior to next shift	SQ

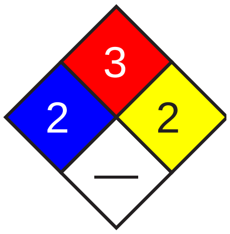
NS: Non-specific determinant; also seen after exposure to other materials.
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.
B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: 34.4 °C Tag Closed Cup
Autoignition Temperature: 490 °C
LEL: 1.1% v/v
UEL: 7.0% v/v

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.



Fire Diamond

Fire Incompatibility: WARNING: May decompose violently or explosively on contact with other substances.
This substance is one of the relatively few compounds which are described as "endothermic" i.e. heat is absorbed into the compound, rather than released from it, during its formation.
The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation.

Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds.
Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous.
Contamination with polymerization catalysts - peroxides, persulfates, oxidizing agents - also strong acids, strong alkalies, will cause polymerization with exotherm - generation of heat.
Polymerization of large quantities may be violent - even explosive.
Polymerization may occur at elevated temperatures.
Polymerization may be accompanied by generation of heat as exotherm.
Process is self accelerating as heating causes more rapid polymerization.
Exotherm may cause boiling with generation of acrid, toxic and flammable vapor.
Polymerization and exotherm may be violent if contamination with strong acids, amines or catalysts occurs.
Polymerization and exotherm of material in bulk may be uncontrollable and result in rupture of storage tanks.
Polymerization may occur if stabilizing inhibitor becomes depleted by aging.
Stabilizing inhibitor requires dissolved oxygen to be present in liquid for effective action.
Specific storage requirements must be met for stability on ageing and transport.
Contact with alkali solutions or glycols will remove inhibitor and render material unstable on storage.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor.
Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer. Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment

Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Butyl rubber gloves. Safety footwear.

Respiratory Protection:
Exposure Range >100 to <700 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 700 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Barrier cream. Skin cleansing cream.
Impervious apron.
Overalls.
Eyewash unit.
Ensure there is ready access to a safety shower.

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
TEFLON	Best selection
SARANEX-23	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless flammable liquid; floats on water. Soluble in alcohol and hydrocarbons. Contains stabilizing Inhibitor. Sweet aromatic odor at low concentrations. Sharp, penetrating odor at high concentrations.

Physical State: Liquid
Vapor Pressure (kPa): 1.27 at 30 °C
Vapor Density (Air=1): 3.6
Formula Weight: 104.16
Specific Gravity (H_2O=1, at 4 °C): 0.99 at 25 °C
Water Solubility: Sparingly soluble in water
Evaporation Rate: 0.49 (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 145 °C (293 °F)
Freezing/Melting Point Range: -31 °C (-23.8 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Material contains a stabilizer/polymerization inhibitor system that provides workable but not indefinite shelf life.
Storage at higher temperatures and long term storage may result in polymerization with solidification. In larger quantities, e.g. 200 liter drums, this may result in generation of heat (exotherm); which may release highly irritating hot styrene vapor. Do not open hot exotherming drums - cool externally with water to avoid vapor release.
Polymerization may occur at elevated temperatures. Polymerization may be accompanied by generation of heat as exotherm. Process is self accelerating as heating causes more rapid polymerization. Exotherm may cause boiling with generation of acrid, toxic and flammable vapor.
Polymerization and exotherm may be violent if contamination with strong acids, amines or catalysts occurs.
Polymerization and exotherm of material in bulk may be uncontrollable and result in rupture of storage tanks.
Polymerization may occur if stabilizing inhibitor becomes depleted by aging.
Stabilizing inhibitor requires dissolved oxygen to be present in liquid for effective action.
Specific storage requirements must be met for stability on ageing and transport.

Storage Incompatibilities: WARNING: May decompose violently or explosively on contact with other substances. This substance is one of the relatively few compounds which are described as "endothermic" i.e. heat is absorbed into the compound, rather than released from it, during its formation.

The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation. Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds. Segregate from strong oxidizers and acids.

DO NOT USE brass or copper containers/stirrers.

Attacks, softens and may dissolve rubber, many plastics, paints and coatings.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 5000 mg/kg	Skin (human): 500 mg - no skin effects.
Inhalation (human)LC_{Lo}: 10000 ppm/30m.	Skin (rabbit): 500 mg - mild
Inhalation (human) TC_{Lo}: 0.02 mg/m^3	Skin (rabbit): 100% - moderate
Inhalation (human) TC_{Lo}: 600 ppm	Eye (rabbit): 18 mg
Inhalation (rat): 24000 mg/m^3/4h	Eye (rabbit): 100 mg/24h - moderate

See NIOSH, *RTECS* WL 3765000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it will react rapidly with both hydroxyl radicals and ozone with a combined, calculated half-life of about 5 hours. In night-time air, it will degrade rapidly by reaction with atmospheric nitrate radicals. If released to environmental bodies of water, it will volatilize relatively rapidly and biodegrade, but is not expected to hydrolyze. If released to soil it will biodegrade and have a low soil mobility.

Ecotoxicity: TLm Lepomis macrochirus (bluegill) 25.1 mg/l/96 hr in water hardness of 20 mg/l calcium carbonate /Static bioassay; LC_{50} Cyprinodon variegatus (sheepshead minnow) 9.1 mg/l/96 hr, ambient salinity from 10-30 parts per trillion and temp from 25-31 °C /Static bioassay; TLm Artemia salina (Brine shrimp) 68 mg/l/24 hr; 52 mg/l/48 hr /Conditions of bioassay not specified

Henry's Law Constant: 0.00275

BCF: not expected

Biochemical Oxygen Demand (BOD): theoretical 18%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.95

Soil Sorption Partition Coefficient: K_{oc} = estimated at 550 to 555

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.
BEWARE: Empty solvent, paint, lacquer and flammable liquid drums present a severe explosion hazard if cut by flame torch or welded. Even when thoroughly cleaned or reconditioned the drum seams may retain sufficient solvent to generate an explosive atmosphere in the drum.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: STYRENE MONOMER, INHIBITED
Hazard Class: 3.2
ID No.: 2055
Packing Group: III
Label: Flammable Liquid[3]

Additional Shipping Information: VINYLBENZENE

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin
TET2190

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

61

Material Name: 2, 3, 7, 8-Tetrachlorodibenzo-*p*-dioxin **CAS Number:** 1746-01-6

Chemical Formula: $C_{12}H_4Cl_4O_2$

EINECS Number: 217-122-7

ACX Number: X1002670-1

Synonyms: 2,3,7,8-CZTEROCHLORODWUBENZO-P-DWUOKSYNY; DIBENZO(B,E)(1,4)DIOXIN,2,3,7,8-TETRACHLORO-; DIBENZO-P-DIOXIN,2,3,7,8-TETRACHLORO-; DIOKSYNY; DIOXIN; DIOXIN (HERBICIDE CONTAMINANT); DIOXINE; TCDBD; 2,3,7,8-TCDD; TCDD; 2, 3, 7, 8-TETRACHLORODIBENZO-*P*-DIOXIN; 2,3,7,8-TETRACHLORODIBENZO(B,E)(1,4)DIOXAN; 2, 3, 7, 8-TETRACHLORODIBENZO-P-DIOXIN; 2,3,6,7-TETRACHLORODIBENZO-P-DIOXIN; 2,3,7,8-TETRACHLORODIBENZO(B,E)(1,4)DIOXIN; 2,3,7,8-TETRACHLORODIBENZO-1,4-DIOXIN; 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN; TETRACHLORODIBENZODIOXIN; 2,3,6,7-TETRACHLORODIBENZOIDIOXIN; TETRADIOXIN

Derivation: TCDD is not manufactured, but is formed as a by-product of chlorobenzenes, chlorophenols, and the herbicides 2, 4, 5-trichlorophenoxyacetic acid (2, 4, 5-T) and 2-(2, 4, 5-trichlorophenoxy)propionic acid (Silvex) which are produced from 2, 4, 5-trichlorophenol (TCP). 2, 4, 5-T, commonly known as Agent Orange, was the defoliant used during the Vietnam War. TCP, 2, 4, 5-T and Silvex are no longer commercially produced in the U.S. As a chemical and toxicological standard, TCDD can be prepared by catalytic condensation of potassium 2, 4, 5-trichlorophenate. TCDD has been released to the environment during the incineration of chemical wastes including chlorinated benzenes, chlorophenols, and biphenyl ethers, from the improper disposal of certain chlorinated chemical wastes, in emissions from wood burning in the presence of chlorine, in accidental fires involving transformers containing PCBs, and from the use of the herbicides 2, 4, 5-T and Silvex.

General Use: TCDD is an extremely toxic, unwanted by-product and essentially has no beneficial uses. It may be used as a research chemical.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin	1746-01-6	ca 100% wt.

Trace Impurities: TCDD normally persists as a contaminant in TCP in variable amounts (0.07-6.2 mg/kg). Consequently, the concentrations of TCDD in different batches of Agent Orange varied greatly with an average concentration of about 2 ppm.

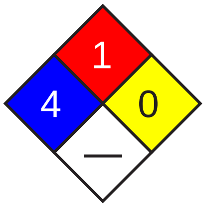
OSHA PEL

NIOSH REL

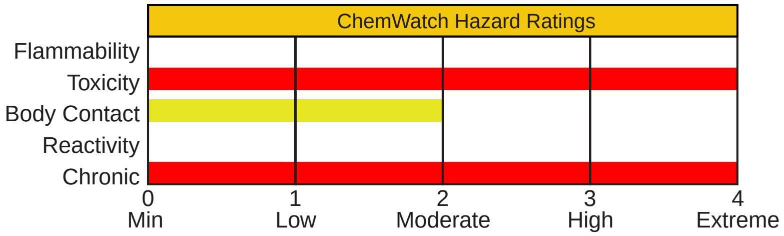
DFG (Germany) MAK
TWA: 10 pg/m^3; PEAK: 80 pg/m^3; skin; measured as inhalable fraction of the aerosol.

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
4 Health
1 Flammability
0 Reactivity

ANSI Signal Word

Danger!

Poison

Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, crystalline solid. Corrosive. Poison. Other Acute Effects: chloracne, metabolic disorders, nervous system/liver damage. Chronic Effects: teratogenesis/tumorigenesis/immunological dysfunction (animal data). Potential human carcinogen.

Potential Health Effects

Target Organs: Skin, liver, and nervous system.

Primary Entry Routes: Inhalation (dust),* skin contact, ingestion.

Acute Effects The observed health effects from clinical or epidemiological studies of populations who were occupationally and non-occupationally exposed cannot be solely attributed to TCDD because of the concurrent exposure to 2, 4, 5-T and TCP and to other herbicides as well. There is no report of human exposure to TCDD alone.

Inhalation: Shortness of breath, headaches, fatigue, severe muscle pains, weakness, and digestive disturbance. Most symptoms develop slowly, over many days.

Eye: Conjunctivitis and chemical burns.

Skin: Chemical burns. In most cases, chloracne appears within 2 to 4 weeks after initial exposure. It consists of blackheads with small, pale-yellow cysts. In severe cases, there may be papules (red spots) or even pustules (pus-filled spots). This acne-like rash appears on the cheekbones under the eyes and behind the ears in very mild cases. With increasing severity, the rest of the face and neck are affected and the outer upper arms, chest, back, abdomen, outer thighs and genitalia may be involved in varying degrees in the worst cases. In the worst cases, lesions may be active 15 or more years after the contact has ceased. Chloracne may also appear after ingestion or inhalation. Skin fragility, hirsutism (excessive growth of hair of normal or abnormal distribution), and photosensitivity may also occur.

Ingestion: Nausea, vomiting, and possible pancreatitis.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Not listed; EPA - Not listed; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: Skin, liver, nervous and endocrine system disorders.

Chronic Effects: Lack of energy, loss of sex drive, personality and mood changes, numbness, weakness and pain in the legs, liver damage, chloracne, and elevated blood lipids. TCDD increased the incidence of a variety of tumors in animals, but human data is inconclusive. Little is known of the human health effects (if any) as a result of long-term exposures to low concentrations.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Flush with water to remove solid particles; follow with a soap and water wash of exposed areas. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

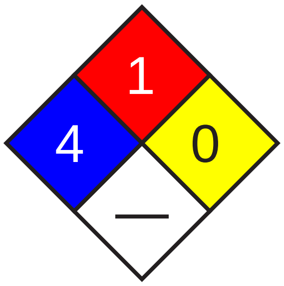
Note to Physicians: For an acute exposure, obtain liver function tests, CBC, prothrombin time, serum lipids, and uroporphyrins. EMG may be useful in detecting subclinical neuropathy. Current analytical techniques to detect dioxins in human tissue specimens involve gas chromatography and mass spectrometry. Chloracne may respond to topical retinoic acid, and oral tetracyclines may help secondary pustular follicles. Resistant cases may require dermabrasion or acne surgery. Isotretinoin may be tried.

Special Precautions/Procedures: Emergency personnel should protect against contamination.

Section 5 - Fire-Fighting Measures

Flash Point: None reported.
Autoignition Temperature: None reported.
LEL: None reported.
UEL: None reported.
Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam extinguisher.
General Fire Hazards/Hazardous Combustion Products: Toxic fumes of chlorine.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

See DOT ERG



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel of spill, evacuate all unnecessary personnel, remove heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against skin and eye contact and dust inhalation.
Small Spills: Carefully collect and place in sealed containers for disposal.
Large Spills: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways. Avoid generating dust. *Do not* sweep! Provide an organized procedure of containment, collection, and disposal of contaminated solutions and residues generated during cleanup. Provide separate facilities for decontamination of large equipment. Conduct repetitive wash/rinse cycles separately, either by using different locations or by spacing in time.

See DOT ERG

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120). Also EPA regulations.

Section 7 - Handling and Storage

Handling Precautions: Handle with extreme caution. Take all the necessary precautions to avoid any exposure. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.
Recommended Storage Methods: Store in tightly closed and properly labeled containers in a cool, well-ventilated area.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Isolate work areas involving TCDD or TCDD-contaminated materials. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.
Administrative Controls: Consider preplacement and periodic medical examinations with emphasis on the skin, liver, nervous and endocrine systems. Regularly monitor glassware, bench tops, instruments, and tools with wipe tests (wipe with filter paper and measure amount of TCDD).
Personal Protective Clothing/Equipment: Consider disposable clothing due to the uncertainty of adequate decontamination. Wear protective clothing consisting of both outer (zippered coverall with attached hood and draw string or elastic sleeves, gloves and closure boots) and inner (cotton overalls, undershirts, undershorts, gloves, and socks) garments. For dust or particulate exposure, wear coveralls of a non-woven fabric such as Tyvek or spun bonded polyethylene. For exposure to liquids, wear coveralls, gloves, and boots made of chemically resistant materials such as Saranax coated Tyvek or butyl, nitrile, or neoprene rubber. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For situations where TCDD contamination is low (e.g., exposure to dust contaminated with low levels of TCDD), wear an air-purifying respirator until the extent and characterization of the exposure can be determined. For materials highly contaminated with TCDD, wear respirators that consist of self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive pressure mode. An alternate method utilizes a combination Type C supplied-air respirator, with full facepiece, operated in a pressure-demand mode and equipped with auxiliary positive pressure self-contained air supply. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Shower and change clothes after potential exposures or at the end of the work day. Separate contaminated work clothes from street clothes. Launder before reuse. Place disposable clothing in marked and approved containers for disposal. Remove this material from your shoes and clean personal protective equipment. To prevent cross-contact, provide segregated decontamination locations with separate, controlled, and well-marked entry/exit routes and locations. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless needles.
Physical State: Solid
Vapor Pressure (kPa): 7.4 x 10^{-10} mm Hg at 77 °F (25 °C)
Formula Weight: 322
Freezing/Melting Point: 581-583 °F (305-306 °C)
Water Solubility: 19.3 ng/L
Other Solubilities: *o*-dichlorobenzene (1.4 g/L); chlorobenzene (0.72 g/L); benzene (0.57 g/L); chloroform (0.37 g/L); acetone (0.11 g/L); *n*-octanol (0.05 g/L); methanol (0.01 g/L); lard oil (0.04 g/L)

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: TCDD is relatively stable toward heat, acids, and alkalis. It is changed chemically when exposed in isooctane or *n*-octanol to UV light. Hazardous polymerization cannot occur. Avoid heat and ignition sources.

Storage Incompatibilities: None reported.

Hazardous Decomposition Products: Thermal oxidative decomposition of TCDD can produce toxic fumes of chlorine. Decomposition begins at 932 °F (500 °C) and complete decomposition occurs within 21 sec at 1472 °F (800 °C).

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 20 µg/kg.
Mammal, oral, LD_{50}: 4200 ng/kg produced changes of the liver, kidney, ureter, bladder, and spleen.
Acute Skin Effects:
Human, skin, TD_{Lo}: 107 µg/kg produced dermatitis and allergic reaction.
Irritation Effects:
Rabbit, eye: 2 mg caused moderate irritation.
Other Effects:
Rat, oral: 6500 ng/kg/13 weeks (intermittent) caused changes in liver and thymus weight and pigmented or nucleated red blood cells.
Rat, oral: 27 µg/kg/65 weeks (continuous) caused liver and kidney tumors.
Rat, oral: 52 µg/kg/2 yr (intermittent) caused liver and thyroid tumors.
Tumorgenicity, mouse, skin: 97 µg/kg/13 weeks (intermittent) caused diffuse hepatitis (hepatocellular necrosis); changes in spleen; and death.
Human cell: 100 pmol/L caused unscheduled DNA synthesis.
Monkey, oral, TD_{Lo}: 92 ng/kg (46 weeks prior to mating, on each day during gestation, and for 17 weeks following birth) caused effects on the newborn (behavioral; delayed effects).
Human cell: 10 nmol/L caused DNA inhibition.

See *RTECS* HP3500000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When released to the atmosphere, gas-phase TCDD is degraded by reaction with hydroxyl radicals and direct photolysis (half-life = 8.3 days). Particulate-phase TCDD may be physically removed from air by wet and dry deposition. TCDD may be transported long distances through the atmosphere with surface water sediments being an ultimate environmental sink of airborne particulates. TCDD will absorb to sediment and limit the overall rate by which TCDD is removed from water. TCDD near the water's surface may experience significant photodegradation. 1.5 yr is the persistence half-life of TCDD in lakes. TCDD is generally resistant to biodegradation. Photodegradation on terrestrial surfaces may be an important transformation process. During warm conditions, volatilization from soil surfaces may be a major removal mechanism. Volatilization of TCDD from dry soil surfaces is likely to be faster than from wet soil surfaces. TCDD that has been mixed into soil depths beneath the upper surface boundary will volatilize extremely slowly. On soil surfaces, persistence half-life of TCDD on soil surfaces varies from less than 1 yr to 3 yr. Half-lives in soil interiors may be as long as 12 yr. TCDD is immobile in soil and is not expected to leach. Lateral movement due to surface erosion may occur.

Ecotoxicity: No data found.

Henry's Law Constant: 1.62×10^{-5} atm m^3/mole at 25 °C (estimated)

BCF: Bioconcentration will occur in aquatic organisms. Due to TCDD's low solubility in water and lipids as well as its low partition coefficient in lipids, TCDD is not likely to accumulate in as many biological systems as DDT.

Octanol/Water Partition Coefficient: log K_{ow} = 7.02

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a) 1 lb (0.454 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Not listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification

Material Name: 1,1,1,2-Tetrachloroethane **CAS Number:** 630-20-6
Chemical Formula: $C_2H_2Cl_4$
Structural Chemical Formula: $ClCH_2CCl_3$
EINECS Number: 211-135-1
ACX Number: X1004972-8
Synonyms: 1,1,1,2-Tetrachloroethane; 1,1,1,2-TETRACHLOROETHANE; ASYM-TETRACHLOROETHANE; ETHANE,1,1,1,2-TETRACHLORO-
General Use: Solvent, cleansing and degreasing of metals.

Section 2 - Composition / Information on Ingredients

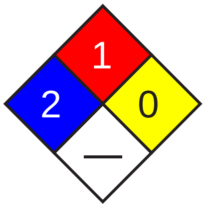
Name	CAS	%
1,1,1,2-tetrachloroethane	630-20-6	>98

OSHA PEL

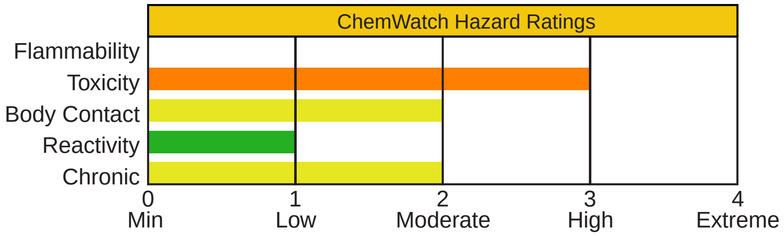
ACGIH TLV

NIOSH REL
Handle with caution in the workplace. (Chloroethanes).

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
0	Flammability
0	Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Yellowish red liquid. Severely irritating to eyes; irritating to skin. Other Acute Effects: vertigo, headache, nervousness, numbness, tremors, chemosis, hyperemia. Chronic Effects: appetite loss, nausea, tired feeling, headache, blistering of skin.

Potential Health Effects

Target Organs: skin, eyes
Primary Entry Routes: inhalation
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract and lungs and may be harmful if inhaled. Respiratory irritation and pulmonary edema may follow inhalation exposures.
Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration. The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Skin: The liquid is discomforting to the skin, it is absorbed by the skin and is capable of causing skin reactions which may lead to dermatitis.
Toxic effects may result from skin absorption.
Dermal exposure leads to dryness, scaling, inflammation and purpuric rash.
Ingestion: The liquid is discomforting to the gastrointestinal tract and may be fatal if swallowed.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class C, Possible human carcinogen; MAK - Not listed.

Chronic Effects: The material may accumulate in the human body and progressively cause tissue damage. Chronic exposures to tetrachloroethane produce jaundice, liver enlargement, fatty degeneration, hepatic necrosis and cirrhosis.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air. Lay patient down. Keep warm and rested. If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and wash with fresh running water. Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water). Wash affected areas thoroughly with water (and soap if available). Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water. Avoid giving milk or oils. Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treatment regime for carbon tetrachloride may be useful.

1.Acute exposures to carbon tetrachloride present, initially, with CNS depression followed by hepatic and renal dysfunction.

2.Respiratory depression and cardiac dysrhythmias are an immediate threat to life.

3.Since a major fraction of absorbed carbon tetrachloride is exhaled in first hour, good tidal volumes should be maintained in severely poisoned patients; hyperventilation may be an additional therapeutic modality.

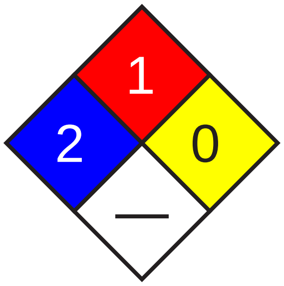
4.Ipecac syrup, lavage, activated charcoal or catharsis may all be used in the first 4 hours.

5.Since reactive metabolites may cause hepatorenal toxicity, administration of N-acetyl-L-cysteine may reduce complications.

Experience with this therapy is limited.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Nonflammable

Extinguishing Media: Water spray or fog. Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Noncombustible.
Not considered to be a significant fire risk.
Expansion or decomposition on heating may lead to violent rupture of containers.
Decomposes on heating and may produce toxic fumes of carbon monoxide (CO). May emit acrid smoke. May emit poisonous fumes.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot. Cool fire exposed containers with water spray from a protected location. If safe to do so, remove containers from path of fire. Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Wipe up. Place in a suitable labeled container for waste disposal.

Large Spills: Environmental hazard - contain spillage.
Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so. Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Neutralize/decontaminate residue.
Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains. After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation. Wear protective clothing when risk of exposure occurs. Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practice. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Glass container; Metal can; Metal drum; Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Storage Requirements: Do not store above 50 deg. C. DO NOT use aluminum or galvanized containers.
Store in original containers. Keep containers securely sealed. Store in a cool, dry, well-ventilated area. Store away from incompatible materials and foodstuff containers.
Protect containers against physical damage and check regularly for leaks.
Observe manufacturer's storing and handling recommendations.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection NIOSH approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; Chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Nitrile gloves.
Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Heavy, colorless liquid with chloroform odor. Soluble in alcohol and ether.
Physical State: Liquid
Vapor Density (Air=1): >1
Formula Weight: 169.85
Specific Gravity (H_2O=1, at 4 °C): 1.598
Evaporation Rate: Fast
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 130.5 °C (267 °F) at 760 mm Hg
Freezing/Melting Point: -70.2 °C (-94.36 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.1% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of elevated temperatures.
Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents. Avoid strong bases. Reacts violently with sodium, potassium, nitrates and 2,4-dinitrophenyl disulfide.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 670 mg/kg
Inhalation (mouse) LC_{50}: 2100 ppm/4 hr
Oral (mouse) LD_{50}: 1500 mg/kg
Inhalation (rabbit) LC_{50}: 2000 ppm/4 hr
Dermal (rabbit) LC_{50}: 2800 ppm/4 hr

Irritation

Skin (rabbit): 500 mg/24 hr
Eye (rabbit): 100 mg - SEVERE

See *RTECS* KI 8450000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on land, it would be expected to leach through soil and volatilize from the soil surface. If released into water, it would be primarily lost by volatilization (estimated half-life 4.2 hr from a model river). Adsorption to sediment is expected to be relatively low and bioconcentration in aquatic organisms would not be significant. It is extremely stable in the atmosphere, reacting with photochemically produced hydroxyl radicals with an estimated half-life of 550 days. However, it will be susceptible to washout by rain. Due to its persistence, it will disperse over long distances and slowly diffuse into the stratosphere where it would be rapidly degraded.
Ecotoxicity: LC_{50} Bluegill 20 mg/l/24 hr (95% confidence limit 16-24 mg/l) /Conditions of bioassay not specified
Henry's Law Constant: calculated at 2.7×10^{-3}
BCF: estimated at 12
Octanol/Water Partition Coefficient: log $K_{ow} = 2.66$
Soil Sorption Partition Coefficient: $K_{oc} = 399$

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Toxic, liquids, organic, n.o.s.
ID: UN2810
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: T14, TP2, TP13, TP27
Packaging: **Exceptions:** None **Non-bulk:** 201 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** B **Other:** 40

Shipping Name and Description: Toxic, liquids, organic, n.o.s.
ID: UN2810
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB2, T11, TP2, TP13, TP27
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic, liquids, organic, n.o.s.
ID: UN2810
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, T7, TP1, TP28
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U208 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per RCRA Section 3001 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection

Genium Group, Inc.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2004-07

Tetrahydrofuran
TET5760

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Tetrahydrofuran **CAS Number:** 109-99-9
Chemical Formula: C_4H_8O
EINECS Number: 203-726-8
ACX Number: X1001473-8
Synonyms: AGRISYNTH THF; BUTANE ALPHA,DELTA-OXIDE; BUTANE,1,4-EPOXY-; BUTANE,ALPHA,DELTA-OXIDE; BUTYLENE OXIDE; CYCLOTETRAMETHYLENE OXIDE; DIETHYLENE OXIDE; 1,4-EPOXYBUTANE; FURANIDINE; FURAN,TETRAHYDRO-; HYDROFURAN; OXACYCLOPENTANE; OXOLANE; TETRAHYDROFURAAN; TETRAHYDROFURAN; TETRAHYDROFURANNE; TETRAIDROFURANO; TETRAMETHYLENE OXIDE; THF
General Use: Solvent for high polymers, especially polyvinyl chloride, and in histological techniques.
As reaction medium for Grignard and metal hydride reactions.
In the synthesis of butyrolactone, succinic acid, 1,4-butanediol diacetate.
May be used for fabrication of articles for packaging, transporting, or storing of food if residual amount does not exceed 1.5% of the film.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
tetrahydrofuran	109-99-9	>95
2,6-di-tert-butyl-4-methylphenol	128-37-0	0.025

OSHA PEL
TWA: 200 ppm; 590 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 200 ppm; 590 mg/m^3;
STEL: 250 ppm; 735 mg/m^3.

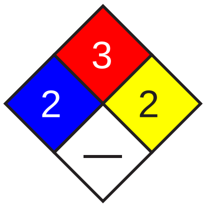
ACGIH TLV
TWA: 200 ppm; STEL: 250 ppm.

NIOSH REL
TWA: 200 ppm, 590 mg/m^3;
STEL: 250 ppm, 735 mg/m^3.

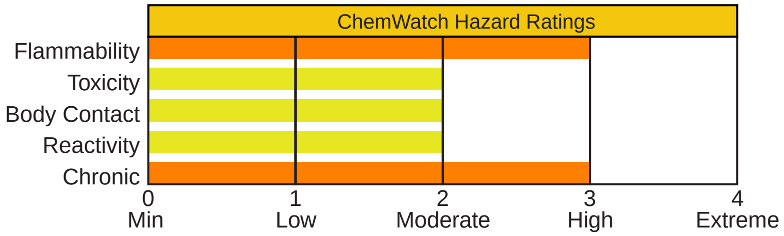
IDLH Level
2000 ppm (10% LEL).

DFG (Germany) MAK
TWA: 50 ppm; PEAK: 100 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
- ② Health
- ③ Flammability
- ② Reactivity

ANSI Signal Word

Danger!

Explosive

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear to water-white liquid; fruity odor. Irritating to eyes/skin/respiratory tract. Also causes: headache, nausea, and dizziness. Forms explosive peroxides when exposed to air or sunlight! Flammable.

Potential Health Effects

Target Organs: eyes, central nervous system (CNS), skin, respiratory system
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The material is moderately discomforting to the upper respiratory tract and may be harmful if inhaled. Inhalation of vapor may aggravate a pre-existing respiratory condition.

Overexposure by inhalation may result in the irritation of the mucous membrane and cause coughing, chest pains, nausea, dizziness, headache and narcosis. Exposure to high concentrations can affect the central nervous system due to the strong narcotic effect of the material.

Concentrations greater than 25000 ppm were required to produce anesthesia in animals. Anaesthetic properties are poor in that onset is delayed and recovery slow. Pronounced hypotensions and marked respiratory hypernea accompany narcosis. Other symptoms include muscular hypotonia and disappearance of corneal reflexes followed by coma and death.

Eye: The material is highly discomforting to the eyes, may cause chemical burns and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

THF applied as a 20% aqueous solution to rabbit eyes produced irritation.

Skin: The material is moderately discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.

Open cuts, abraded or irritated skin should not be exposed to this material.

Toxic effects may result from skin absorption.

Skin contact may cause smarting and reddening of the skin and after prolonged exposure dermatitis may result due to the defatting effect of the material.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed.

On ingestion tetrahydrofuran itself may not cause internal injury, however, furan present in certain grades of tetrahydrofuran may cause liver and kidney damage.

WARNING: The intake of alcoholic beverages enhance the toxicity effects.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Repeated exposure has been associated with cytolytic hepatitis and fatty degeneration of the liver.

A case history suggests that interaction of tetrahydrofuran and enflurane (an anesthetic) may provoke epilectic seizures following surgery.

Inhalation of THF at concentrations greater than 3000 ppm, 8 hours/day for 20 days produced irritation and evidence for hepatic and renal injury in animals. Male rats inhaling more than 5000 ppm THF for 12 weeks, 4 hours/day showed signs of systemic intoxication, skin and respiratory irritation, liver function disturbance and abnormalities in glucose function. Muscle acetylcholinesterase activity increased in a concentration-dependent manner in male rats that inhaled 200 ppm for 18 weeks, 6 hours/day. Hepatic protein and mixed function oxidase activity also increased. At 2000 ppm, liver function was inhibited. In a 13-week inhalation study, ataxia was reported in rats at 5000 ppm and narcosis in mice at 1800 ppm. Hepatocytomegaly developed in mice of both sexes at 5000 ppm whilst uterine atrophy and degeneration of the adrenal cortex was found in female mice.

The parent compound of tetrahydrofuran, furan, is carcinogenic in rats based on an increased incidence of cholangiocarcinoma and hepatocellular neoplasms of the liver and increased incidences of mononuclear cell leukemia. In male and female mice, furan induced hepatocellular neoplasms and benign pheochromocytomas of the adrenal gland.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

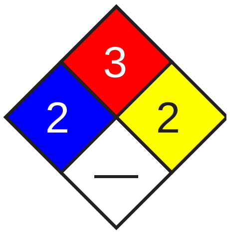
Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: -14.444 °C Closed Cup
Autoignition Temperature: 321 °C
LEL: 2% v/v
UEL: 11.8% v/v
Extinguishing Media: Alcohol stable foam; dry chemical powder; BCF (where regulations permit).
Carbon dioxide.
Water spray or fog - Large fires only.
NOTE: Water may be an ineffective extinguishing media. The vapor pressure of even dilute solutions in a 0.3% solution in water has a flash point of 70 C.
Water fog may be used on small fires.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Dangerous hazard when exposed to heat, flame and oxidizers.
Vapor may readily form an explosive mixture with air.
May form explosive peroxides on standing or following concentration by distillation.
Review of stocks and testing for peroxide content by given tested procedures at 3-monthly intervals is recommended, together with safe disposal of peroxidic samples.
[Peroxide containing residues can often be rendered innocuous by pouring into an excess of sodium carbonate solution].
Heating may cause expansion or decomposition leading to violent rupture of containers.
Decomposes on heating and produces toxic fumes of carbon dioxide (CO_2) and carbon monoxide (CO).
Fire Incompatibility: Avoid contact with acids, bases, oxidizing agents, oxygen, air, light and heat. Contact with lithium aluminum hydride or with sodium or potassium hydroxide can be hazardous when peroxides are present.
Product may polymerize in the presence of cationic initiators such as Lewis acids or strong proton acids.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Cool fire-exposed containers with water spray from a protected location.
Do not approach containers suspected to be hot.
If safe to do so, remove containers from path of fire.
Avoid spraying water onto liquid pools.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Wear impervious gloves and safety glasses.
If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.
Shut off all possible sources of ignition and increase ventilation.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Place spilled material in clean, dry, sealable, labeled container.
Wash spill area with detergent and water.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Shut off all possible sources of ignition and increase ventilation.
No smoking or bare lights within area.
Stop leak if safe to do so.
Water spray or fog may be used to disperse vapor.
Contain spill with sand, earth or vermiculite.
Use extreme caution to avoid a violent reaction.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect, using a spark-free shovel, and seal in labeled drums for disposal.
Any electric cleaning equipment must be explosion proof.
Wash spill area with detergent and water.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Avoid breathing vapors and contact with skin and eyes.
Avoid smoking, bare lights or ignition sources.
Use in a well-ventilated area.
Ground and secure containers when dispensing or pouring.
Vapor may ignite on pumping or pouring due to static electricity.
Use spark-free tools when handling.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Vapor may travel a considerable distance to source of ignition.
Keep containers securely sealed when not in use.
Avoid physical damage to containers.
When handling, DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Recommended Storage Methods: Glass container; Metal can; metal drum. Metal safety cans.
Packing as supplied by manufacturer.
Plastic containers may only be used if approved for flammable liquid.
Check that containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment:
Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Rubber gloves; Neoprene gloves.
PVA gloves.
Safety footwear.
Rubber boots.
Respiratory Protection:
Exposure Range >200 to 1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1000 to <2000 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 2000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Rubber apron.
Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to a safety shower.
Glove Selection Index:

PE/EVAL/PE	Best selection
TEFLON	Satisfactory; may degrade after 4 hours continuous immersion
PVA	Satisfactory; may degrade after 4 hours continuous immersion
VITON/CHLOROBUTYL	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion
CPE	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, mobile liquid with an ether-like odor; mixes with alcohols, ketones, esters and hydrocarbons. Forms potentially explosive peroxides upon long standing in air. These peroxides may explode if concentrated by evaporation or distillation. Saturation vapor concentration: 17.6% at 25 °C.

Physical State: Liquid
Vapor Pressure (kPa): 19.1 at 20 °C
Vapor Density (Air=1): 2.5
Formula Weight: 72.11

Specific Gravity (H_2O=1, at 4 °C): 0.891 at 20 °C
Evaporation Rate: 8.0 (BuAc=1)
pH: Not applicable
pH (1% Solution): 5 (20% aqueous)

Boiling Point: 66 °C (151 °F) at 760 mm Hg
Volatile Component (% Vol): 100
Freezing/Melting Point: -108.5 °C (-163.3 °F)
Water Solubility: 30% in water at 25 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of a stabilizing inhibitor prevents/retards peroxide formation. Product is considered stable under normal handling and storage conditions when it is inhibited and properly stored. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from oxidizing agents, acid, bases, lithium aluminum hydride, sodium or potassium hydroxide, cationic initiators such as Lewis acids or strong proton acids.

In the absence of inhibitors tetrahydrofuran is subject to auto-oxidation with the formation of 2-hydroperoxide. When heated this tends to decompose smoothly but if allowed to accumulate over a considerable period it transforms to other peroxidic species which violently decompose.

Copper(I) chloride has been recommended to remove trace amounts of peroxide. An attempt to remove peroxides by shaking with solid ferrous sulfate, prior to distillation, did not prevent explosion of the distillation residue. Alkali treatment does not appear to be safe.

Peroxides may be destroyed by passage through activated carbon at 20-66 C with contact time in excess of 2 min.

Section 11 - Toxicological Information

Toxicity
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 2816 mg/kg.
Inhalation (human) TC_{Lo}: 25000 ppm
Inhalation (rat) LC_{50}: 2100 ppm/3h

Irritation
Nil reported

See NIOSH, *RTECS* LU5950000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Once released to the environment its behavior is not well understood and very little monitoring data are available. In the atmosphere it should degrade rapidly (half-life - hours to days), especially under smog conditions and should be removed by rain. In water it may biodegrade (limited data) but will not be removed by photodegradation or adsorption to sediment. Spills on soil are expected to evaporate rapidly or leach into groundwater. It is not expected to bioconcentrate in fish or other aquatic organisms.

Ecotoxicity: LC_{50} Pimephales promelas (fathead minnow) 2160 mg/l 96 hr flow-through bioassay, wt 0.12 g, water hardness 45.5 mg/l $CaCO_3$, temp: 25 +/- 1 °C, pH 7.5, dissolved oxygen greater than 60% of saturation

Henry's Law Constant: 1.08×10^{-4}

BCF: none likely

Octanol/Water Partition Coefficient: $\log K_{ow} = 0.46$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.
Flush containers with water immediately on emptying to prevent formation of peroxides.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: TETRAHYDROFURAN
Hazard Class: 3.1
ID No.: 2056
Packing Group: II
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U213 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 1000 lb (453.5 kg)

SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2003-02

Thallium
THA1730

Section 1 - Chemical Product and Company Identification 51/57

Material Name: Thallium **CAS Number:** 7440-28-0
Chemical Formula: Tl
EINECS Number: 231-138-1
Synonyms: RAMOR; THALLIUM
Derivation: Exists in flue dusts from lead and zinc smelters and pyrite burners. Obtained from thallium compounds by electrolysis, precipitation, or reduction.
General Use: Alloyed with mercury for switches and closures which operate at subzero temperatures; used in the manufacture of thallium salts; of mercury alloys and low-melting glasses; used in cardiac imaging; electrodes in dissolved oxygen analyzers; in photoelectric cells, lamps, and electronics; in scintillation counters; as a catalyst in organic synthesis; in magnesium seawater batteries; as a rodenticide (former use).

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Thallium	7440-28-0	ca 99.9 - 100%

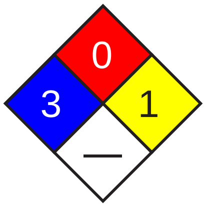
Trace Impurities: (technical grade): lead, zinc, nickel, cadmium, indium, germanium, selenium, tellurium, arsenic

OSHA PEL
TWA: 0.1 mg/m^3; skin.

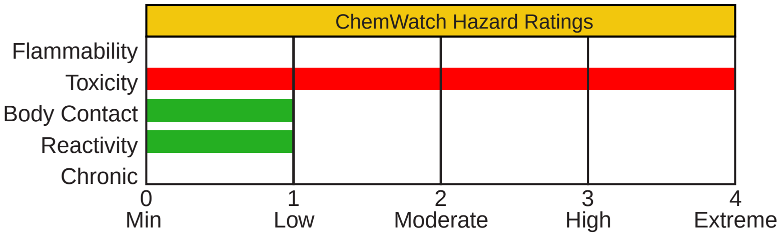
NIOSH REL
TWA: 0.1 mg/m^3.

ACGIH TLV
TWA: 0.1 mg/m^3; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
③ Health
② Flammability
① Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Thallium is a bluish-white, odorless soft metal or powder. It is toxic by ingestion and may be absorbed in toxic amounts through skin contact or inhalation. Exposure also causes: skin sensitization, central nervous system (CNS) and gastrointestinal (GI) tract effects, kidney damage, and death. Exposure is cumulative. Thallium dust is flammable.

Potential Health Effects

Target Organs: Central nervous system (CNS), peripheral nerves, cardiovascular system (CVS), gastrointestinal (GI) tract, hair, eyes, respiratory system, liver, kidneys
Primary Entry Routes: Inhalation, ingestion, skin contact
Acute Effects
Inhalation: Irritation and systemic effects including thallium poisoning. Symptoms of thallium poisoning are often delayed 12 to 24 hours and reach a maximum in the second and third week after exposure. Symptoms include severe sudden abdominal pain, nausea, vomiting, diarrhea, headache, chest pain or tightness, excessive salivation, bloody vomit and stools, sensory nerve disorders, painful tingling in extremities, leg pains, insomnia, hypertension (high blood pressure), tachycardia (rapid heart beat), respiratory failure, decreased visual clarity, impaired color vision, weakness, depression, hair loss, green color to urine, kidney damage, and, in severe cases, tremors, delirium, hallucinations, convulsions, paralysis, coma and death, sometimes within 1 to 2 days. Thallium (metal) is not as toxic as some thallium salts.
Eye: Irritation; may cause vision loss.

Skin: Irritation, acne, hair loss, impaired nail growth ("Mee's lines"); may be absorbed, causing systemic effects.

Ingestion: Sweating, nerve or nerve sheath structural changes, eye muscle changes; may cause systemic effects (see Inhalation).

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Disorders of the CNS, GI tract, kidneys, liver, and eyes may be worsened by exposure to thallium. *Based on animal studies, thallium may cross the placenta to affect an unborn child.*

Chronic Effects: Thallium is a cumulative poison. Chronic effects include systemic effects list under Acute Effects, above, but may also include poor appetite, mood changes, irritability, metallic taste in the mouth, pain in extremities (polyneuritis), alopecia (hair loss), loss of vision, tremor or abnormal muscle jerking, nail changes, dry scaly skin, heart, kidney, and endocrine damage. Permanent brain damage is common.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

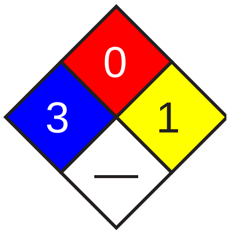
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Monitor for systemic effects.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Seek medical attention.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: If over exposure is suspected, monitor cardiac, renal and hepatic function; medical observation for several days is suggested. The most reliable urine test for thallium is a 24-hour urine quantitative assay. Diethylthiocarbamate has been reported to result in dangerous redistribution of thallium to the CNS and is contraindicated.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Not applicable, probable noncombustible solid

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Flammability Classification: Probable noncombustible solid

Extinguishing Media: For small fires, use dry chemical, carbon dioxide (CO_2) or water spray. For large fires, use water spray, fog, or regular foam. Fire involving tanks or car/trailer loads: fight fire from maximum distance or use unmanned hose holders or monitor nozzles. *Do not* get water inside containers. Cool containers with flooding quantities of water until well after fire is out.

General Fire Hazards/Hazardous Combustion Products: Toxic fumes of thallium. Thallium dust is flammable when exposed to heat or flame. Reacts violently with fluorine.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. *Do not* scatter thallium. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Thoroughly decontaminate equipment after use.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Tag container as defective and return to supplier. Use spark-proof tools and explosion proof equipment. Cleanup personnel should protect against exposure.

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite. Collect in sealed containers for disposal.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. If possible, recover for reuse or recycling.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid any exposure to thallium. To avoid dust inhalation, use only with exhaust ventilation sufficient to reduce airborne concentrations to nonhazardous levels (see Sec. 2). Wear personal protective clothing and equipment to prevent contact with skin and eyes, or dust inhalation (see Sec. 8). Remove contaminated clothing and equipment immediately for proper decontamination. Practice good personal hygiene procedures to prevent inadvertently ingesting this material. Wash any areas which might have come in contact with thallium at the end of the work shift. *Do not* attempt to handle broken containers without proper protective equipment. Whenever possible, transfer thallium directly form storage containers to process containers.

Never eat, drink, or smoke in work areas. Practice disciplined personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from heat, ignition sources, incompatibles, and food and foodstuffs.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations and exhaust ventilate to avoid dust dispersion into the work area. To prevent static sparks, electrically ground and bond all containers and equipment. Provide local exhaust ventilation systems equipped with appropriate dust collectors or scrubbers to maintain airborne concentrations below OSHA PEL (see Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices and PPE which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the eyes, nervous and respiratory systems, liver, kidneys, gastrointestinal tract, and hair. Monitor workplace exposures.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent any skin contact. Wear protective eyeglasses or chemical safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Exposure Range: >0.1 to 1 mg/m 3: air purifying, negative pressure, half mask; >1 to 10 mg/m^3: air purifying, negative pressure, full face; >10 to <15 mg/m^3: supplied air, constant flow/pressure demand, full face; 15 to unlimited mg/m^3: SCBA, pressure demand, full face; cartridge color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter). Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Bluish white powder; odorless.

Physical State: Solid

Vapor Pressure (kPa): 1 mm Hg at 1517 °F (825 °C

Formula Weight: 204.38

Density: 11.85 g/cm^3

pH: Moderately strong base

Boiling Point: 2655 °F (1457 °C)

Freezing/Melting Point: 578.3 °F (303.5 °C)

Ionization Potential (eV): 6.10829 eV

Water Solubility: Insoluble

Other Solubilities: Slightly soluble in hydrochloric acid, 100 parts nitric acid; soluble in sulfuric acid.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Thallium is stable at room temperature in closed containers under normal storage and handling conditions. Exposure to air will result in surface oxidation. Hazardous polymerization cannot occur. Avoid contact with chemical incompatibles, heat, and sources of ignition.

Storage Incompatibilities: Include strong acids and strong oxidizing agents. Reacts violently with fluourine (F_2). Reacts with steam or moist air to produce toxic thallium hydroxide (TlOH), with air to produce thallium (I) oxide (Tl_2O).

Hazardous Decomposition Products: Thermal oxidative decomposition of thallium can produce thallium fumes.

Section 11 - Toxicological Information

Acute Oral Effects:

Man, oral, TD_{Lo}: 5714 µg/kg produced toxic effects: peripheral nerve and sensation - structural change in nerve or sheath; sense organs and special senses - change in extra-ocular muscles; skin and appendages - hair.

Other Effects:

Man, unreported exposure route, LD_{Lo}: 4412 mg/kg.

See NIOSH, *RTECS* XG3425000, for additional data.

Section 12 - Ecological Information

Environmental Fate: May persist indefinitely as cation. Thallium bioaccumulates.

Ecotoxicity: Freshwater: Atlantic salmon, LD_{50}: 0.03 ppm; *daphnia*, 72 hr threshold: 2-4 ppm; *gammarus*, 72 hr threshold: 4 ppm; perch, 72 hr threshold: 60 ppm. Saltwater: brown shrimp, 96 hr LC_{50}: 10 ppm.

Section 13 - Disposal Considerations

Disposal: If possible, recover for reuse or recycling. Contact your supplier or a licensed contractor for detailed recommendations for disposal. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Thallium compounds, n.o.s.
Hazard Class: 6.1
ID No.: UN1707
Packing Group: II
Label: POISON

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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1171 RiverFront Center, Amsterdam, NY 12010
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Issue Date: 2006-06

Toluene
TOL2320

Section 1 - Chemical Product and Company Identification 61

Material Name: Toluene **CAS Number:** 108-88-3
Chemical Formula: C_7H_8
Structural Chemical Formula: $C_6H_5CH_3$
EINECS Number: 203-625-9
ACX Number: X1001512-0
Synonyms: ANTISAL 1A; BENZENE,METHYL-; CP 25; METHACIDE; METHANE,PHENYL-; METHYL BENZENE; METHYL BENZOL; METHYLBENZENE; METHYLBENZOL; PHENYL METHANE; PHENYLMETHANE; TOLUEEN; TOLUEN; TOLUENE; TOLUENO; TOLUOL; TOLUOLO; TOLU-SOL
General Use: Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners; in gasoline and aviation fuel. Used in the manufacture of chemicals, dyes, explosives, benzoic acid.
Some grades of toluene may contain traces of xylene and benzene.
Odor threshold: 2 ppm approx. Odor is not a reliable warning property due to olfactory fatigue.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
toluene	108-88-3	> 99.5

OSHA PEL
TWA: 200 ppm; Ceiling: 300 ppm; 500 ppm, 10-minute maximum peak.

ACGIH TLV
TWA: 50 ppm; skin.

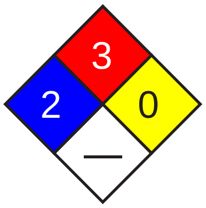
EU OEL
TWA: 192 mg/m^3 (50 ppm); STEL: 384 mg/m^3 (100 ppm).

NIOSH REL
TWA: 100 ppm (375 mg/m^3); STEL: 150 ppm (560 mg/m^3).

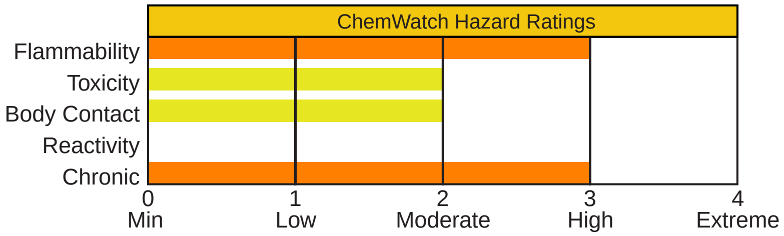
IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 50 ppm; PEAK: 200 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
③ Flammability
⓪ Reactivity

ANSI Signal Word

Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sickly, sweet odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: weakness, headache, dizziness, confusion, insomnia. Chronic Effects: liver/kidney damage, may cause birth defects. Flammable.

Potential Health Effects

Target Organs: Skin, liver, kidneys, central nervous system.
Primary Entry Routes: Inhalation, skin contact/absorbtion.
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract. Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Central nervous system (CNS) depression may include nonspecific discomfort, symptoms of giddiness, headache, dizziness, nausea, anesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness. Serious poisonings may result in respiratory depression and may be fatal.

Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes if exposure is prolonged.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis and it is absorbed by skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Chronic toluene habituation occurs following intentional abuse (glue-sniffing) or from occupational exposure. Ataxia, incoordination and tremors of the hands and feet (as a consequence of diffuse cerebral atrophy), headache, abnormal speech, transient memory loss, convulsions, coma, drowsiness, reduced color perception, frank blindness, nystagmus (rapid, involuntary eye-movements), decreased hearing leading to deafness and mild dementia have all been associated with chronic abuse.

Peripheral nerve damage, encephalopathy, giant axonopathy, electrolyte disturbances in the cerebrospinal fluid and abnormal computer tomographic (CT) scans are common amongst toluene addicts. Although toluene abuse has been linked with kidney disease, this does not commonly appear in cases of occupational toluene exposures. Cardiac and hematological toxicity are however associated with chronic toluene exposure. Cardiac arrhythmia, multifocal and premature ventricular contractions and supraventricular tachycardia are present in 20% of patients who abused toluene-containing paints.

Previous suggestions that chronic toluene inhalation produced human peripheral neuropathy have largely been discounted. However central nervous system (CNS) depression is well documented where blood toluene levels exceed 2.2 mg%. Toluene abusers can achieve transient circulating concentrations of 6.5 mg%. Amongst workers exposed for a median time of 29 years to toluene no subacute effects on neurasthenic complaints and pyschometric test results could be established.

The prenatal toxicity of very high toluene concentrations has been documented for several animal species and man. Malformations indicative of specific teratogenicity have not generally been found. The toxicity described in the literature takes the form of embryo death or delayed fetal growth and delayed skeletal system development. Permanent damage of children has been seen only when mothers had suffered from chronic intoxication as a result of "sniffing".

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Following acute or short-term repeated exposures to toluene:

1. Toluene is absorbed across to alveolar barrier, the blood/air mixture being 11.2/15.6 (at 37 °C) The order of toluene, in expired breath, is of the order of 18 ppm following sustained exposure to 100 ppm.
The tissue/blood proportion is 1/3 except in adipose where the proportion is 8/10.
2.Metabolism by microsomal mono-oxygenation, results in the production of hippuric acid. This may be detected in the urine in amounts between 0.5 and 2.5 g/24hr which represents, on average 0.8 gm/gm of creatinine.
The biological half life of hippuric acid is in the order of 1-2 hours.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
8.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

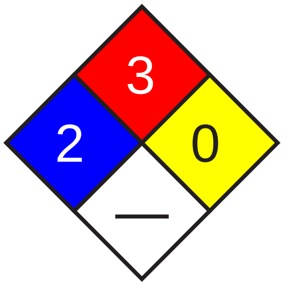
Determinant	Index	Sampling Time	Comments
Hippuric acid in urine	2.5 gm/gm creatinine	End of shift Last 4 hrs of shift	B,NS
Toluene in venous blood	1 mg/L	End of shift	SQ
Toluene in end-exhaled air		End of shift	SQ

NS: Non-specific determinant; also observed after exposure to other material
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.
B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: 4 °C Closed Cup
Autoignition Temperature: 480 °C
LEL: 1.2% v/v
UEL: 7.1% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO) and carbon dioxide (CO_2).

See DOT ERG



Fire Diamond

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.

Nitric acid with toluene, produces nitrated compounds which are explosive.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

Fight fire from a safe distance, with adequate cover.

If safe, switch off electrical equipment until vapor fire hazard removed.

Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protective location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See
DOT
ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.

Avoid breathing vapors and contact with skin and eyes.

Control personal contact by using protective equipment.

Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.

Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.

Use only spark-free shovels and explosion proof equipment.

Collect recoverable product into labeled containers for recycling.

Absorb remaining product with sand, earth or vermiculite.

Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.

Wear protective clothing when risk of exposure occurs.

Use in a well-ventilated area. Prevent concentration in hollows and sumps.

DO NOT enter confined spaces until atmosphere has been checked.

Avoid smoking, bare lights, heat or ignition sources.

When handling, DO NOT eat, drink or smoke.

Vapor may ignite on pumping or pouring due to static electricity.

DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.

Avoid contact with incompatible materials.

Keep containers securely sealed. Avoid physical damage to containers.

Always wash hands with soap and water after handling.

Work clothes should be laundered separately.

Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; Metal drum; Metal safety cans. Packing as supplied by manufacturer.

Plastic containers may only be used if approved for flammable liquid.

Check that containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area; local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.

General exhaust is adequate under normal operating conditions.

Local exhaust ventilation may be required in special circumstances.

If risk of overexposure exists, wear NIOSH-approved respirator. Correct fit is essential to ensure adequate protection.

Provide adequate ventilation in warehouses and enclosed storage areas.

In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:
Exposure Range >200 to <500 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:

PE/EVAL/PE	Best selection
VITON/CHLOROBUTYL	Best selection
VITON	Best selection
PVA	Best selection
TEFLON	Satisfactory; may degrade after 4 hours continuous immersion
SARANEX-23 2-PLY	Poor to dangerous choice for other than short-term immersion
CPE	Poor to dangerous choice for other than short-term immersion
VITON/NEOPRENE	Poor to dangerous choice for other than short-term immersion
SARANEX-23	Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Odor Threshold: 2.14 ppm
Vapor Pressure (kPa): 2.93 at 20 °C
Vapor Density (Air=1): 3.2
Formula Weight: 92.14
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 20 °C
Evaporation Rate: 2.4 (BuAc=1)
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 111 °C (232 °F) at 760 mm Hg
Freezing/Melting Point: -95 °C (-139 °F)
Volatile Component (% Vol): 100
Water Solubility: < 1 mg/mL at 18 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers.

Section 11 - Toxicological Information

Toxicity
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 636 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm
Inhalation (man) TC_{Lo}: 200 ppm
Inhalation (rat) LC_{50}: > 26700 ppm/1h
Dermal (rabbit) LD_{50}: 12124 mg/kg
Reproductive effector in rats

Irritation
Skin (rabbit): 20 mg/24h-moderate
Skin (rabbit): 500 mg - moderate
Eye (rabbit): 0.87 mg - mild
Eye (rabbit): 2 mg/24h - SEVERE
Eye (rabbit): 100 mg/30sec - mild

See *RTECS* XS 5250000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be lost by evaporation from near-surface soil and by leaching to the groundwater. Biodegradation occurs both in soil and groundwater, but it is apt to be slow especially at high concentrations, which may be toxic to microorganisms. The presence of acclimated microbial populations may allow rapid biodegradation. It will not significantly hydrolyze in soil or water under normal environmental conditions. If released into water, its concentration will decrease due to evaporation and biodegradation. This removal can be rapid or take several weeks, depending on temperature, mixing conditions, and acclimation of microorganisms. It will not significantly adsorb to sediment or bioconcentrate in aquatic organisms. If released to the atmosphere, it will degrade by reaction with photochemically produced hydroxyl radicals (half-life 3 hr to slightly over 1 day) or be washed out in rain. It will not be subject to direct photolysis.

Ecotoxicity: LC_{50} Aedes aegypti-4th instar (mosquito larvae) 22 mg/l /Conditions of bioassay not specified; LC_{50} Cyprinodon variegatus (sheepshead minnow) 277-485 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Calandra granaria (grain weevil) 210 mg/l /in air; LC_{50} Cancer magister (crab larvae stage I) 28 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 4.3 ppm 96 hr /Conditions of bioassay not specified; LC_{50} Artemia salina (brine shrimp) 33 mg/l 24 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (striped bass) 7.3 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnows) 55-72 mg/l (embryos), 25-36 mg/l (1-day posthatch protolarvae), and 26-31 mg/l (30-day-old minnows)/ 96 hour /Conditions of bioassay not specified

Henry's Law Constant: 0.0067

BCF: eels 13.2

Biochemical Oxygen Demand (BOD): 0%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.69

Soil Sorption Partition Coefficient: K_{oc} = silty loam 37

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Toluene
ID: UN1294
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U220 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Issue Date: 2006-06

1,2,4-Trichlorobenzene
TRI2350

Section 1 - Chemical Product and Company Identification 61

Material Name: 1,2,4-Trichlorobenzene **CAS Number:** 120-82-1
Chemical Formula: $C_6H_3Cl_3$
Structural Chemical Formula: $C_6H_3Cl_3$
EINECS Number: 204-428-0
ACX Number: X1001590-4
Synonyms: BENZENE,1,2,4-TRICHLORO-; HOSTETEX L-PEC; 1,2,4-TRICHLOROBENZENE; 1,2,5-TRICHLOROBENZENE; 1,3,4-TRICHLOROBENZENE; 1,2,4-TRICHLOROBENZOL; TROJCHLOROBENZEN; UNSYM-TRICHLOROBENZENE
General Use: Solvent in chemical manufacture, dyes and intermediates, dielectric fluid, synthetic transformer oils, lubricants, heat-transfer medium, insecticides.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,2,4-trichlorobenzene	120-82-1	>98

OSHA PEL

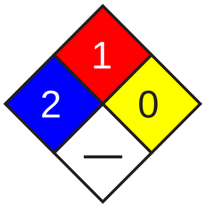
NIOSH REL
Ceiling: 5 ppm (40 mg/m^3).

DFG (Germany) MAK
Skin.

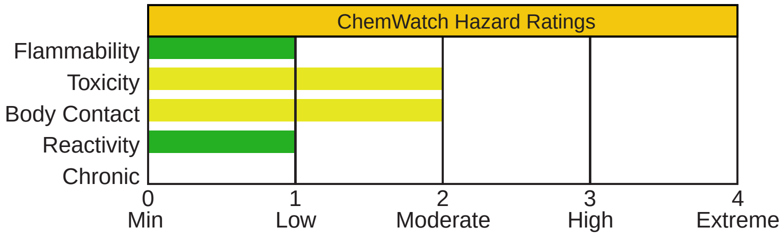
ACGIH TLV
Ceiling: 5 ppm.

EU OEL
TWA: 2 ppm; STEL: 5 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
① Flammability
⓪ Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, liquid; aromatic odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: uncoordination, narcosis, tremors, headache, restlessness, increased heart rate/blood pressure. Chronic Effects: liver/kidney/lung damage (animal data).

Potential Health Effects

Target Organs: skin, eyes, mucous membranes
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
Inhalation of vapor may aggravate a pre-existing respiratory condition.
Target organs from non-lethal exposures of cats, dogs, rats, rabbits and guinea pig include liver, kidney and ganglion cells of the brain. Local pulmonary irritation of the lungs and dyspnea were recorded in animals which later died after inhaling 1,2,4-TCB. Sublethal doses cause liver damage in guinea pigs and lethargy and weight gain in other animals.

Eye: The liquid is discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
The vapor is highly discomforting to the eyes.

Skin: The liquid may produce skin discomfort following prolonged contact.
Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed. Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: No human exposure data available. For this reason health effects described are based on experience with chemically-related materials.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

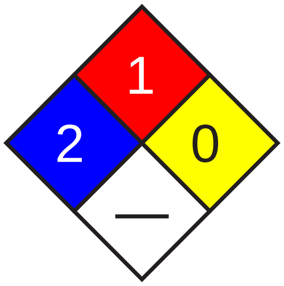
Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: 105 °C Closed Cup
Autoignition Temperature: 571 °C
LEL: 2.5% v/v
UEL: 6.6% v/v

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Combustible. Slight fire hazard when exposed to heat or flame.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit acrid smoke.
Mists containing combustible materials may be explosive.
Combustion products include hydrogen chloride.

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Use water delivered as a fine spray to control fire and cool adjacent area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Wipe up. Place in a suitable labeled container for waste disposal.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Neutralize/decontaminate residue.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses; safety glasses with side shields; chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >5 to 50 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to 500 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >500 to 5000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >5000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Impervious protective clothing.
Eyewash unit.

Glove Selection Index:

NITRILE	Best selection
TEFLON	Best selection
VITON/NITRILE	Best selection
PE	Poor to dangerous choice for other than short-term immersion

SARANEX-23 .... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless liquid with odor resembling that of o-dichlorobenzene. Miscible with ether, benzene, petroleum ether, carbon disulfide. Volatile with steam.

Physical State: Liquid
Odor Threshold: 24.0 mg/m^3
Vapor Pressure (kPa): 0.1 at 40 °C
Vapor Density (Air=1): >6
Formula Weight: 181.44
Specific Gravity (H_2O=1, at 4 °C): 1.46
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 213.5 °C (416 °F) at 760 mm Hg
Freezing/Melting Point: 17 °C (62.6 °F)
Water Solubility: 19 ppm at 22 °C in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Toxicity

Oral (rat) TD_{Lo}: 1800 mg/kg
Oral (rat) LD_{50}: 756 mg/kg
Intraperitoneal (mouse) LD_{50}: 1223 mg/kg
Bacterial mutagen, altered sleep times, somnolence, convulsions, ataxia, maternal effects, effects on embryo, fetotoxicity, fetolethality recorded.

Irritation

Skin (rabbit): 1950 mg/13w - I
- moderate

See *RTECS* DC 2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If it is released to the soil it will probably adsorb to the soil and therefore will not leach appreciably through soil. However, it has been detected in some groundwater samples. It will not hydrolyze or biodegrade in groundwater, but it may biodegrade slowly in the soil based upon the data from one experiment. If released to water it will adsorb to the sediments and may bioconcentrate in aquatic organisms. It will not hydrolyze in surface waters but it may be subject to slow biodegradation. It is expected to evaporate from water with half-lives of 11-22 days for evaporation from a study of a physically mixed, 5.4 m deep seawater microcosm and a half-life of 4.2 hr predicted for evaporation from a model river 1 m deep, flowing at 1 m/sec with a wind velocity of 3 m/sec. Adsorption to sediments or absorption by microorganisms may minimize the rate of evaporation. A half-life of 450 years has been reported for sunlight photolysis in surface waters at 40 deg latitude in summer. If released to the atmosphere, it may react with photochemically produced hydroxyl radicals with a resulting estimated vapor phase half-life in the atmosphere of 18.5 days.
Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) > 46.8 mg/l/24 hr; > 46.8 mg/l/48 hr; 21.4 mg/l/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 2.4 ppm/14 days /Conditions of bioassay not specified; LC_{50} Salmo gairdneri (rainbow trout) 1.95 mg/l/48 hr at 15 °C /Conditions of bioassay not specified
Henry's Law Constant: calculated at 3.9 x10^{-3}
BCF: rainbow trout 980 to 1620
Biochemical Oxygen Demand (BOD): theoretical 78%, 20 days
Octanol/Water Partition Coefficient: log K_{ow} = 4.02
Soil Sorption Partition Coefficient: K_{oc} = 1441

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Trichlorobenzenes, liquid
ID: UN2321
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, T4, TP1
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2002-02

1,1,1-Trichloroethane
MET2840

Section 1 - Chemical Product and Company Identification

Material Name: 1,1,1-Trichloroethane **CAS Number:** 71-55-6
Chemical Formula: $C_2H_3Cl_3$
Structural Chemical Formula: CH_3CCl_3
Synonyms: AEROTHENE MM; AEROTHENE TT; ALGYLEN; ALPHA-T; BALTANA; CF 2; CHLOROETENE; CHLOROETHANE-NU; CHLOROETHENE; CHLOROETHENE NU; CHLOROFORM,METHYL-; CHLOROTENE; CHLOROTHANE NU; CHLOROTHENE; CHLOROTHENE (INHIBITED); CHLOROTHENE NU; CHLOROTHENE SM; CHLOROTHENE VG; CHLOROTHENE(INHIBITED); CHLORTEN; CHLORTHANE-NU; CHLORYLEN; DOWCLENE LS; ETHANA NU; ETHANE,1,1,1-TRICHLORO-; GEMALGENE; GENKLENE; ICI-CF 2; INHIBISOL; METHYL CHLOROFORM; METHYLCHLOROFORM; METHYLTRICHLOROMETHANE; SOLVENT 111; STROBANE; TAFCLEAN; 1,1,1-TCE; TCEA; 1,1,1-TRICHLOORETHAAN; 1,1,1-TRICHLORAETHAN; TRICHLORAN; 1,1,1-TRICHLOROETHANE; ALPHA-TRICHLOROETHANE; TRICHLORO-1,1,1-ETHANE; TRICHLOROETHANE; 1,1,1-TRICHLOROETHANE (STABILIZED); TRICHLOROMETHYLMETHANE; 1,1,1-TRICLOROETANO; TRIELENE; TRI-ETHANE
General Use: Used as a solvent for metal degreasing and vapor degreasing. Used in pesticides, some protective coatings, adhesives and cements, polishes, printing inks. Component of so called "safety" i.e. (nonflammable) solvents. Material is highly volatile and may quickly form concentrated atmosphere in confined or unventilated area. Vapor is heavier than air and may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,1,1-trichloroethane	71-55-6	>94

OSHA PEL
TWA: 350 ppm; 1900 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 350 ppm; 1900 mg/m^3;
STEL: 450 ppm; 2450 mg/m^3.

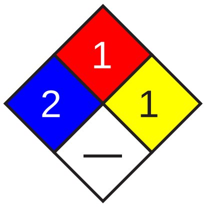
ACGIH TLV
TWA: 350 ppm, 1910 mg/m^3;
STEL: 450 ppm, 2460 mg/m^3.

NIOSH REL
Ceiling: 350 ppm, 1900 mg/m^3;
15-minute.

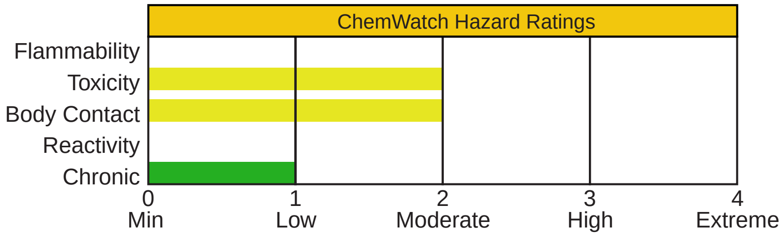
IDLH Level
700 ppm.

DFG (Germany) MAK
TWA: 200 ppm, 1100 mg/m^3;
PEAK: 200 ppm, 1100 mg/m^3;
skin, ceiling, local irritant effects determine peak value.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
① Flammability
① Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid with a sweet odor. Irritating to eyes/skin/respiratory tract. Also causes: headache, dizziness, incoordination; mild liver and kidney dysfunction may occur. Vapor will burn with a strong ignition source.

Potential Health Effects

Target Organs: skin, eyes, central nervous system (CNS), cardiovascular system
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The vapor is mildly discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Anesthetic and narcotic effects (with dulling of senses and odor fatigue) are a consequence of exposure to chlorinated solvents.
Individual response varies widely; odor may not be considered objectionable at levels which quickly induce central nervous system effects.
High vapor concentrations may give a feeling of euphoria. This may result in reduced responses, followed by rapid onset of unconsciousness, possible respiratory arrest and death.
Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.
WARNING: Odor is not considered objectionable at levels likely to result in central nervous system effects (500-1000 ppm).
If the odor is strong, leave the area promptly; ventilate well before returning. Avoid becoming a casualty.
Perception of odor may decline after several hours of exposure (olfactory fatigue).
Sensitive humans may experience anesthetic effects from short exposures at 800-1000 ppm. These effects readily occur at concentrations of 2000 ppm or greater. Numerous deaths due to depression of the nervous system, control of respiration, and/or fatal cardiac arrhythmia have been reported following inhalation. Autopsy has revealed intracerebral hemorrhage and passive congestion of the brain. Use in clinical anaesthesiology confirms the cardiotoxicity of 1,1,1-trichloroethane. Volunteers exposed to 200 ppm or 400 ppm for 4 hours on two occasions (with six day separation between each) exhibited increases in reaction time and average body sway. In a further study male subjects repeatedly exposed at 350 ppm showed impaired reaction time, perceptual speed and manual dexterity.
Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The vapor is discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Skin: The liquid is discomforting to the skin and may cause drying of the skin, which may lead to dermatitis.
Toxic effects may result from skin absorption.
Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Ingestion: The liquid is highly discomforting and toxic if swallowed.
Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.
Considered an unlikely route of entry in commercial/industrial environments.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.
Toxic effects are increased by consumption of alcohol.
In a study conducted on workers exposed to 1,1,1-trichloroethane for periods ranging from several months to 6 years no adverse effects was noted when compared with a matched control group. Exposures for some workers exceeded 200 ppm during the study period.
Chronic exposure may result in liver and kidney damage.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Avoid giving milk or oils.
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

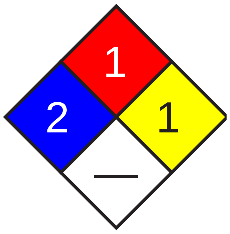
Note to Physicians: For acute or short-term repeated exposure to 1,1,1-trichloroethane:
1.Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.
2. Institute prompt supportive measures to combat CNS depression.
3.An adequate title volume of 10-15 mL/kg body weight should be maintained.
4.For ingestion consider gastric lavage. A cuffed endotracheal tube, to protect airway, should be used if lavage given.
5. Consider activated charcoal approx 30 -50 gram in water slurry to follow lavage. Material is a GI tract irritant and a cathartic. Consider standard cathartic to hasten elimination.

BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Trichloroethane in end-exhaled air	40 ppm	Prior to last shift of work-week	
Trichloroacetic acid in urine	10 mg/L	End of work-week	NS,SQ
Total trichloroethanol in urine	30 mg/L	End of shift at end of work-week	NS,SQ
Total trichloroethanol in blood	1 mg/m	End of shift at end of work-week	NS

NS: Non-specific determinant; also seen after exposure to other materials
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: > 93.3 °C
Autoignition Temperature: 500 °C
LEL: 7.5% v/v
UEL: 12.5% v/v

Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Nonflammable liquid. However vapor will burn when in contact with high temperature flame. Ignition ceases on removal of flame.
May form a flammable/explosive mixture in an oxygen enriched atmosphere. Heating may cause expansion/vaporization with violent rupture of containers. Decomposes on heating and produces corrosive fumes of hydrochloric acid, carbon monoxide and small amounts of toxic phosgene.

Fire Incompatibility: Avoid reaction with strong oxidizing agents (particularly oxygen in gas or liquid form and nitrogen dioxide), strong bases, sodium and sodium-potassium alloys. Powdered metals; magnesium, zinc and aluminum.
Contact with water may result in the slow formation of hydrochloric acid.
Attacks natural rubber.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Wipe up. Place in a suitable labeled container for waste disposal.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain or absorb spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid smoking, bare lights or ignition sources. When handling, DO NOT eat, drink or smoke. Avoid contact with incompatible materials.
Keep containers securely sealed when not in used. Avoid physical damage to containers. Always wash hands with soap and water after handling. Working clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing/handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Glass bottle. Inhibited grades may be stored in metal drums.
DO NOT use aluminum or galvanized containers.
Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Butyl rubber gloves; Neoprene gloves.
Safety footwear.
Respiratory Protection:
Exposure Range >350 to <700 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 700 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties
Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.
Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection

VITON	Best selection
TEFLON	Best selection
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
PVDC/PE/PVDC	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion
HYPALON	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, highly volatile liquid. Miscible in most organic solvents. Mild chloroform-like odor.

Physical State: Liquid
Vapor Pressure (kPa): 14 at 20 °C
Vapor Density (Air=1): 4.6
Formula Weight: 133.42
Specific Gravity (H_2O=1, at 4 °C): 1.34 at 20 °C
Water Solubility: 0.4% by weight
Evaporation Rate: 12.8 (n-(BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 74 °C (165 °F) at 760 mm Hg
Freezing/Melting Point Range: -30.4 °C (-22.72 °F)
Volatile Component (% Vol): 100
Decomposition Temperature (°C): 260

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with strong oxidizers (particularly oxygen in gas or liquid form and nitrogen dioxide), strong bases, acetone, sodium and sodium-potassium alloys, magnesium, zinc and aluminum.
Avoid contact with water as the slow formation of hydrochloric acid results.
Attacks natural rubber.
Aerosols containing this material must not be packed in aluminum

Section 11 - Toxicological Information

TOXICITY
Oral (human) TD_{Lo}: 670 mg/kg
Oral (rat) LD_{50}: 10300 mg/kg
Inhalation (human) TC_{Lo}: 920 ppm/70 min
Inhalation (man) LC_{Lo}: 27000 mg/m^3/10m
Inhalation (man) TC_{Lo}: 200 ppm/4 hr
Inhalation (man) TC_{Lo}: 350 ppm
Inhalation (rat) LC_{50}: 18000 ppm/4h
Dermal (rabbit) LD_{Lo}: 1000 mg/kg

IRRITATION
Skin (rabbit): 20 mg/24 hr moderate
Skin (rabbit): 5000 mg/12 d-I mild
Eye (man): 450 ppm/8 hr
Eye (rabbit): 2 mg/24 hr SEVERE
Eye (rabbit): 100 mg mild

See NIOSH, *RTECS* KJ 2975000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Releases to surface water will decrease in concentration almost entirely due to evaporation. Spills on land will decrease in concentration almost entirely due to volatilization and leaching. Releases to air may be transported long distances and partially return to earth in rain. In the troposphere, it will degrade very slowly by photooxidation and also slowly diffuse to the stratosphere where photodegradation will be rapid.

Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 133 ppm/7 day /Conditions of bioassay not specified; EC_{50} Pimephales promelas (fathead minnow) 28.8 mg/l/96 hr (confidence limit 23.0 -36.2 mg/l), flow-through bioassay with measured concentrations, 25.6 °C, dissolved oxygen 6.5 mg/l, hardness 46.4 mg/l $CaCO_3$, alkalinity 42.6 mg/l $CaCO_3$, and pH 7.99

Henry's Law Constant: 8 x10^{-3}
BCF: bluegills 28
Octanol/Water Partition Coefficient: log K_{ow} = 2.49
Soil Sorption Partition Coefficient: K_{oc} = 183

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Reclaim solvent at an approved site.

Evaporate or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: 1,1,1-TRICHLOROETHANE
Hazard Class: 6.1(b)
ID No.: 2831
Packing Group: III
Label: Harmful[6]

Additional Shipping Information: METHYLCHLOROFORM

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U226 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection

Genium group inc.

1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

1,1,2-Trichloroethane
TRI2650

Section 1 - Chemical Product and Company Identification 61

Material Name: 1,1,2-Trichloroethane **CAS Number:** 79-00-5

Chemical Formula: $C_2H_3Cl_3$

Structural Chemical Formula: $ClCH_2CHCl_2$

EINECS Number: 201-166-9

ACX Number: X1000040-5

Synonyms: BETA-T; ETHANE TRICHLORIDE; ETHANE,1,1,2-TRICHLORO-; 1,1,2-TRICHLORETHANE; 1,1,2-TRICHLOROETHANE; 1,2,2-TRICHLOROETHANE; BETA-TRICHLOROETHANE; TROJCHLOROETAN(1,1,2); VINYL TRICHLORIDE

General Use: In the production of vinylidene chloride (1,1-dichloroethylene). Minor uses include solvent for fats, resins, waxes and oils and in pharmaceutical manufacture. Detected in ambient urban air at concentrations up to 0.223 ug/m^3. Degraded in the troposphere by reaction with hydroxyl radicals (t1/2 = 24 days) to hydrochloric acid, phosgene, formyl chloride and chloroacetyl chloride.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,1,2-trichloroethane	79-00-5	>98

OSHA PEL
TWA: 10 ppm; 45 mg/m^3; skin.

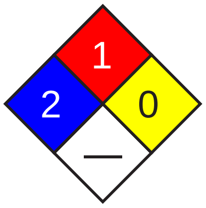
ACGIH TLV
TWA: 10 ppm; skin.

NIOSH REL
TWA: 10 ppm (45 mg/m^3); skin (Chloroethanes).

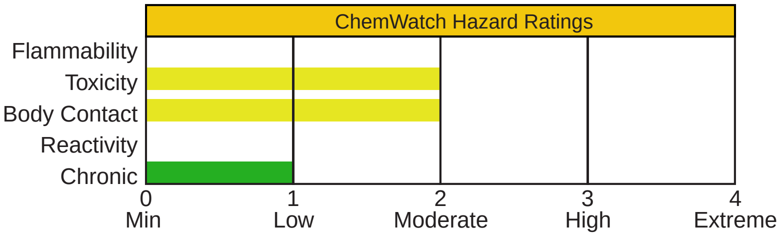
IDLH Level
100 ppm.

DFG (Germany) MAK
TWA: 10 ppm; PEAK: 20 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
0	Flammability
0	Reactivity

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet, pleasant odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: anesthesia manifested by CNS effects, headache, dizziness, drowsiness, incoordination. Chronic Effects: liver/kidney damage, coma, death.

Potential Health Effects

Target Organs: skin, eyes, central nervous system (CNS), respiratory system, liver, kidneys

Primary Entry Routes: inhalation, skin contact/absorption

Acute Effects

Inhalation: The vapor is mildly discomforting to the upper respiratory tract.

Inhalation hazard is increased at higher temperatures.

Toxic effects are increased by consumption of alcohol.

Anesthetic and narcotic effects (with dulling of senses and odor fatigue) are a consequence of exposure to chlorinated solvents. Individual response varies widely; odor may not be considered objectionable at levels which quickly induce central nervous system effects.

High vapor concentrations may give a feeling of euphoria. This may result in reduced responses, followed by rapid onset of unconsciousness, possible respiratory arrest and death.

Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.

Narcotic concentrations also produce ocular and upper respiratory irritation.

Exposures at 2000 ppm for 4-hours are lethal in rats with deaths occurring over the following 14-days. Rats inhaling 250 ppm for 4-hours survived but developed hepatic and renal necrosis.

Sixteen 7-hour exposures at 30 ppm resulted in minor fatty changes and cloudy swelling in the liver of female rats.

Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes.

The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin and may cause drying of the skin, which may lead to dermatitis.

Toxic effects may result from skin absorption.

Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

In rabbits signs of intoxication were produced following application of 0.5g/kg - these included liver and kidney damage.

The permeability coefficient through intact human skin is calculated to be 8.4 x 10-3 cm/hr.. It has been calculated that if both hands are exposed to liquid 1,1,2-TCE for 1-minute, total dermal uptake is 13.9 mg.

Topical application to the forearms of a healthy adult male for 5 minutes caused localized hyperemia, transient blanching, pain and a burning sensation.

Ingestion: The liquid is highly discomforting and toxic if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Considered an unlikely route of entry in commercial/industrial environments.

Ingestion produced sedation, gastric irritation, lung hemorrhage and liver and kidney damage in rodents. When mice were given > 44 mg/kg/day in the drinking water for 90-days they showed decreased hemaglutination, decreased phagocytosis and reduced macrophage function.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class C, Possible human carcinogen; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Chronic exposure may result in liver and kidney damage. Long-term exposure to the vapor produces chronic gastric symptoms, fat deposition in the kidneys and lung damage in man.

When rats received 0.002 or 0.006 mg/week subcutaneously there was no significant increase in benign mesenchymal and epithelial tumors though the high-dose group had a higher incidence of sarcomas. When administered by gavage there was positive evidence of carcinogenicity in mice characterized by hepatocellular carcinomas and pheochromocytomas of the adrenal gland. This was not the case in rats.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

Avoid giving milk or oils.

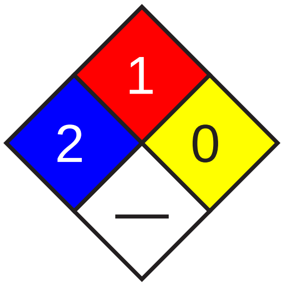
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Do not give adrenalin (epinephrine) or related drugs. Treat symptomatically.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: None
Autoignition Temperature: 460 °C
LEL: 6% v/v
UEL: 15.5% v/v
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Nonflammable liquid.
However vapor will burn when in contact with high temperature flame. Ignition ceases on removal of flame.
May form a flammable/explosive mixture in an oxygen enriched atmosphere. Heating may cause expansion/vaporization with violent rupture of containers. Decomposes on heating and produces corrosive fumes of hydrochloric acid, carbon monoxide and small amounts of toxic phosgene.
Fire Incompatibility: Avoid reaction with strong oxidizing agents (particularly oxygen in gas or liquid form and nitrogen dioxide), strong bases, sodium and sodium-potassium alloys. Powdered metals; magnesium, zinc and aluminum.
Contact with water may result in the slow formation of hydrochloric acid.
Attacks natural rubber.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Wipe up. Place in a suitable labeled container for waste disposal.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain or absorb spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid smoking, bare lights or ignition sources. When handling, DO NOT eat, drink or smoke. Avoid contact with incompatible materials.
Keep containers securely sealed when not in used. Avoid physical damage to containers. Always wash hands with soap and water after handling. Working clothes should be laundered separately.

Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing/handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Glass bottle.
Inhibited grades may be stored in metal drums.
DO NOT use aluminum or galvanized containers.
Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Butyl rubber gloves; Neoprene gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >10 to <100 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 100 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: odor threshold unknown

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:

TEFLON	Best selection
VITON	Best selection
BUTYL	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless nonflammable liquid with sweet odor. Soluble in ethanol, chloroform, diethyl ether.

Physical State: Liquid
Odor Threshold: 0.5 to 165 ppm
Vapor Pressure (kPa): 2.5 at 20 °C
Vapor Density (Air=1): 4.55
Formula Weight: 133.4
Specific Gravity (H_2O=1, at 4 °C): 1.439
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 113.8 °C (237 °F) at 760 mm Hg
Freezing/Melting Point: -36.6 °C (-33.88 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.44 g/100 g water at 20 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with strong oxidizers (particularly oxygen in gas or liquid form and nitrogen dioxide), strong bases, acetone, sodium and sodium-potassium alloys, magnesium, zinc and aluminum.
Avoid contact with water as the slow formation of hydrochloric acid results.
Attacks natural rubber.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 836 mg/kg
Inhalation (rat) LC_{Lo}: 2000 ppm/4h
Dermal (rabbit) LD_{50}: 5377 mg/kg

Reproductive effector

Irritation
Skin (rabbit): 500 mg (open)-mild
Skin (rabbit): 810 mg/24 h-SEVERE
Skin (rabbit): 500 mg/24h - mild
Eye (rabbit): 162 mg - mild
Eye (rabbit): 500 mg/24 h - mild

See *RTECS* KJ 3150000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Releases to water will primarily be lost through evaporation. Once in the atmosphere, it will photodegrade slowly by reaction with hydroxyl radicals (half-life 24-50 days in unpolluted atmospheres to a few days in polluted atmospheres). It has a low soil partition coefficient and will readily leach where biodegradation, if it occurs, may be very slow. Bioconcentration is not a significant process.
Ecotoxicity: LC_{50} Pimephales promelas (fathead minnow) 81.6 mg/l/96 hr (95% confidence limit not reliable), flow-through bioassay with measured concentrations, 25.2 °C, dissolved oxygen 8.0 mg/l, hardness 45.2 mg/l calcium carbonate, alkalinity 42.7 mg/l calcium carbonate, and pH 7.49
Henry's Law Constant: 8.24×10^{-4}
BCF: fish < 1
Octanol/Water Partition Coefficient: $\log K_{ow} = 2.17$
Soil Sorption Partition Coefficient: $K_{oc} = 83$ to 209

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Reclaim solvent at an approved site.
Evaporate or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Toxic, liquids, organic, n.o.s.
ID: UN2810
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: T14, TP2, TP13, TP27
Packaging: **Exceptions:** None **Non-bulk:** 201 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** B **Other:** 40

Shipping Name and Description: Toxic, liquids, organic, n.o.s.
ID: UN2810
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*

Special Provisions: IB2, T11, TP2, TP13, TP27

Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243

Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L

Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic, liquids, organic, n.o.s.

ID: UN2810

Hazard Class: 6.1 - Poisonous materials

Packing Group: III - Minor Danger

Symbols: G - Technical Name Required

Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*

Special Provisions: IB3, T7, TP1, TP28

Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241

Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L

Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U227 Toxic Waste

CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)

SARA 40 CFR 372.65: Listed

SARA EHS 40 CFR 355: Not listed

TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Issue Date: 2002-02

Trichloroethylene
TRI2710

Section 1 - Chemical Product and Company Identification 54

Material Name: Trichloroethylene **CAS Number:** 79-01-6
Chemical Formula: C_2HCl_3
Structural Chemical Formula: $ClCH=CCl_2$
Synonyms: ACETYLENE TRICHLORIDE; ALGYLEN; ANAMENTH; BENZINOL; BLACOSOLV; BLANCOSOLV; CECOLENE; CHLORILEN; 1-CHLORO-2,2-DICHLOROETHYLENE; CHLORYLEA; CHLORYLEA,CHORYLEN,CIRCOSOLV,CRAWHASPOL,DOW-TRI,DUKERON,PER-A-CLOR,TRIAD,TRIAL,TRI-PLUS M,VITRAN; CHLORYLEN; CHORYLEN; CIRCOSOLV; CRAWHASPOL; DENSINFLUAT; 1,1-DICHLORO-2-CHLOROETHYLENE; DOW-TRI; DUKERON; EPA PESTICIDE CHEMICAL CODE 081202; ETHENE,TRICHLORO-; ETHINYL TRICHLORIDE; ETHYLENE TRICHLORIDE; ETHYLENE,TRICHLORO-; FLECK-FLIP; FLOCK FLIP; FLUATE; GEMALGENE; GERMALGENE; LANADIN; LETHURIN; NARCOGEN; NARKOGEN; NARKOSOID; NIALK; NSC 389; PERM-A-CHLOR; PERM-A-CLOR; PETZINOL; PHILEX; TCE; THRETHYLEN; THRETHYLENE; TRETHYLENE; TRI; TRIAD; TRIAL; TRIASOL; TRICHLOORETHEEN; TRICHLOORETHYLEEN,TRI; TRICHLORAETHEN; TRICHLORAETHYLEN,TRI; TRICHLORAN; TRICHLOREN; TRICHLORETHENE; TRICHLORETHYLENE; TRICHLORETHYLENE,TRI; TRICHLOROETHENE; 1,1,2-TRICHLOROETHYLENE; TRICHLOROETHYLENE; TRICHLOROETHYLENE; 1,2,2-TRICHLOROETHYLENE; TRI-CLENE; TRICLENE; TRICLORETENE; TRICLOROETILENE; TRIELENE; TRIELIN; TRIELINA; TRIELINE; TRIKLONE; TRILEN; TRILENE; TRILINE; TRIMAR; TRIOL; TRI-PLUS; TRI-PLUS M; VESTROL; VITRAN; WESTROSOL
General Use: Mainly used for vapor degreasing; solvent in textile and electronics industries; for adhesives, lubricants and consumer products (such as spot removers and rug cleaners).
Until recently, it was used to make hop extracts for beer, decaffeinated coffee and spice extracts.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
trichloroethylene	79-01-6	> 99

OSHA PEL
TWA: 100 ppm; Ceiling: 200 ppm, 300 ppm, 5-minute maximum peak in any 2 hours.

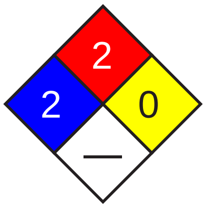
OSHA PEL Vacated 1989 Limits
TWA: 50 ppm; 270 mg/m^3; STEL: 200 ppm; 1080 mg/m^3.

ACGIH TLV
TWA: 50 ppm, 269 mg/m^3; STEL: 100 ppm, 537 mg/m^3.

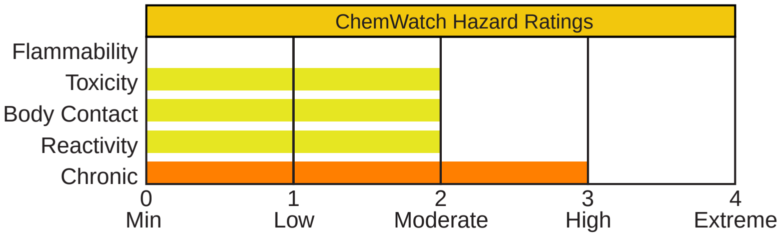
NIOSH REL
No data found.

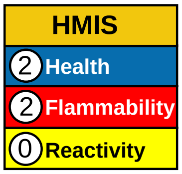
IDLH Level
1000 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Inhalation: irregular heart beat, drunkenness. Chronic: heart, liver and kidney damage, dermatitis. Birth defects and cancer may occur based on animal studies. Flammable.

Potential Health Effects

Target Organs: respiratory system, central nervous system (CNS), peripheral nervous system, cardiovascular system, liver, kidneys, skin

Primary Entry Routes: inhalation, skin contact, eye contact, ingestion (rarely)

Acute Effects

Inhalation: The vapor is mildly discomforting to the upper respiratory tract.

Inhalation hazard is increased at higher temperatures.

Anesthetics and narcotic effects (with dulling of senses and odor fatigue) are a consequence of exposure to chlorinated solvents.

Individual response varies widely; odor may not be considered objectionable at levels which quickly induce central nervous system effects.

High vapor concentrations may give a feeling of euphoria. This may result in reduced responses, followed by rapid onset of unconsciousness, possible respiratory arrest and death.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Evidence of acute human toxicity comes mainly from the use of TCE as an anesthetic, Tachypnea and ventricular arrhythmias are experienced at inhaled concentrations exceeding 15000 ppm. Systemic toxicity is low following anesthesia. Occasional hepatotoxicity (liver dysfunction) has been reported; this is probably due to the breakdown of TCE to dichloroacetylene and phosgene by soda-lime present in some anesthetic devices. The effects of TCE appear to be enhanced in some individuals by simultaneous exposure to caffeine, ethanol and other drugs. "Degreasers Flush" describes a reddening of facial, neck, and back skin and is seen after intake of substantial quantities of ethanol by certain individuals after exposures to TCE.

Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes.

The material may produce moderate eye irritation leading to inflammation.

Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin and may cause drying of the skin, which may lead to dermatitis.

Toxic effects may result from skin absorption.

Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).

This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.

Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Repeated exposures may produce severe ulceration.

Localized application may produce pustular eruptions, pruritus and erythema. A permeability coefficient of 1.6×10^{-2} cm/hr has been calculated by the US EPA. Percutaneous absorption is unlikely to contribute significantly to total body burdens unless dermatitis is present.

Ingestion: The liquid is highly discomforting and toxic if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A5, Not suspected as a human carcinogen; EPA - Not listed; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Sensitive humans may experience anesthetic effects from short exposures.

Chronic effects of exposure include fatigue, headache, irritability, vomiting, skin flush and intolerance to alcohol.

Liver, kidney, heart and neurological damage may also result from chronic overexposure.

Alcohol intake may increase the toxic effects of the material.

A variety of disturbances have been seen among workers exposed at concentrations ranging from 1 to 335 ppm. These disturbances increased with the length of exposure (to 5 years or more) and where more prominent when exposures exceeded 40 ppm. Increased complaints of alcohol intolerance, tremors, giddiness and anxiety were amongst symptoms recorded. Variation in effects in different occupational settings may be due to different physical workloads.

There appeared to be no increase in the expected rates of congenital defects in children born to women exposed to TCE over a 13 year period.

Epidemiological studies consistently fail to show a link between cancers and TCE exposure. This is significant because of the tens of thousands of exposed workers monitored.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Avoid giving milk or oils.
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.
Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.
Following acute or short-term continued exposures to trichloroethylene:
1.Trichloroethylene concentration in expired air correlates with exposure. 8 hours exposure to 100 ppm produces levels of 25 ppm immediately and 1 ppm 16 hours after exposures.
2.Most mild exposure respond to removal from the source and supportive care.
Serious toxicity most often results from hypoxemia or cardiac dysrhythmias so that oxygen, intubation, intravenous lines and cardiac monitoring should be started initially as the clinical situation dictates.
3.Ipecac syrup should be give to alert patients who ingest more than a minor amount and present within 2 hours.
4.The efficacy of activated charcoal and cathartics is unclear.
5.The metabolites, trichloracetic acid, trichlorethanol and to a lesser degree, chloral hydrate, may be detected in the urine up to 16 days postexposure.

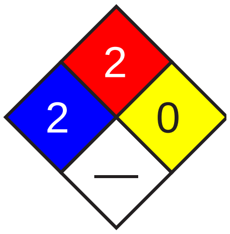
BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Trichloroacetic acid in urine	10 mg/gm creatinine	End of work-week	NS
Trichloroacetic acid AND Trichloroethanol in urine	300 mg/mg creatinine	End of shift at end of work-week	NS
Free Trichloroethanol in blood	4 mg/L	End of shift at end of work-week	NS
Trichloroethylene in end-exhaled air			SQ
Trichloroethylene in blood			SQ

NS: Non-specific determinant; also seen after exposure to other materials
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 32.222 °C Closed Cup

Autoignition Temperature: 420 °C

LEL: 8% v/v

UEL: 10.5% v/v

Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).

Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Vapor will burn when in contact with high temperature flame.

May form a flammable/explosive mixture in an oxygen enriched atmosphere. Heating may cause expansion/vaporization with violent rupture of containers. Decomposes on heating and produces corrosive fumes of hydrochloric acid, carbon monoxide and small amounts of toxic phosgene.

Fire Incompatibility: Avoid reaction with strong oxidizing agents (particularly oxygen in gas or liquid form and nitrogen dioxide), strong bases, sodium and sodium-potassium alloys. Powdered metals; magnesium, zinc and aluminum.

Contact with water may result in the slow formation of hydrochloric acid.

Attacks natural rubber.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

Use water delivered as a fine spray to control fire and cool adjacent area.

Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.

Avoid breathing vapors and contact with skin and eyes.

Control personal contact by using protective equipment.

Contain and absorb spill with sand, earth, inert material or vermiculite.

Wipe up. Place in a suitable labeled container for waste disposal.

Large Spills: Clear area of personnel and move upwind.

Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

Increase ventilation.

No smoking or bare lights within area.

Stop leak if safe to do so.

Contain and absorb spill with sand, earth, inert material or vermiculite.

Collect and seal in labeled drums for disposal.

If contamination of drains or waterways occurs, advise emergency services.

After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.

Wear protective clothing when risk of overexposure occurs.

Use in a well-ventilated area. Prevent concentration in hollows and sumps.

DO NOT enter confined spaces until atmosphere has been checked.

DO NOT allow material to contact humans, exposed food or food utensils.

Avoid smoking, bare lights or ignition sources. When handling, DO NOT eat, drink or smoke. Avoid contact with incompatible materials.

Keep containers securely sealed when not in used. Avoid physical damage to containers. Always wash hands with soap and water after handling. Working clothes should be laundered separately.

Launder contaminated clothing before reuse.

Observe manufacturer's storing/handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Inhibited grades may be stored in metal drums.

DO NOT use aluminum or galvanized containers. Check that containers are clearly labeled and free from leaks.

Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVA gloves. Polyethylene gloves.
Viton gloves.
PVC boots.

Respiratory Protection:
Exposure Range >100 to <1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: odor threshold unknown

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
TEFLON	Best selection
VITON	Satisfactory; may degrade after 4 hours continuous immersion
VITON/NEOPRENE	Poor to dangerous choice for other than short-term immersion
VITON/NITRILE	Poor to dangerous choice for other than short-term immersion
HYPALON	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless liquid with a sweetish, chloroform-like odor, miscible with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 7.87 at 20 °C
Vapor Density (Air=1): 4.54
Formula Weight: 131.38
Specific Gravity (H_2O=1, at 4 °C): 1.47 at 15 °C
Water Solubility: < 1 mg/mL at 21 °C

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 87 °C (189 °F)
Freezing/Melting Point Range: -73 °C (-99.4 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Decomposes in the presence of moisture to produce corrosive acid.
Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with strong oxidizers (particularly oxygen in gas or liquid form and nitrogen dioxide), strong bases, acetone, sodium/sodium-potassium alloys, magnesium, zinc and aluminum.
Avoid contact with water as the slow formation of hydrochloric acid results.
Attacks natural rubber.
Haloalkenes are highly reactive. Some of the more lightly substituted lower members are highly flammable; many members of the group are peroxidizable and polymerizable.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (human) LD_{Lo}: 7000 mg/kg	Skin (rabbit): 500 mg/24h - SEVERE
Oral (man) TD_{Lo}: 2143 mg/kg	Eye (rabbit): 20 mg/24h - SEVERE
Oral (rat) LD_{50}: 5650 mg/kg	
Inhalation (man) LC_{Lo}: 2900 ppm	
Inhalation (human) TD_{Lo}: 812 mg/kg	
Inhalation (human) TC_{Lo}: 6900 mg/m^3/10 m	
Inhalation (man) TC_{Lo}: 2900 ppm	
Inhalation (man) TC_{Lo}: 110 ppm/8h	
Inhalation (man) TC_{Lo}: 160 ppm/83 m	

See NIOSH, *RTECS* KX 4550000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: LC_{50} Sheepshead minnow 20 mg/l/96 hr. /Conditions of bioassay not specified; LC_{50} Mexican axolotl (3-4 wk after hatching) 48 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Clawed toad (3-4 wk after hatching) 45 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnow) 40.7 mg/l/96 hr (95% confidence limits 31.4-71.8 mg/l) /Flow-through test; EC_{10} Pimephales promelas (fathead minnow) 15.2 mg/l/24 hr; 16.9 mg/l/48 hr; 15.5 mg/l/72 hr; 13.7 mg/l/96 hr; Toxic effect for all concentrations specified: loss of equilibrium. /Flow-through bioassay; Toxicity Threshold (Cell Multiplication Inhibition Test) Scenedesmus quadricauda(green algae) >1000 mg/l /Time not specified, conditions of bioassay not specified; Toxicity Threshold (Cell Multiplication Inhibition Test) Pseudomonas putida (bacteria) 65 mg/l ; LC_{50} Grass shrimp 2 mg/l/96 hr. /Conditions of bioassay not specified

Henry's Law Constant: 1×10^{-2}

BCF: bluegill 17 to 39

Biochemical Oxygen Demand (BOD): 0%, 20 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 2.29$

Soil Sorption Partition Coefficient: $K_{oc} = 2.0$

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Reclaim solvent at an approved site.
Evaporate or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1(b)
ID No.: 1710
Packing Group: III
Label: Harmful[6]

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U228 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Vanadium Pentoxide
VAN4420

Section 1 - Chemical Product and Company Identification 54

Material Name: Vanadium Pentoxide **CAS Number:** 1314-62-1
Chemical Formula: O_5V_2
Structural Chemical Formula: V_2O_5
Synonyms: ANHYDRIDE VANADIQUE; C.I. 77938; DIVANADIUM PENTAOXIDE; DIVANADIUM PENTOXIDE; DIVANADIUM PENTOXIDE DUST; VANADIC ACID ANHYDRIDE; VANADIC ANHYDRIDE; VANADIC ANHYDRIDE DUST; VANADIC ANHYDRIDE FUME; VANADIO,PENTOSSIDO DI; VANADIUM (5) OXIDE; VANADIUM OXIDE; VANADIUM OXIDE DUST; VANADIUM OXIDE FUME; VANADIUM PENTAOXIDE; VANADIUM PENTAOXIDE DUST; VANADIUM PENTAOXIDE FUME; VANADIUM PENTOXIDE; VANADIUM PENTOXIDE DUST; VANADIUMPENTOXID; VANADIUMPENTOXYDE; VANADIUM,PENTOXYDE DE; WANADU PIECIOTLENEK
General Use: As a catalyst in oxidation reactions e.g. production of SO_3 for sulfuric acid. For the manufacture of yellow glass; inhibiting ultra-violet light transmission in glass. As a developer in photography. Mordant in textile dyeing.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
vanadium pentoxide	1314-62-1	>98

OSHA PEL
Ceiling: 0.5 mg/m^3; as V_2O_5, respirable.

OSHA PEL Vacated 1989 Limits
TWA: 0.05 mg/m^3; $V^{(2)}O^{(5)}$, respirable. Other Values: mg/m^3, Ceiling, Fume, as $V^{(2)}O^{(5)}$ mg/m^3; 0.05.

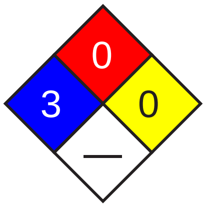
ACGIH TLV
TWA: 0.05 mg/m^3; respirable dust or fume.

NIOSH REL
Ceiling: 0.05 mg/m^3; 15-minute, total dust, as V.

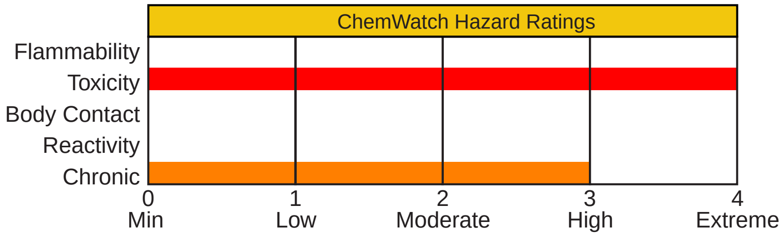
IDLH Level
35 mg/m^3; as V.

DFG (Germany) MAK
TWA: 0.05 mg/m^3; substances with systemic effects, onset of effects within 2 hours, half-life two hours to shift length, measured as respirable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
0 Flammability
0 Reactivity

ANSI Signal Word

Danger!

Poison

Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Yellow to red crystalline powder. Corrosive to eyes/skin/respiratory tract. Poison! Also causes: cough, shortness of breath, chest pain, sore throat, pulmonary edema, asthma, contact dermatitis. Chronic: emphysema and bronchitis may occur.

Potential Health Effects

Target Organs: respiratory system, skin, eyes
Primary Entry Routes: inhalation

Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.

Poisoning by vanadium dust inhalation is common in industry. First symptoms include irritation of the respiratory tract and conjunctivae, fits of dry coughing, rales, acute bronchitis and bronchospasm, nasal catarrh, blood-stained sputum (hemoptysis) and a greenish-black discoloration of the tongue. Systemic symptoms often develop and may include anorexia, anemia, nausea, headache, insomnia, nervousness, dizziness, derangement of kidney function, tremor, psychic disturbance and blindness.

Eye: The dust may be discomforting to the eyes, may be harmful following absorption, may cause lachrymation (tears) and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The dust may be discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.

Ingestion: The material may be mildly discomforting to the gastrointestinal tract and may be fatal if swallowed.

Rats orally poisoned by vanadium salts show immediate distress, with a hemorrhagic exudate from nose, marked diarrhea, paralysis of the hind limbs, labored respiration, convulsions (sometimes with asphyxia) and death. Rats appeared to survive cumulative doses several times larger than the single lethal dose but in all cases the toxic syndromes, mentioned above, developed. Pathology showed congestion of many internal organs with fatty degeneration of liver and kidney and, sometimes, focal hemorrhage in lung and adrenal cortex being prominent.

Vanadium has the same magnitude of toxicity as pentavalent arsenic.

Anionic vanadium is said to be more toxic than the cationic form.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Sensitivity reactions may occur with repeated exposure. These are expressed by increased severity of symptoms.

Vanadium is thought to be an essential trace element with the required level in human nutrition thought to be very low. Feeding trials in humans conducted over 45-94 days (1575-8375 mg of ammonium vanadyl tartrate) produced gastrointestinal distress but no changes in clinical chemistry.

Ingestion of 50 mg/day resulted in transient green discoloration of the tongue. Amongst workers in a vanadium refinery exposed at levels of up to 12 mg/m^3 cases of respiratory irritation and chronic bronchitis have been described. Emphysema and intoxication was found in boiler cleaners (vanadium is found in soot generated in oil-burning facilities) where vanadium exposures ranged from 30-104 mg/m^3. Vanadium exposed workers complain of significantly more wheezing than their matched controls although no differences appear in chest radiography, forced vital capacity (FCV) or FEV1 in workers exposed at levels of 0.1 to 3.9 mg/m^3.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.

Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.

Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.

Quickly remove all contaminated clothing, including footwear.

Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center.

If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.

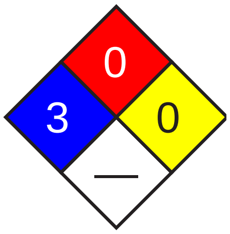
Note: DO NOT INDUCE VOMITING in an unconscious person.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

BAL has no apparent therapeutic benefit in vanadium poisoning but edetate calcium disodium and disodium catechol disulfonate are effective antidotes in animals.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: There is no restriction on the type of extinguisher which may be used.
General Fire Hazards/Hazardous Combustion Products: Noncombustible. Not considered to be a significant fire risk; however, containers may burn.
Fire Incompatibility: Avoid reaction with strong acids.
A mixture of calcium, vanadium oxide, sulfur and moisture can cause a severe fire.
Reacts violently with chlorine trifluoride, producing flame.
Fire-Fighting Instructions: Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent spillage from entering drains or waterways.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Neutralize/decontaminate residue.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid smoking, bare lights or ignition sources. When handling, DO NOT eat, drink or smoke. Avoid contact with incompatible materials.
Keep containers securely sealed when not in used. Avoid physical damage to containers. Always wash hands with soap and water after handling. Working clothes should be laundered separately.
Launder contaminated clothing before reuse.
Observe manufacturer's storing/handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Plastic drum.
Metal drum.
Polyethylene or polypropylene container.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.

Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Rubber gloves; PVC gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >0.5 to 5 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >5 to <35 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range 35 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)

Other: Overalls. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Yellowish-brown odorless powder. Soluble in acids and alkali.
Physical State: Divided solid
Vapor Pressure (kPa): Negligable
Vapor Density (Air=1): Not applicable
Formula Weight: 181.88
Specific Gravity (H_2O=1, at 4 °C): 3.357 at 18 °C
Water Solubility: 1 g/125 ml water
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 1750 °C (3182 °F)
Freezing/Melting Point Range: 690 °C (1274 °F)
Volatile Component (% Vol): Not applicable
Decomposition Temperature (°C): 1750

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Stable under normal storage conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with strong acids, calcium and sulfur.

Section 11 - Toxicological Information

TOXICITY
Oral (rat) LD_{50}: 10 mg/kg
Intraperitoneal (rat) LD_{50}: 12 mg/kg
Subcutaneous (rat) LD_{50}: 14 mg/kg
Oral (mouse) LD_{50}: 23 mg/kg
Subcutaneous (mouse) LD_{50}: 10 mg/kg
Inhalation (human) TC_{Lo}: 1 mg/m^3/8h
Inhalation (human) TC_{Lo}: 346 mg/m^3
Inhalation (rat) TC_{Lo}: 70 mg/m^3/2h

IRRITATION
Nil reported

Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis). Coma, post-implantation mortality, fetolethality, specific developmental abnormalities and effects on the embryo reported.

See NIOSH, *RTECS* YW 2450000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: Aquatic toxicity: 55 ppm/96 hr/fathead minnows/TLm/hard water 13 ppm/96 hr/fathead minnows/TL2m/soft water

BCF: no food chain concentration potential

Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: VANADIUM PENTOXIDE
Hazard Class: 6.1(b)
ID No.: 2862
Packing Group: III
Label: Harmful[6]

Section 15 - Regulatory Information

EPA Regulations:

- **RCRA 40 CFR:** Listed P120
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 1000 lb (453.5 kg)
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 1000 lb
  - **TPQ:** 100/10000 lb
- **TSCA:** Listed

Section 16 - Other Information

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Material Safety Data Sheet Collection
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Issue Date: 2000-07

Vinyl Chloride
MSDS 382
VIN2980

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Vinyl Chloride **CAS Number:** 75-01-4

Chemical Formula: C_2H_3Cl

Structural Chemical Formula: $CH_2{=}CHCl$

Synonyms: CHLORETHENE; CHLORETHYLENE; CHLOROETHENE; CHLOROETHYLENE; CHLORURE DE VINYLE; CLORURO DI VINILE; ETHENE,CHLORO-; ETHYLENE MONOCHLORIDE; ETHYLENE,CHLORO-; MONOCHLOROETHENE; MONOCHLOROETHYLENE; MONOCHOROETHENE; MONOVINYL CHLORIDE (MVC); TROVIDUR; VC; VCM; VINILE (CLORURO DI); VINYL C MONOMER; VINYL CHLORIDE; VINYL CHLORIDE MONOMER; VINYL CHLORIDE MONOMER (VCM); VINYL CHLORIDE,INHIBITED; VINYLCHLORID; VINYLE(CHLORURE DE); WINYLU CHLOREK

General Use: Used in the plastics industry; as a refrigerant; in organic syntheses

Section 2 - Composition / Information on Ingredients

Name	CAS	%
vinyl chloride	75-01-4	>98

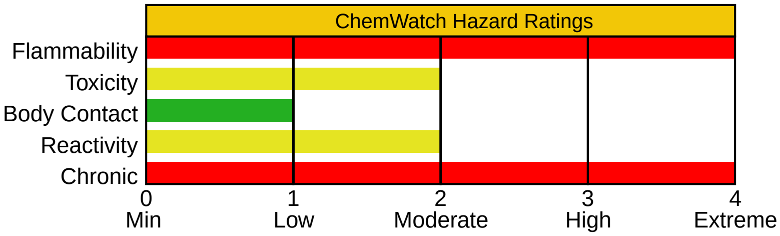
OSHA PEL
No data found.

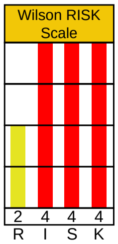
NIOSH REL
No data found.

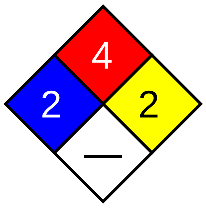
ACGIH TLV
TWA: 5 ppm; 13 mg/m^3.

Section 3 - Hazards Identification

HMIS
3 Health
4 Flammability
2 Reactivity







Fire Diamond

ANSI Signal Word

Danger!

Flammable

Compressed Gas

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas; pleasant ethereal odor. Compressed gas can cause frostbite. Toxic. Also causes: CNS depression. Chronic: reproductive effects, skin/blood changes, arthralgias, bone effects (hand), vascular disorder (fingers/toes). Cancer hazard. Flammable

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact

Target Organs: liver, central nervous system (CNS), respiratory system, lymphatic system, bone, connective tissue of the skin

Acute Effects

Inhalation: The gas is highly discomforting and may be fatal if inhaled.

Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.

Depression of the central nervous system is the most outstanding effect of most halogenated aliphatic hydrocarbons. Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin).

A single 5 minute inhalation exposure of 8000-25000 ppm caused nausea, headache and dizziness among volunteers. After cessation of exposure only 3-5% of the parent compound was exhaled unchanged. Metabolism by microsomal cytochrome P-450 results in the production of chloroethylene oxide and 2-chloroacetaldehyde and subsequent urinary elimination as thiodiglycolic acid. Half-life is 4-5 hours.

Vinyl chloride and related vinyl monomers possess narcotic action and produce depending upon concentration, characteristic neurological effects, a state of euphoria, followed by a state of inebriation, similar to ethanol intoxication.

Exposure of mice, rats and guinea pigs at 100,000-300,000 ppm caused concentration-dependent mortality. Pulmonary edema, inflammation, hyperemia, congestion and engorgement were recorded - liver and kidney involvement was surprisingly low. Deaths were due to central arrest in narcosis.

Eye: The vapor is discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The vapor is mildly discomforting to the skin.

Toxic effects may result from skin absorption.

Vinyl chloride acts upon the skin and produces a sensation of heat.

Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.

Ingestion: Not normally a hazard due to physical form of product.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Listed; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Repeated exposure of laboratory animals to vinyl chloride produced little liver or kidney damage. Repeated exposures produce neurological effects in man with somnolence prominent. Dyspeptic disturbances include epigastric pain, swelling, discomfort, heaviness in the right hypochondrium and anorexia. Congestive hepatomegaly may mimic toxic hepatitis without jaundice. Some case become chronic. Allergic dermatitis and schleroderma and Raynaud's syndrome have been observed. Repeated exposure of workers has caused increased liver enzyme concentrations, restricted blood flow, bone degeneration in the fingers, liver and spleen enlargement, nervous system disturbance, CNS depression, decreased respiratory function and emphysema.

A dose-dependent relationship between exposure and the incidence of several tumor types has been established. Exposures to high concentrations have little additional effect because the action of metabolites is responsible for the carcinogenicity rather than the action of the parent molecule. Formation rates of the metabolites are limited and dose-dependent and once the enzyme systems responsible for vinyl chloride activation are saturated, greater doses do not produce a corresponding increase in tumor incidence. Reports of hepatic angiosarcoma and respiratory cancers in vinyl chloride workers have appeared over many years. Cancers of the respiratory system (primarily angiosarcoma), brain as well as lymphomas occur more often than might be expected among men occupationally exposed to vinyl chloride for at least one year.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.

Quickly remove all contaminated clothing, including footwear.

Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

In case of cold burns (frostbite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing if possible and without rubbing.

Do not apply hot water or radiant heat. Apply a clean, dry dressing.

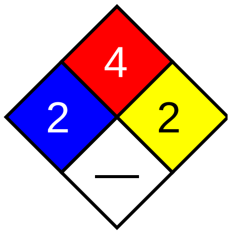
Transport to hospital or doctor.

Ingestion: Not normally a hazard due to physical form of product. DO NOT delay. Immediately transport to hospital or doctor.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically. Do not give adrenalin (epinephrine) or related drugs.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: -78 °C Open Cup
Autoignition Temperature: 472 °C
LEL: 3.6% v/v
UEL: 33% v/v
Extinguishing Media: Dry chemical powder. DANGER: Deliver media remotely.
For minor fires: Flooding quantities only.
For large fires: Do not attempt to extinguish.
General Fire Hazards/Hazardous Combustion Products: WARNING: Long standing in contact with air and light may result in the formation of potentially explosive peroxides.
Liquid and vapor are highly flammable.
Dangerous hazard when exposed to heat or flame.
Severe vapor explosion hazard, when exposed to flame or spark.
Heating may cause expansion or decomposition leading to violent rupture of containers.
Decomposition may produce toxic fumes of hydrogen chloride.
Fire Incompatibility: Avoid reaction with copper, aluminum, oxidizing agents and certain catalytic impurities.
Explosion hazard may follow contact with incompatible materials. Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Fight fire from a safe distance, with adequate cover.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Consider evacuation.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
If safe to do so, stop flow of gas.
Do not approach cylinders suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
Use water delivered as a fine spray to control the fire and cool adjacent area.
Given its high vapor density spilled vinyl chloride is slow to disperse and will collect in low lying areas.

Section 6 - Accidental Release Measures

Small Spills: Erect warning notices and seal off area.
1. Avoid breathing vapor and any contact with liquid or gas. Protective equipment including respirator should be used.
2. Do NOT enter confined spaces were gas may have accumulated.
3. Shut of all sources of possible ignition and increase ventilation.
4. Clear area of personnel.
5. Stop leak only if safe to so do.
6. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve.
7. Keep area clear of personnel until gas has dispersed.

Large Spills: Supply maximum air ventilation (explosion proof equipment) to keep concentration well below lower flammability limit.
1. Clear area of all unprotected personnel and move upwind.
2. Contact fire department and advise them of the location and nature of hazard.
3. May be violently or explosively reactive.
4. Wear full body clothing with breathing apparatus.
5. Consider evacuation.
6. Shut off all possible sources of ignition and increase ventilation.
7. No smoking or bare lights within area.
8. Use extreme caution to prevent violent reaction.
9. Stop leak only if safe to so do.
10. Water spray or fog may be used to disperse vapor.
11. Do NOT enter confined space where gas may have collected.
12. Keep area clear until gas has dispersed.

When leaking containers have been removed or leak has been stopped, hose spill area down with copious quantities of water. Allow any liquid to evaporate prior to wash down.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Used in closed pressurized systems, fitted with safety relief valve.
Vented gas is flammable, denser than air and will spread. Vent path must not contain ignition sources, pilot lights, bare flames.
Atmospheres must be tested and O.K. before work resumes after leakage.

Obtain a work permit before attempting any repairs.
Do not attempt repair work on lines, vessels under pressure.
Handle and open container with care.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
DO NOT transfer gas from one cylinder to another.

Recommended Storage Methods: Check that containers are clearly labeled.
Cylinder fitted with valve protector cap.
Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Cylinder valve must be closed when not in use or when empty.
Cylinder must be properly secured either in use or in storage.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.
Aerosol pack.
Vacuum insulated container.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Fans and electrical equipment must be explosion-proof to meet TLV requirements. Approved respirators must be available for non-routine and emergency situations.
Areas where gas cylinders are stored/used require discrete, controlled exhaust ventilation.
Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment

Eyes: Close fitting gas tight goggles and DO NOT wear contact lenses.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Neoprene rubber gloves.

Respiratory Protection:
Exposure Range >1 to 50 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range >50 to 1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties

Other: Protective overalls, closely fitted at neck and wrist. Eye-wash unit.
IN CONFINED SPACES:
1. Non-sparking protective boots
2. Static-free clothing.

Glove Selection Index:

VITON	A
NITRILE	B

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: A colorless poisonous gas at ambient temperature, with a mild sweet odor in high concentrations. It liquefies readily under increased pressure or at reduced temperatures. Soluble in alcohol, ether, carbon tetrachloride and benzene.

Physical State: Liquefied gas
Vapor Pressure (kPa): 343.5 at 20 °C
Vapor Density (Air=1): 2.2
Formula Weight: 62.5
Specific Gravity (H_2O=1, at 4 °C): 0.912 at 20 °C
Water Solubility: Slightly soluble
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: -13.37 °C (8 °F)
Freezing/Melting Point Range: -153.8 °C (-244.84 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Presence of heat source and direct sunlight (ultra-violet radiation).
Presence of elevated temperatures.
Presence of an ignition source.
Storage in unsealed containers.
Stable under normal storage conditions. Polymerization may occur at elevated temperatures and in the presence of ignition sources.

Storage Incompatibilities: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Avoid peroxides, copper and copper alloys and plastics.
Haloalkenes are highly reactive. Some of the more lightly substituted lower members are highly flammable; many members of the group are peroxidizable and polymerizable.
If peroxidation occurs, vinyl chloride tends to self-polymerize violently and this has resulted in several industrial accidents.
Accidental exposure of the recovered monomer to atmospheric oxygen for a long period resulted in the formation of an unstable polyperoxide which initiated explosion. A 20-30% aqueous solution has been used to destroy the peroxide.
An explosion in a valve in a liquid monomer line appears to have been caused by traces of nitrogen oxides remaining after passivation of the line by nitric acid.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 500mg/kg	Nil reported
Oral (rat) TD_{Lo}: 3463mg/kg/52w	
Inhalation (rat) TC_{Lo}: 1ppm/4h/52w	
Inhalation (man) TC_{Lo}: 200ppm/14y	

Tumors of the sense organs, vascular system, respiratory system, gastrointestinal system, skin and liver, lymphoma, paternal effects, effects on fertility, fetotoxicity, specific developmental abnormalities involving the musculoskeletal system recorded.

See NIOSH, *RTECS* YZ 3200000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be subject to rapid volatilization with reported half-lives of 0.2 and 0.5 days for evaporation from soil at 1 and 10 cm incorporation, respectively. Any which does not evaporate will be expected to be highly to very highly mobile in soil and it may leach to the groundwater. It may be subject to biodegradation under anaerobic conditions such as exists in flooded soil and groundwater. If released to water, it will not be expected to hydrolyze, to bioconcentrate in aquatic organisms or to adsorb to sediments. It will be subject to rapid volatilization with an estimated half-life of 0.805 hr for evaporation from a river 1 m deep with a current of 3 m/sec and a wind velocity of 3 m/sec. In waters containing photosensitizers such as humic acid, photodegradation will occur fairly rapidly. Limited existing data indicate that it is resistant to biodegradation in aerobic systems and therefore, it may not be subject to biodegradation in aerobic soils and natural waters. It will not be expected to hydrolyze in soils or natural waters under normal environmental conditions. If released to the atmosphere, it can be expected to exist mainly in the vapor-phase in the ambient atmosphere and to degrade rapidly in air by gas-phase reaction with photochemically produced hydroxyl radicals with an estimated half-life of 1.5 days.
Ecotoxicity: No data found.
Henry's Law Constant: 0.0560
BCF: estimated at 7
Biochemical Oxygen Demand (BOD): none
Octanol/Water Partition Coefficient: log K_{ow} = calculated at 0.6
Soil Sorption Partition Coefficient: K_{oc} = estimated at 56

Section 13 - Disposal Considerations

Disposal: The gas should be burned in a high temperature furnace equipped with an afterburner and scrubber to remove HCl formed.
Follow applicable federal, state, and local regulations.
Return all damaged and empty cylinders and containers to the supplier.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: VINYL CHLORIDE, INHIBITED OR STABILISED
Hazard Class: 2.1
ID No.: 1086
Packing Group: None
Label: Flammable Gas[2]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U043 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001; per CWA Section 307(a); per CAA Section 112 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date:.............................1999-11 **Review Date:** 2000-07

Section 1 - Chemical Product and Company Identification 54

Material Name: Vinylidene Chloride **CAS Number:** 75-35-4
Chemical Formula: $C_2H_2Cl_2$
Structural Chemical Formula: $H_2C{=}CCl_2$
Synonyms: 1,1-DICHLOROETHYLENE; ASYM-DICHLOROETHYLENE; CHLORURE DE VINYLIDENE; 1,1-DCE; 1,1-DICHLOROETHENE; 1,1-DICHLOROETHENE (9CI); AS-DICHLOROETHYLENE; ETHENE,1,1-DICHLORO-; ETHYLENE,1,1-DICHLORO-; SCONATEX; VDC; VINYLIDENE CHLORIDE; VINYLIDENE CHLORIDE (II); VINYLIDENE CHLORIDE (INHIBITED); VINYLIDENE CHLORIDE MONOMER; VINYLIDENE CHLORIDE(II); VINYLIDENE CHLORIDE,INHIBITED; VINYLIDENE CHLORIDE,MONOMER; VINYLIDENE DICHLORIDE; VINYLIDINE CHLORIDE
General Use: Reactive monomer in manufacture of vinylidene polymer plastics and copolymers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
vinylidene chloride	75-35-4	>98

OSHA PEL
No data found.

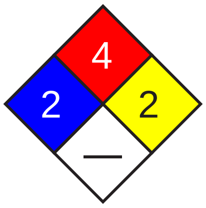
OSHA PEL Vacated 1989 Limits
TWA: 1 ppm; 4 mg/m^3.

ACGIH TLV
TWA: 5 ppm, 20 mg/m^3.

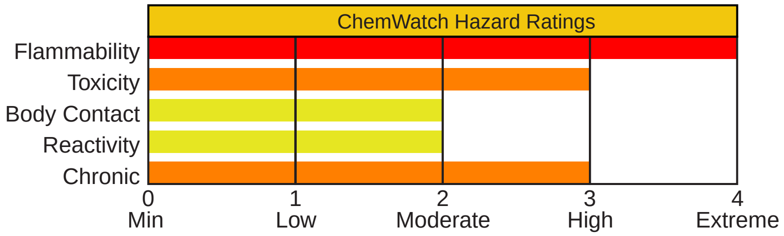
NIOSH REL
No data found.

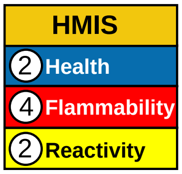
DFG (Germany) MAK
TWA: 2 ppm, 8 mg/m^3; PEAK: 4 ppm, 16 mg/m^3; ceiling, substances with systemic effects, onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating. Also causes: narcosis, drunkenness, unconsciousness, conjunctivitis, transient corneal injury, iritis. Chronic: hepatic/renal dysfunction. Flammable. Combustion by-products include phosgene and hydrogen chloride.

Potential Health Effects

Target Organs: skin, eyes, central nervous system (CNS), liver, kidneys
Primary Entry Routes: inhalation
Acute Effects
Inhalation: Depression of the central nervous system is the most outstanding effect of most halogenated aliphatic hydrocarbons. Inebriation and excitation, passing into narcosis, is a typical reaction. In severe acute exposures there is always a danger of death from respiratory failure or cardiac arrest due to a tendency to make the heart more susceptible to catecholamines (adrenalin).
Vapor concentrations of 400 ppm are said to induce symptoms of drunkenness leading to unconsciousness.
Extensive hemorrhagic centrolobular liver necrosis was seen in rats 6 hours after a 4-hour exposure to 200 ppm.
Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor when concentrated has pronounced eye irritation; this gives some warning of high vapor concentrations. If eye irritation occurs seek to reduce exposure with available control measures, or evacuate area.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting to the gastrointestinal tract and toxic if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

A single oral dose of 500 mg/kg elicited extensive liver enzyme changes.

Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident, a single organ alone is (almost) never involved.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class C, Possible human carcinogen; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: The material may accumulate in the human body and progressively cause tissue damage.

Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Vinylidene chloride is toxic to the liver and kidneys. After exposure to 48 ppm continuously for 90 days, liver damage was evident in rats and deaths occurred among monkeys and guinea pigs. In this study only rats showed evidence of renal (kidney) tubular injury.

It is proposed that vinylidene chloride may undergo microsomal oxidation to produce oxiranes. These are highly reactive and covalently bind to nucleic acids producing mutations and possibly cancers. The monohalogenated alkenes are thought be more carcinogenic than their dihalogenated counterparts.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

Avoid giving milk or oils.

Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treatment that is employed in carbon tetrachloride exposures follows:

1.Acute exposures to carbon tetrachloride present, initially, with CNS depression followed by hepatic and renal disfunction.

2.Respiratory depression and cardiac dysrhythmias are an immediate threat to life.

3.Since a major fraction of absorbed carbon tetrachloride is exhaled in first hour, good tidal volumes should be maintained in severely poisoned patients; hyperventilation may be an additional therapeutic modality.

4.Ipecac syrup, lavage, activated charcoal or catharsis may all be used in the first 4 hours.

5.Since reactive metabolites may cause hepatorenal toxicity, administration of N-acetyl-L-cysteine may reduce complications.

Experience with this therapy is limited.

Section 5 - Fire-Fighting Measures

Flash Point: -16.111 °C Open Cup

Autoignition Temperature: 570 °C

LEL: 7.3% v/v

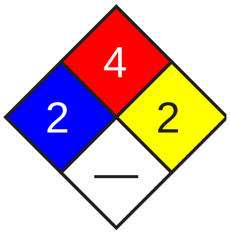
UEL: 16% v/v

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.

Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.

Severe fire hazard when exposed to heat, flame and/or oxidizers.



Fire Diamond

Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include hydrogen chloride and phosgene.

Fire Incompatibility: Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous. Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Polymerization may occur at elevated temperatures.
Polymerization may be accompanied by generation of heat as exotherm.
Process is self accelerating as heating causes more rapid polymerization.
Exotherm may cause boiling with generation of acrid, toxic and flammable vapor.
Polymerization and exotherm may be violent if contamination with strong acids, amines or catalysts occurs.
Polymerization and exotherm of material in bulk may be uncontrollable and result in rupture of storage tanks.
Polymerization may occur if stabilizing inhibitor becomes depleted by aging.
Stabilizing inhibitor requires dissolved oxygen to be present in liquid for effective action.
Specific storage requirements must be met for stability on ageing and transport.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Material contains a stabilizer / polymerization inhibitor system that provides workable but not indefinite shelf life.
Storage at higher temperatures and long term storage may result in polymerization with solidification. In larger quantities e.g. 200 l drums this may result in generation of heat (exotherm); which may release highly irritating hot vapor. Do not open hot exotherming drums - cool externally with water to avoid vapor release.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.

DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
DO NOT use aluminum or galvanized containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream and Butyl rubber gloves or Nitrile rubber gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >5 to 250 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range >250 to 5000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >5000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties

Other: Overalls. Eyewash unit.

Glove Selection Index:

PVA	Best selection
VITON	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless highly flammable liquid with pleasant chloroform-like odor. Soluble in organic solvents. Presence of a stabilizing inhibitor prevents / retards peroxide formation.

Physical State: Liquid
Vapor Density (Air=1): >1
Formula Weight: 96.94
Specific Gravity (H_2O=1, at 4 °C): 1.2129
Water Solubility: 0.04% by weight
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point Range: 31.7 °C (89 °F) at 760 mm Hg
Freezing/Melting Point Range: -122.5 °C (-188.5 °F)

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: May form explosive peroxides on standing or following concentration by distillation.
Review of stocks and testing for peroxide content by given tested procedures at 3-monthly intervals is recommended, together with safe disposal of peroxidic samples.
Peroxide containing residues can often be rendered innocuous by pouring into an excess of sodium carbonate solution.
Presence of a stabilizing inhibitor prevents/retards peroxide formation.
Stable under controlled storage conditions provided material contains adequate stabilizer/polymerization inhibitor.
Bulk storages may have special storage requirements.
In absence of inhibitor and in the presence of air, vinylidene chloride rapidly absorbs oxygen with formation of a violently explosive peroxide.
Peroxides initiate vinylidene chloride polymerization, producing insoluble polymer which absorbs peroxide. This results in separated polymer with concentrate of peroxide. In the dry state and 15% or more peroxide present this is readily detonated by heat or shock.
Hindered phenols are suitable inhibitors to prevent peroxidation.

Storage Incompatibilities: WARNING: Long standing in contact with air and light may result in the formation of potentially explosive peroxides.
Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous.

Explosion hazard may follow contact with incompatible materials.
Contamination with polymerization catalysts - peroxides, persulfates, oxidizing agents - also strong acids, strong alkalies, will cause polymerization with exotherm - generation of heat. Polymerization of large quantities may be violent - even explosive.
Light or water tend to promote self-polymerization.
Haloalkenes are highly reactive. Some of the more lightly substituted lower members are highly flammable; many members of the group are peroxidizable and polymerizable.
When stored at between -40 and 25 C in the absence of an inhibitor and in the presence of air, vinylidene chloride rapidly absorbs oxygen with the formation of a violently explosive peroxide. This peroxide initiates polymerization to produce an insoluble polymer which adsorbs the peroxide. Separation of the polymer in the dry state must be avoided since if more than 15% of the peroxide is present, the polymer may be detonatable by slight shock or friction.
Hindered phenols have been used to prevent peroxidation. Reaction products with ozone are particularly dangerous.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 200 mg/kg	Nil reported
Inhalation (human) TC_{Lo}: 25 ppm	
Inhalation (rat) LC_{50}: 6350 ppm/4 hr	

See NIOSH, *RTECS* KV 9275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Once in the atmosphere it will degrade rapidly by photooxidation with a half-life of 11 hours in relatively clean air or under 2 hours in polluted air. If spilled on land, part will evaporate and part will leach into the groundwater where its fate is unknown, but degradation is expected to be slow based upon microcosm studies. It would not be expected to bioconcentrate into fish.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) 249 mg/l/24 hr, 48 hr, 72 hr, 96 hr in a static bioassay using sea water; EC_{50} Skeletonema costatum (alga) > 712,000 ug/l/96 hr, Toxic effects: Inhibition chlorophyll synthesis; reduced cell counts. /Conditions of bioassay not specified; LC_{50} Lepomis macrochirus (bluegill) 74 mg/l at 24 hr & 96 hr, temp at 21-23 °C, water hardness 32-48 mg/l (calcium carbonate), pH 6.7-7.8, dissolved oxygen concentration 7.0-8.8 mg/l (static bioassay); LC_{50} Mysidopsis bahia (mysid shrimp) > 798 mg/l/24 hr, 48 hr, 72 hr; 224 mg/l/96 hr in a static bioassay using seawater; LC_{50} Menidia beryllina (inland silverside) 250 ppm/96 hr in a static bioassay in synthetic seawater at 23 °C with mild aeration

Henry's Law Constant: 2.61×10^{-2}

BCF: not significant

Octanol/Water Partition Coefficient: $\log K_{ow} = 1.48$

Soil Sorption Partition Coefficient: K_{oc} = estimated at 150

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: VINYLIDENE CHLORIDE, INHIBITED
Hazard Class: 3.1
ID No.: 1303
Packing Group: I
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U078 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium Publishing Corp.
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Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2000-07

Xylene
MSDS 318
XYL2260

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Xylene **CAS Number:** 1330-20-7

Chemical Formula: C_8H_{10}

Structural Chemical Formula: $C_6H_4(CH_3)_2$

Synonyms: BENZENE,DIMETHYL-; COMPONENT 1 (83%): XYLENES; COMPONENT 2 (17%): ETHYL BENZENE; DIMETHYLBENZENE; DIMETHYLBENZENES; EPA PESTICIDE CHEMICAL CODE 086802; KSYLEN; METHYL TOLUENE; METHYLTOLUENE; VIOLET 3; XILOLI; XYLENE; XYLENEN; XYLOL; XYLOLE

General Use: A strong solvent for general use in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
xylene	1330-20-7	> 95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

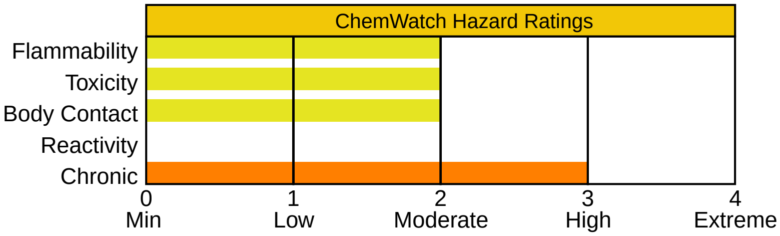
NIOSH REL
TWA: 100 ppm; 435 mg/m^3.
STEL: 150 ppm; 655 mg/m^3.

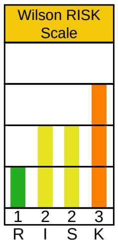
DFG (Germany) MAK
TWA: 100 ppm; 440 mg/m^3.

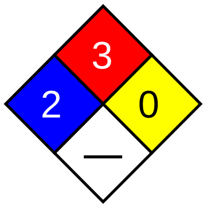
ACGIH TLV
TWA: 100 ppm; 434 mg/m^3;
STEL: 150 ppm; 651 mg/m^3.

Section 3 - Hazards Identification

HMIS
2 Health
3 Flammability
0 Reactivity







Fire Diamond

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to the eyes/skin/respiratory tract. Also causes: dizziness, nausea, and drowsiness. Chronic: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects based on animal data. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin

Acute Effects

Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.

Inhalation hazard is increased at higher temperatures.

Toxic effects are increased by consumption of alcohol.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.

Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is highly discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Small excess risks of spontaneous abortion and congenital malformation was reported amongst women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.

Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

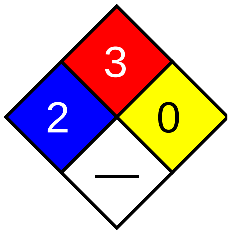
Note to Physicians: For acute or short-term repeated exposures to xylene:

1.Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended. The use of charcoal and cathartics is equivocal.
2.Pulmonary absorption is rapid with about 60-65% retained at rest.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 25.6 °C
Autoignition Temperature: 241 °C
LEL: 1.0% v/v
UEL: 7.0% v/v
Extinguishing Media: Alcohol stable foam; dry chemical powder; carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.

Use only spark-free shovels and explosion proof equipment.

Collect recoverable product into labeled containers for recycling.

Absorb remaining product with sand, earth or vermiculite.

Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.

Wear protective clothing when risk of overexposure occurs.

Use in a well-ventilated area. Prevent concentration in hollows and sumps.

DO NOT enter confined spaces until atmosphere has been checked.

Avoid smoking, bare lights or ignition sources.

Avoid generation of static electricity. DO NOT use plastic buckets.

Ground all lines and equipment. Use spark-free tools when handling.

Avoid contact with incompatible materials.

When handling, DO NOT eat, drink or smoke.

Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.

Work clothes should be laundered separately.

Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.

Check all containers are clearly labeled and free from leaks.

Plastic containers may only be used if approved for flammable liquids.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.

CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.

General exhaust is adequate under normal operating conditions.

Local exhaust ventilation may be required in specific circumstances.

If risk of overexposure exists, wear NIOSH-approved respirator.

Correct fit is essential to obtain adequate protection.

Provide adequate ventilation in warehouse or closed storage areas.

In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.

Safety footwear.

Do NOT use this product to clean the skin.

Other: Overalls. Impervious protective clothing.

Eyewash unit.

Ensure there is ready access to an emergency shower.

Glove Selection Index:

PE/EVAL/PE	A
PVA	A
VITON	A
TEFLON	A
PVDC/PE/PVDC	C
NATURAL+NEOPRENE	C
NEOPRENE/NATURAL	C
NITRILE+PVC	C
HYPALON	C
NAT+NEOPR+NITRILE	C
BUTYL	C
BUTYL/NEOPRENE	C
NITRILE	C
NEOPRENE	C

A: Best selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to dangerous choice for other than short-term immersion

PVC..C

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear colorless flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Water Solubility: Practically insoluble in water
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable

pH (1% Solution): Not applicable.
Boiling Point Range: 137 °C (279 °F) to 140 °C (284 °F)
Freezing/Melting Point Range: -47 °C (-53 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Unless otherwise specified data extracted from RTECS - Registry of Toxic Effects of Chemical Substances

TOXICITY
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 4300 mg/kg
Inhalation (human) TC_{Lo}: 200 ppm
Inhalation (man) LC_{Lo}: 10000 ppm/6h
Inhalation (rat) LC_{50}: 5000 ppm/4h
Reproductive effector in rats

IRRITATION
Skin (rabbit):500 mg/24h moderate
Eye (human): 200 ppm irritant
Eye (rabbit): 87 mg mild
Eye (rabbit): 5 mg/24h SEVERE

See NIOSH, *RTECS* ZE 2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most of the xylenes are released into the atmosphere where they may photochemically degrade by reaction with hydroxyl radicals (half-life 1-18 hr). The dominant removal process in water is volatilization. Xylenes are moderately mobile in soil and may leach into groundwater where they are known to persist for several years, despite some evidence that they biodegrade in both soil and groundwater. Bioconcentration is not expected to be significant.
Ecotoxicity: LC_{50} Rainbow trout 13.5 mg/l/96 hr /Conditions of bioassay not specified; LD_{50} Goldfish 13 mg/l/24 hr /Conditions of bioassay not specified
Henry's Law Constant: 0.22
BCF: estimated at 2.14 to 2.20
Octanol/Water Partition Coefficient: log K_{ow} = 3.12 to 3.20
Soil Sorption Partition Coefficient: K_{oc} = 48 to 68

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: XYLENES
Hazard Class: 3.2
ID No.: 1307
Packing Group: III
Label: Flammable Liquid[3]

Additional Shipping Information: XYLOLS

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U239 Toxic Waste; Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per RCRA Section 3001 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Research Date: ....1999-11 **Review Date:** 2000-07

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Material Safety Data Sheet Collection
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Issue Date: 2006-06

2,4-Xylenol
DIM7200

Section 1 - Chemical Product and Company Identification 61

Material Name: 2,4-Xylenol **CAS Number:** 105-67-9
Chemical Formula: $C_8H_{10}O$
Structural Chemical Formula: $(CH_3)_2C_6H_3OH$
EINECS Number: 203-321-6
ACX Number: X1001858-1
Synonyms: BACTICIN; BENZENE,2,4-DIMETHYL-1-HYDROXY-; BULK LYSOL BRAND DISINFECTANT; 2,4-DIMETHYLPHENOL; 4,6-DIMETHYLPHENOL; 2,4-DMP; DU COR CONCENTRATED FLY INSECTICIDE; EPA PESTICIDE CHEMICAL CODE 086804; GABLE-TITE DAR CREOSOTE (CREOLA); GABLE-TITE LIGHT CREOSOTE (CREOLA); GALLEX; 1-HYDROXY-2,4-DIMETHYLBENZENE; 4-HYDROXY-1,3-DIMETHYLBENZENE; 4-HYDROXY-M-XYLENE; LYSOL BRAND DISINFECTANT; PHENOL,2,4-DIMETHYL-; 2,4-XYLENOL; AS-M-XYLENOL; ASYM-O-XYLENOL; M-4-XYLENOL; M-XYLENOL
General Use: Used for preparation of coal tar disinfectants, solvents, pharmaceuticals, insecticides and fungicides, plasticizers, rubber chemicals, additives to lubricants and petrol, wetting agents, dyestuffs.

Section 2 - Composition / Information on Ingredients

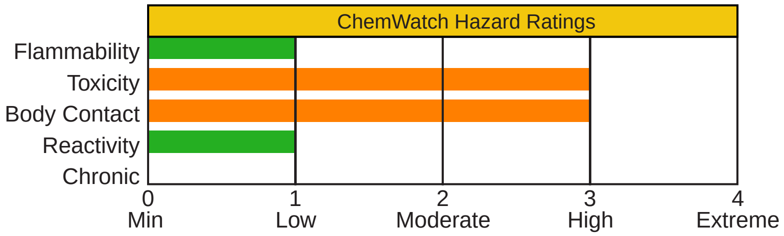
Name	CAS	%
2,4-xylenol	105-67-9	>99

OSHA PEL

NIOSH REL

ACGIH TLV

Section 3 - Hazards Identification



ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White crystalline solid or liquid; sweet tarry odor. Severely irritating. Toxic by all routes. Other Acute Effects: cardiovascular/CNS effects; thirst, sweating, nausea, diarrhea, cyanosis. Chronic Effects: liver/kidney damage. Will burn.

Potential Health Effects

Target Organs: Skin, eyes, respiratory tract, central nervous system (CNS), cardiovascular system, heart, kidneys
Primary Entry Routes: accidental skin and eye contact and by inhalation of vapors especially at higher temperatures
Acute Effects
Inhalation: The material is harmful and discomforting to the upper respiratory tract.
Pulmonary absorption may lead to systemic toxicity affecting the cardiovascular and central nervous systems. Inhalation of phenol and some of its derivatives may produce profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis, hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema with pneumonia. Respiratory failure and kidney damage may follow. Phenols may exhibit local anesthetic properties and, in general, are central nervous system depressants at high concentrations.

The dihydroxy derivatives act as simple phenols but their effects are largely limited to local irritation. Trihydroxy derivatives may reduce the oxygen content of blood at sufficient exposure levels. Methyl phenols (cresols) typically do not pose significant inhalation hazards due to relatively low vapor pressures and objectionable odors. Substituted phenols produce similar effects to phenol although such effects may only be evident at high levels of exposure. Alkyl substitution tends to increase toxicity.

Eye: The material is highly discomforting to the eyes and may be capable of causing burns.

Some phenol derivatives may produce mild to severe eye irritation with redness, pain and blurred vision. Permanent eye injury may occur; recovery may also be complete or partial.

Skin: The material is highly discomforting to the skin, is rapidly absorbed and may be capable of causing burns.

Toxic effects may result from skin absorption.

Toxicology is identical in most respects to phenol exposures.

Evidence exists that oral effects are less severe than when the substance is introduced through dermal wounds, body cavities or even unbroken skin.

Irrespective of the route of exposure there is no doubt that the major hazard stems from systemic effects. Although the onset of poisoning is amazingly abrupt, the dangerous phase of intoxication is usually complete within 24 hours.

Phenol and some of its derivatives may produce mild to severe skin irritation on repeated or prolonged contact, producing second and third degree chemical burns. Rapid cutaneous absorption may lead to systemic toxicity affecting the cardiovascular and central nervous system.

Absorption through the skin may result in profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis (following the formation of methemoglobin), hyperactivity, stupor, falling blood pressure, hyperpnea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema followed by pneumonia. Respiratory failure and kidney damage may follow.

Ingestion: The material is toxic if swallowed and may be corrosive and capable of causing burns.

Considered an unlikely route of entry in commercial/industrial environments.

Some phenol derivatives may produce mild to severe damage within the gastrointestinal tract. Absorption may result in profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis (following the formation of methemoglobin), hyperactivity, stupor, falling blood pressure, hyperpnea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema followed by pneumonia. Respiratory failure and kidney damage may follow.

Severe phenol ingestions cause hypotension, coma, ventricular dysrhythmias, seizures and white coagulative chemical burns.

Phenol does not uncouple oxidative phosphorylation like dinitrophenol and pentachlorophenol and thus does not cause a heat exhaustion-like syndrome.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic exposure to low doses may result in liver and kidney damage.

Prolonged exposure to some derivatives of phenol may produce dermatitis, anorexia, weight loss, weakness, muscle aches and pain, liver damage, dark urine, skin eruptions, diarrhea, nervous disorders with headache, salivation, fainting, increased skin and scleral pigmentation, vertigo and mental disorders.

Section 4 - First Aid Measures

See
DOT
ERG

Inhalation: • If fumes or combustion products are inhaled, remove to fresh air.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- If breathing is shallow or has stopped, ensure clear airway and apply resuscitation, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital or doctor.

Eye Contact: If this product comes in contact with the eyes:
- Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: If spilled on skin:
- Remove contaminated clothing, swab repeatedly with glycerin, PEG (polyethylene glycol), or PEG/methylated spirit mixture or if necessary with methylated spirit alone.
- Contamination of skin with phenol and some of its derivatives may produce rapid collapse and death.
- After skin contamination, keep patient under observation for at least 24-48 hours.
- Phenol-decontaminating fluid is more effective than water in removing phenol from the skin and retarding absorption; olive oil or vegetable oil may also be used; do not use mineral oil.
- Alcohols (methylated spirit, for example) may enhance absorption and their use alone may be ill-advised; some authorities however continue to advise the use of such treatment.
- Rapid water dilution of phenol burns may increase systemic absorption by decreasing the extent of the coagulum

and thus allowing greater absorption.

Ingestion: Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to phenols/cresols:

- Phenol is absorbed rapidly through lungs and skin. Massive skin contact may result in collapse and death.
- Ingestion may result in ulceration of upper respiratory tract; perforation of esophagus and/or stomach, with attendant complications, may occur. Esophageal stricture may occur.
- An initial excitory phase may present. Convulsions may appear as long as 18 hours after ingestion. Hypotension and ventricular tachycardia that require vasopressor and antiarrhythmic therapy, respectively, can occur.
- Respiratory arrest, ventricular dysrhythmias, seizures and metabolic acidosis may complicate severe phenol exposures so the initial attention should be directed towards stabilization of breathing and circulation with ventilation, intubation, intravenous lines, fluids and cardiac monitoring as indicated.
- Vegetable oils retard absorption; do not use paraffin oils or alcohols. Gastric lavage, with endotracheal intubation, should be repeated until phenol odor is no longer detectable; follow with vegetable oil. A saline cathartic should then be given. Alternatively: Activated charcoal (1g/kg) may be given. A cathartic should be given after oral activated charcoal.
- Severe poisoning may require slow intravenous injection of methylene blue to treat methemoglobinemia.
- Renal failure may require hemodialysis.
- Most absorbed phenol is biotransformed by the liver to ethereal and glucoronide sulfates and is eliminated almost completely after 24 hours.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
• Total phenol in blood creatinine	250 mg/g	End of shift	B, NS

B: Background levels occur in specimens collected from subjects not exposed

NS: Non-specific determinant; also seen after exposure to other materials.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: > 112 °C Closed Cup

Extinguishing Media: Water spray or fog. Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: • Combustible.

- Slight fire hazard when exposed to heat or flame.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).
- May emit acrid smoke.
- Mists containing combustible materials may be explosive. Avoid creating dust - may present dust explosion hazard. Dry dust can be electrostatically charged by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport. Build-up of electrostatic charge may be prevented by grounding. Vapor may readily form an explosive mixture with air. Other combustion products include carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with oxidizing agents i.e., nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.

- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or waterways.
- Use water delivered as a fine spray to control fire and cool adjacent area.
- Avoid spraying water onto liquid pools.
- Do not approach containers suspected to be hot.
- Cool fire-exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: • Remove all ignition sources.

- Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Control personal contact by using protective equipment.
- Use dry clean up procedures and avoid generating dust.
- Place in a suitable labeled container for waste disposal.

Large Spills: Pollutant.
- Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or waterways.
- No smoking, bare lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse/absorb vapor.
- Contain or absorb spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
- If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of overexposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- Do not enter confined spaces until atmosphere has been checked.
- Do not allow material to contact humans, exposed food or food utensils.
- Avoid smoking, bare lights or ignition sources.
- When handling, do not eat, drink or smoke.
- Avoid contact with incompatible materials.
- Keep containers securely sealed when not in used.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately. Launder contaminated clothing before reuse.
- Observe manufacturer's storage/handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Glass container. Polyethylene or polypropylene container. Plastic pail. Polylined drum. Packing as recommended by manufacturer. Check that all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Supplied-air type respirator may be required in special circumstances. An approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields. Chemical goggles. Full face shield. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, e.g. PVC. Wear safety footwear.

Other: • Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White crystalline solid or liquid with a sweet tarry odor.

Physical State: colorless crystals or needles

Odor Threshold: 0.0005 to 0.4 mg/m^3

Vapor Pressure (kPa): 0.0621 mm Hg at 20 °C

Vapor Density (Air=1): > 1

Formula Weight: 122.16

Specific Gravity (H_2O=1, at 4 °C): 0.965 at 20 °C/4 °C

Evaporation Rate: not applicable

pH: not applicable

Boiling Point: 211.5 °C (413 °F) at 766 mm Hg

Freezing/Melting Point: 25.4 °C (77.72 °F) to 26 °C (78.8 °F)

Volatile Component (% Vol): not applicable

Water Solubility: < 1 mg/mL at 18 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD$_{50}$: 3200 mg/kg
Dermal (rat) LD$_{50}$: 1040 mg/kg

Tumorigenic.

Irritation
Nil reported

See *RTECS* ZE5600000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When released in water it will degrade principally due to biodegradation with a half-life of hours to days at ambient temperature. In humic waters oxidation by alkyl peroxy radicals may also be important. Adsorption to sediment and particulate matter in the water column will only be moderate and bioconcentration in fish should not be significant. If spilled on soil, it will probably adsorb moderately to the soil and biodegrade in several days. In the atmosphere, it will degrade during daylight hours by reaction with photochemically produced hydroxyl radicals (half-life 8 hr). At night it will probably degrade very rapidly by reaction with nitrate radicals. Washout by rain will also be an effective removal process.
Ecotoxicity: LC$_{50}$Lemina minor (duckweed) 292,800 ug/l/48 hr /Static, unmeasured bioassay; LC$_{50}$Pimephales promelas (fathead minnow) 17 mg/l/96 hr /Flow through bioassay; TL$_{m}$ Carassius carassius (crucian carp) 30 mg/l/24 hr /Conditions of bioassay not specified; LC$_{50}$Daphnia magna (cladoceran) 2,120 ug/l/48 hr /Static, unmeasured bioassay; TL$_{m}$ Salvelinus (trout embryo) 28 mg/l/24 hr /Conditions of bioassay not specified
Henry's Law Constant: estimated at 6 x10^{-7}
BCF: fish 1.8 to 2.18
Octanol/Water Partition Coefficient: log K$_{ow}$ = 2.30
Soil Sorption Partition Coefficient: K$_{oc}$ = estimated at 425

Section 13 - Disposal Considerations

Disposal: • Consult manufacturer for recycling options and recycle where possible.
• Follow applicable local, state, and federal regulations.
• Incinerate residue at an approved site.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Xylenols
ID: UN2261
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4, T7, TP2
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U101 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed

TSCA: Listed

Section 16 - Other Information

Zinc
ZIN1000

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Zinc **CAS Number:** 7440-66-6
Chemical Formula: Zn
EINECS Number: 231-175-3
ACX Number: X1002588-8
Synonyms: ASARCO L 15; BLUE POWDER; C.I. 77945; C.I. PIGMENT BLACK 16; C.I. PIGMENT METAL 6; EMANAY ZINC DUST; GRANULAR ZINC; HODGSONS ZINC DUST - HYFINE & STANDARD; JASAD; MERRILLITE; PASCO; ZINC; ZINC DUST
Derivation: Manufactured by concentrating zinc ore, roasting the concentrate, followed with thermal smelting (reduction with carbon); by reducing the zinc oxide with carbon in retorts from which the resultant zinc is distilled and condensed; or by the hydrometallurgical or electrolytical process where the zinc oxide is leached from the roasted or calcined material with sulfuric acid to form zinc sulfate solution which is then leached from electrolyzed cells to deposit zinc on the cathodes.
General Use: Used in alloys (dental amalgams, brass), metallic driers, mixed-metal stabilizers, automotive parts, electrical fuses, storage and dry-cell batteries, in vacuum fluorescence displays, in electrical contact grease, in bearings, in paper defoxing, galvanizing iron and other metals, protective coating, desilverizing agent for lead, deoxidizing bronze, reducing agent in organic chemistry, reagent in analytical chemistry, extracting gold, electroplating, metal spraying, anodic inhibitors, fungicides, nutrition, roofing, gutters, engravers' plates, cable wrappings, railroad car linings, purifying fats, bleaching glue, canteens, and organ pipes.

Section 2 - Composition / Information on Ingredients

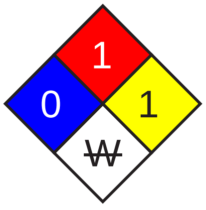
Name	CAS	%
Zinc	7440-66-6	special high-grade (99.990%), high-grade (99.95%), intermediate (99.5%), brass special (99%), prime western (98%).

Trace Impurities: Tin, lead, iron, cadmium, arsenic, cesium, antimony, and zinc chloride (increases corrosion resistance).

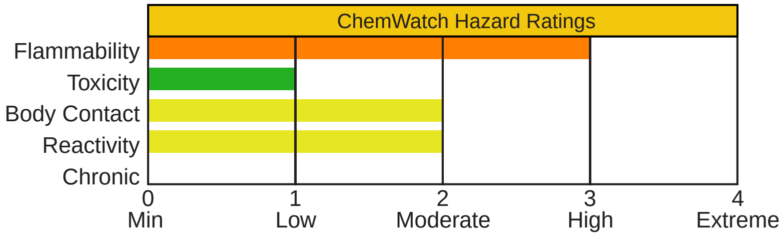
OSHA PEL **NIOSH REL**

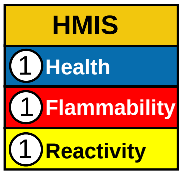
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!


Explosive


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Bluish-white lustrous metal with white coating of basic carbonate on exposure to moist air. Dust forms explosive mixtures with water. Dust is flammable, may ignite spontaneously in air.

Potential Health Effects

Target Organs: Respiratory system, eyes, and skin

Primary Entry Routes: Inhalation and eye and skin contact

Acute Effects

Inhalation: Exposure to dust may result in cough. Heated zinc may give off zinc oxide (ZnO) fumes. Characteristics of exposure include sweet taste, dry throat, injury to mucous membrane, cough, weakness, aches, chills, fever, nausea, and vomiting. Concentrations of ZnO particulates at 45 to 870 mg/m^3 cause "metal fume fever," a transient condition characterized by fever, chills, muscle pain, and vomiting. Recovery normally occurs within 24 to 48 hours. Tolerance may develop but is generally lost over a weekend.

Eye: Zinc dust particles can irritate the eyes. Zinc salts will precipitate eye protein and cause corneal and lens changes.

Skin: A human skin irritant.

Ingestion: Relatively non-toxic, though significant ingestion (12 g) of metallic zinc was reported to cause lethargy, light headedness, staggering gait, and difficulty writing, suggesting cerebellar dysfunction. Ingestion of acidic food or beverages stored in zinc or galvanized containers can lead to nausea, vomiting, diarrhea, and abdominal pain.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Abnormally large amounts of zinc may enter and leave the body for years without resulting in symptoms or clinical evidence. Zinc poisoning has been associated with prolonged consumption of water from galvanized pipes. Symptoms include irritability, muscular stiffness and pain, loss of appetite and nausea. Ingestion of excessive doses for prolonged periods alters the immune response and causes copper and iron deficiency, anemia, headache, vomiting, chills, fever, malaise, and abdominal pain.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed. Apply artificial respiration if victim is not breathing. Administer oxygen if breathing is difficult.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation develop.

Skin Contact: Remove contaminated clothing and rinse with flooding amounts of water. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

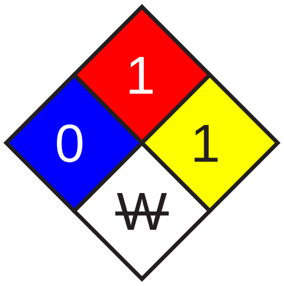
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Maintain hydration and observe for metabolic acidosis, hypocalcemic tetany, anuria, liver damage, gastric perforation, and pyloric stenosis. For pulmonary edema (noncardiogenic), maintain ventilation and oxygenation with close arterial blood gas monitoring. Early use of PEEP and mechanical ventilation may be needed to maintain pO_2 greater than 50 mm Hg with FIO_2 less than 60%. For eye exposure, rinse with 0.05 M neutral sodium edetate to help prevent or reverse a portion of the protein precipitation.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Not applicable, combustible solid

Autoignition Temperature: Cloud, 1256 °F (680 °C); dust layer, 860 °F (460 °C); powder 650 mJ spark.

LEL: Dust cloud explosion, 0.5 oz/ft^3

UEL: None reported.

Flammability Classification: Combustible solid

Extinguishing Media: *Do not* use water or foam. Use a Class D fire extinguisher, dry chemical, dry ground limestone, dry clay, soda ash, lime, or sand, or withdraw from area and let fire burn.

General Fire Hazards/Hazardous Combustion Products: Fire will produce irritating, corrosive and/or toxic gases. Inhalation or contact with vapors, substance, or decomposition products may cause severe injury or death. Zinc dust reacts vigorously or explosively on contact with water. It produces flammable gases on contact with water or moist air. It may be ignited by heat, sparks or flames and may re-ignite after fire is extinguished. Dust forms explosive mixtures with air.

Fire-Fighting Instructions: *Do not* get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank as rupture or explosion may be imminent. *Do not* release runoff from fire control methods to sewers or waterways as runoff may create fire or explosion hazard. Corrosive solutions may be produced on contact with water. Move containers from fire area if it can be done without undue risk. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing will only provide limited protection.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Eliminate all ignition sources (no smoking, flares, sparks or flames). Isolate spill or leak area immediately for at least 160 to 330 feet (50 to 100 meters) in all directions. *Do not* walk through or touch spilled material. For large spills consider downwind evacuation for at least 800 feet (250 meters). Keep unauthorized personnel away, stay upwind, keep out of low areas, and ventilate area before entry.

See DOT ERG

Small Spills: Cover with dry earth, dry sand, or other non-combustible material followed with plastic sheet to minimize spreading or contact with rain. With a clean shovel, carefully scoop material into a dry, sealed container and move container from spill area. Cleanup personnel should protect against dust inhalation and skin and eye contact.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Bulk dust in damp state may heat spontaneously and ignite on exposure to air. . Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Protect against physical damage. Store in a cool, dry ventilated place away from heat and ignition sources and incompatibles.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Routinely evaluate exposure to zinc by collecting personal and area air samples. Prevention of metal fume fever is a matter of keeping exposure of workers below the level of zinc oxide concentration currently accepted as satisfactory for working with metal in the industry (15 mg/m^3) by employment of proper local exhaust ventilation to collect fumes at their source. Enclose operations and/or provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Post hazard and warning information in the work area. In addition, educate, train, and communicate all information on the health and safety hazards of zinc to potentially exposed workers.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator equipped with particulate (dust/fume/mist) filters. Particulate filters must be checked daily before work for physical damage and replaced as needed. If, while wearing a filter cartridge or canister respirator, you can smell, taste, or otherwise detect zinc, or in the case of a full facepiece respirator you experience eye irritation, leave the area immediately. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. *Do not* take contaminated work clothes home. Launder before reuse. Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to zinc dust. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Bluish-white lustrous metal or dark powder.

Physical State: Solid

Vapor Pressure (kPa): 1 mm Hg at 908.6 °F (487 °C); 60 mm Hg at 1292 °F (700 °C)

Formula Weight: 65.38

Specific Gravity (H_2O=1, at 4 °C): 7.14 at 77 °F (25°C)

Boiling Point: 1666.4 °F (908 °C)

Freezing/Melting Point: 787.1 °F (419.5 °C)

Ionization Potential (eV): 9.39405 eV

Water Solubility: Insoluble **Other Solubilities:** Soluble in acid, alkalies, acetic acid

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Zinc powder is stable at room temperature in closed containers under normal storage and handling conditions. However, moist zinc can react exothermically and ignite spontaneously in air. Hazardous polymerization cannot occur. Avoid exposure to moisture, heat, and ignition sources (flares, sparks, cigarettes, and open flames).

Storage Incompatibilities: Avoid contact with acids, alkali hydroxides (e.g., sodium hydroxide), ammonium nitrate, ammonium sulfide, arsenic oxide, barium dioxide, barium oxide, barium nitrate, cadmium, carbon disulfide, catalytic metals, chlorates, chlorides, chlorine, chlorinated rubber, chromium (VI) oxide, ethyl acetoacetate + tribromoneopentyl alcohol, fluorine, halogenated hydrocarbons, hydrazine mononitrate, hydroxylamine, lead azide, lead nitride, magnesium nitrate, manganese chloride, nitric acid, *o*-nitroanisole, nitrobenzene, nonmetals, oxidizing agents (sulfur, oxygen), paint primer base, pentacarbonyliron, performic acid, potassium chlorate, potassium nitrate, potassium peroxide, seleninyl bromide, selenium, sodium chlorate, sodium peroxide, tellurium, transition metal halides, and water.

Hazardous Decomposition Products: Thermal oxidative decomposition of zinc metal/powder can produce hydrogen gas and zinc oxide fumes (of particle diameter <=1 µm).

Section 11 - Toxicological Information

Irritation Effects:

Human, skin, standard Draize test, 300 µg over 3 days intermittently caused mild irritation.

Other Effects:

Acute Inhalation Effects: Human, inhalation, 124 mg/m^3/50 minutes, resulted in toxic effects on lung, thorax, or respiration - cough and dyspnea, and skin and appendages - sweating.

See *RTECS* ZG8600000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Bioaccumulation may be significant (Biological Concentration Factor (BCF) ranges from 85 to 100,000). Zinc can persist in water indefinitely.

Ecotoxicity: Chronic aquatic toxicity limits: 0.04 ppm; toxicity to aquatic plants: 25 ppm. Rainbow trout, LC$_{50}$ = 4 ppm/48 hrs; zebrafish (embryo), LC$_{50}$ = 19 ppm/72 hrs. Zinc accumulates in gill tissue and bone. Zinc is thought to exert its toxic action by forming insoluble compounds with the mucous that covers the gills, by damage to the gill epithelium, or by an internal poison.

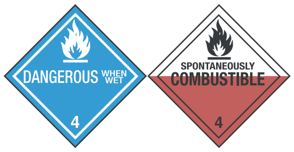
Section 13 - Disposal Considerations

Disposal: Reclaim for salvage or reuse. Unsalvageable waste may be buried in an approved landfill. Maximum concentration in effluent to sewer or stream is 1 ppm. Criteria for land treatment or burial disposal practices are under significant review. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

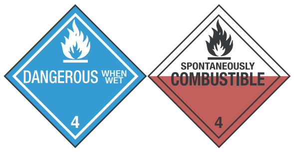
Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

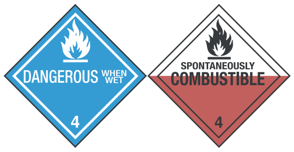
Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.



Shipping Name and Description: Zinc powder *or* Zinc dust
ID: UN1436
Hazard Class: 4.3 - Dangerous when wet material
Packing Group: I - Great Danger
Symbols:
Label Codes: 4.3 - Dangerous When Wet, 4.2 - Spontaneously Combustible
Special Provisions: A19, IB4, IP1, N40
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 15 kg
Vessel Stowage: **Location:** A **Other:**



Shipping Name and Description: Zinc powder *or* Zinc dust
ID: UN1436
Hazard Class: 4.3 - Dangerous when wet material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 4.3 - Dangerous When Wet, 4.2 - Spontaneously Combustible
Special Provisions: A19, IB7, IP2
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 15 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** A **Other:**



Shipping Name and Description: Zinc powder *or* Zinc dust
ID: UN1436
Hazard Class: 4.3 - Dangerous when wet material
Packing Group: III - Minor Danger
Symbols:
Label Codes: 4.3 - Dangerous When Wet, 4.2 - Spontaneously Combustible
Special Provisions: IB8, IP4
Packaging: **Exceptions:** None **Non-bulk:** 213 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

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Appendix D-7

Incident Investigation Report

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Incident / Near-Miss Investigation Report

☐ OSHA Recordable	☐ First Aid Injury	☐ Fire	Date of Incident:
☐ Lost Workday Injury	☐ Vehicle Accident	☐ Spill / Leak	
☐ Restricted Duty Injury	☐ Equipment Damage	☐ Near Miss	Incident Number:

Every employee injury, accident, and near miss must be reported within 24 hours of the injury. If the incident results in hospitalization, an immediate report must be made by telephone to the Project Manager and the Health and Safety Officer.

Project Information

Project Name: | Project #

Location of Incident:

Employee

Name: | Employee Number:

Employment Status: ☐ Regular ☐ Part Time | How long in present job?

Injury or Illness Information

Where did the incident / near miss occur? (number, street, city, state, zip):

Employee’s specific activity at the time of the incident / near miss:

Equipment, materials, or chemicals the employee was using when the incident / near miss occurred (e.g., the equipment employee struck against or that struck the employee; the vapor inhaled or material swallowed; what the employee was lifting, pulling, etc.):

Describe the specific injury or illness (e.g., cut, strain, fracture, etc.):

Body part(s) affected (e.g., back, left wrist, right eye, etc.):

Name and address of treatment provider (e.g., physician or clinic): | Phone No.:

If hospitalized, name and address of hospital: | Phone No.:

Date of injury or onset of illness: / / | Time of event or exposure: ☐ AM ☐ PM

Did employee miss at least one full shift’s work? ☐ No ☐ Yes, 1st date absent (MM/DD/YYYY) / /

Has employee returned to work? ☐ Regular work ☐ Restricted work ☐ No
☐ Yes, date returned (MM/DD/YYYY) / /

To whom reported: | Other workers injured / made ill in this event? ☐ Yes ☐ No

Description of Incident / Near Miss: (Describe what happened and how it happened.)

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Incident / Near-Miss Investigation Report

Motor Vehicle Accident (MVA)				Company Vehicle?	☐ Yes ☐ No		
Accident Location (street, city, state)							
Vehicle Towed?	☐ Yes ☐ No	Other Vehicle ?	☐ Yes ☐ No	# Vehicles Towed:		# of Injuries:	

Spill		
Material Spilled:	Quantity:	Source:
Agency Notifications:		
Cost of Incident $		

Third Party Incidents			
Name of Owner:		Address:	Telephone:
Description of Damage:			
Witness Name:		Address:	Telephone:
Witness Name:		Address:	Telephone:

#	Root Cause and Contributing Factors: Conclusion (Describe in Detail Why Incident / Near Miss Occurred)
1	
2	
3	
4	
5	

Root Cause(s) Analysis (RCA):

1. Lack of skill or knowledge.
2. Lack of or inadequate operational procedures or work standards.
3. Inadequate communication of expectations regarding procedures or work standards.
4. Inadequate tools or equipment.
5. Correct way takes more time and / or requires more effort.
6. Short-cutting standard procedures is positively reinforced or tolerated.
7. Person thinks there is no personal benefit to always doing the job according to standards.
8. Uncontrollable.

#	RCA #	Solution(s): How to Prevent Incident / Near Miss From Reoccurring	Person Responsible	Due Date	Closure Date

Investigation Team Members		
Name	Job Title	Date

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date
	Project Manager	
	Health and Safety Reviewer	

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Appendix D-8

Lockout/Tagout Equipment-Specific Energy Control Procedure

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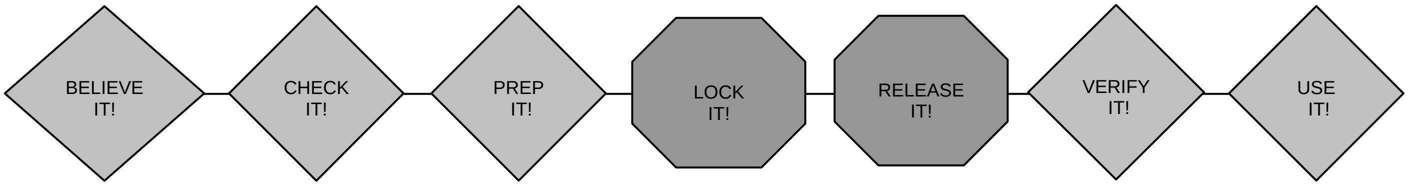
Lockout / Tagout Equipment-Specific Energy Control Procedure



Equipment Identification:

Hazardous Energy Source		Isolation Device			Verifying Lockout Means of Verification of Lockout
Type and Magnitude	Function	Type	Location	I.D. No.	
Electrical 120v					
Pneumatic					
Hydraulic					
Mechanical					
Potential					
Gravity					
Other					
Other					
Other					
Area:		**Date of Last Review:**			**Authorized by:**

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Appendix D-9

Air Monitoring Form

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Air Monitoring Log

Project:

Date:

Monitoring Instruments:

Air Monitor:

Activity:

Level of Protection:

Time	Location	Instrument Reading	Comments

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Appendix D-10

Vinyl Chloride NIOSH Method #1007

VINYL CHLORIDE

1007

CH_2=CHCl MW: 62.50 CAS: 75-01-4 RTECS: KU9625000

METHOD: 1007, Issue 2 **EVALUATION: FULL**

Issue 1: 15 February 1984
Issue 2: 15 August 1994

OSHA : 1 ppm; C 5 ppm
NIOSH: lowest feasible; carcinogen
ACGIH: 5 ppm; carcinogen
(1 ppm = 2.56 mg/m^3 @ NTP)

PROPERTIES: BP -14 °C; vapor density 2.2 (air = 1); lower explosive limit = 4% v/v in air

SYNONYMS: chloroethylene; chloroethethene.

SAMPLING

SAMPLER:	SOLID SORBENT TUBE (2 tandem tubes, each with 150 mg activated coconut charcoal)
FLOW RATE:	0.05 L/min
VOL-MIN:	0.7 L
-MAX:	5 L
SHIPMENT:	separate primary and backup tubes and cap each
SAMPLE STABILITY:	10 days @ 25 °C
BLANKS:	2 to 10 field blanks per set

ACCURACY

RANGE STUDIED:	1 to 64 mg/m^3 [1]
BIAS:	- 6%
OVERALL PRECISION ($\hat{S}_{rT}$):	0.06 [1]
ACCURACY:	± 17.8%

MEASUREMENT

TECHNIQUE:	GAS CHROMATOGRAPHY, FID
ANALYTE:	vinyl chloride
DESORPTION:	1 mL carbon disulfide; 30 min
INJECTION ALIQUOT:	5 µL
COLUMN:	stainless steel, 6.1 m x 3.2 mm, 10% SE-30 on 80/100 mesh Chromosorb W (AW-DMCS)
CARRIER GAS:	He, 40 mL/min
TEMPERATURE-INJECTOR:	230 °C
-DETECTOR:	230 °C
-COLUMN:	60 °C
CALIBRATION:	solutions of vinyl chloride in CS_2
RANGE:	2 to 200 µg per sample [1]
ESTIMATED LOD:	0.04 µg per sample [1]
PRECISION ($\bar{S}_r$):	not determined

APPLICABILITY: The working range is 0.4 to 40 mg/m^3 (0.16 to 16 ppm) for a 5-L air sample. The method is applicable to 15-min samples at concentrations of 1 ppm or higher.

INTERFERENCES: Other than the possibility of loss of sample upon storage of two weeks or more at room temperature, none have been noted.

OTHER METHODS: This is a revision of P&CAM 178 [2].

REAGENTS:

1. Carbon disulfide,* chromatographic quality.
2. Vinyl chloride,*, 99.9%, in lecture bottle fitted with valve and septum.
3. Calibration stock solutions 0.26 mg/mL.
   a. Insert the tip of a gas syringe containing 1 mL vinyl chloride gas under the surface of 5 mL CS_2 in a 10-mL volumetric flask.
   b. Open the valve of the syringe and withdraw the plunger to pull CS_2 into the barrel. (As vinyl chloride dissolves, a vacuum will be created, pulling CS_2 into the syringe.)
   c. Push the solution from the syringe into the flask. Rinse the syringe twice with 1-mL portions of CS_2 and add the washings to the flask.
   d. Dilute to the mark with CS_2.
4. Helium, purified.
5. Hydrogen, purified.
6. Air, filtered.

* See SPECIAL PRECAUTIONS.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and an acute fire and explosion hazard (flash point = -30 °C); work with it only in a hood.

Vinyl chloride is a human carcinogen [3].

EQUIPMENT:

1. Sampler: two tandem glass tubes, 7 cm long, 6-mm OD, 4-mm ID, flame-sealed ends, each containing 150 mg of 20/40 mesh activated (600 °C) coconut shell charcoal. A silylated glass wool plug precedes the charcoal beds and a 3-mm urethane foam plug follows the charcoal beds. Plastic caps are included for sealing after use. Pressure drop across each tube at 1 L/min airflow must be less than 3.4 kPa.

   NOTE: A pair of two-section (100 mg/50 mg) tubes may be used. (SKC ST226-01, or equivalent).
2. Personal sampling pump, 0.05 L/min, with flexible connecting tubing.
3. Gas chromatograph, flame ionization detector, integrator and column (page 1007-1).
4. File.
5. Bent wire for removing plugs from sampling tube.
6. Vials, 2-mL, glass with PTFE-lined septa and crimp-on seals.
7. Volumetric flasks, 10-mL, with polyethylene stoppers.
8. Pipettes, delivery, 1.0-mL, graduated in 0.1-mL increments, 2- and 5-mL, with pipet bulb.
9. Air sampling bags, Tedlar, 10-L.
10. Gas syringe, with gas-tight valve, 0.1- and 1-mL.
11. Syringe, 10-µL, with 0.1-µL graduations.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the tubes immediately before sampling. Attach two tubes, with ends touching, with a short piece of tubing. Label one tube as the back tube and insert the back tube into the flexible tubing attached to the personal sampling pump.
3. Sample at 0.05 L/min for 15 to 100 min. Do not sample more than 5 L of air.
4. Separate the primary and backup tubes and cap each tube for shipment.

SAMPLE PREPARATION:

5. Add 1.0 mL CS_2 to an empty vial. Loosely cap the vial.
6. Score each sampler tube with a file in front of the glass wool plug. Break the tube at the score line.
7. Transfer the charcoal from the front and back tubes to separate vials. Discard the glass wool and foam plugs. Seal the vials with septum caps immediately.
8. Allow to stand for 30 min, with occasional agitation. Analyze the sample within the next 30-min period.

CALIBRATION AND QUALITY CONTROL:

9. Calibrate with at least six working standards covering the range 0.2 to 200 µg per sample.
   a. Add known amounts of calibration stock solution to CS_2 in 10-mL volumetric flasks and dilute to the marks, using serial dilution as appropriate.
      NOTE: Working standards can be stored at -20 °C for at least three days.
   b. Analyze together with samples and blanks (steps 12 and 13).
   c. Prepare calibration graphs of peak area vs. quantity (µg) of vinyl chloride per tube and peak area vs. quantity (ng) per injection.
10. Determine desorption efficiency (DE) at least once for each lot of charcoal used in the calibration range (step 9). Prepare three tubes at each of five levels plus three media blanks.
    a. Prepare three atmospheres of vinyl chloride in air by injecting 0.01, 0.08, and 0.2 mL vinyl chloride gas into 10 L air in Tedlar bags. The resulting concentrations are approximately 2.6, 21 and 52 mg/m^3.
    b. Following steps 1 through 4, sample these atmospheres according to the following scheme:

Concentration in Bag (mg/m^3)	Volume Sampled (L)	Quantity of Vinyl Chloride (µg)
2.6	0.8	2
	2.2	6
21	0.8	17
	2.2	46
52	2.5	130

      Obtain three samples at each level.
    c. Desorb (steps 6 through 8) and analyze together with working standards (steps 12 and 13). No vinyl chloride should be found on the back tubes.
    d. Analyze the atmospheres in the bags (steps 12 and 13) using 1-mL gas samples to verify concentration.
    e. Prepare a graph of DE vs. µg of vinyl chloride recovered.
11. Analyze three quality control blind spikes and three analyst spikes to ensure that the calibration graph and DE graph are in control.

MEASUREMENT:

12. Set the gas chromatograph according to manufacturer's instructions and to conditions given on page 1007-1. Inject sample aliquot manually using solvent flush technique or with autosampler. The retention time of vinyl chloride is about 1.7 min.
    NOTE: If peak area is above the linear range of the working standards, dilute with CS_2, reanalyze and apply the appropriate dilution factor in calculations.
13. Measure peak area.

CALCULATIONS:

14. Determine the mass, µg (corrected for DE) of vinyl chloride found in the sample front (W_f) and back (W_b) tubes, and in the average media blank (B).
    NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.
15. Calculate concentration, C, of vinyl chloride in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - 2B)}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

The method was evaluated with single 150-mg coconut shell charcoal tubes (100-mg front beds and 50-mg back) [1]. Atmospheres were generated at four concentrations between 1 and 64 mg/m^3. Recoveries, based on atmosphere concentrations calculated from the volumes of vinyl chloride and dilution air, averaged 94% with a pooled relative standard deviation ($\hat{S}_{rT}$) of 0.06. Samples at the 3-µg level showed no loss of vinyl chloride when stored for 12 days at room temperature or 19 days at -20 °C. There may be significant loss of vinyl chloride from samples stored for 14 days at room temperature [4]. The 1% breakthrough capacity for a 150-mg bed of coconut charcoal, challenged at 100 mL/min with vinyl chloride in air at 16 mg/m^3 and a relative humidity of 70%, was 4.6 L [5].

REFERENCES:

[1] Hill, R. H., Jr., C. S. McCammon, A. T. Saalwaechter, A. W. Teass, and W. J. Woodfin. Anal. Chem., 48, 1395-1398 (1976).
[2] NIOSH Manual of Analytical Methods, 2nd. ed., V. 1, P&CAM 178, U.S. Department of Health and Human Services, Publ. (NIOSH) 77-157-A (1977).
[3] TLVs - Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment 1993-94, ACGIH, Cincinnati, OH (1993).
[4] Cuddeback, J. E., W. R. Burg, and S. R. Birch, Environ. Sci. Technol., 9, 1168-1171 (1975).
[5] Matsumura, Y. Ind. Health, 18, 61-67 (1980).

METHOD WRITTEN BY:

A. W. Teass, Ph.D., NIOSH/DBBS.

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Appendix D-11

Health and Safety Inspection Form

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Infrastructure, environment, buildings

Health and Safety Inspection Form

Project Name:	**Date:**			
Project Number:	**Location:**			
Prepared By:	**Project Manager:**			
Auditor:	**HSS On Site:**			
	YES	**NO**	**N/A**	**COMMENTS**
GENERAL				
Is the HASP on site?				
Is the HASP finalized and approved?				
Is the OSHA poster displayed?				
Are emergency telephone numbers posted?				
Is emergency eyewash immediately available?				
Is an emergency shower immediately available?				
Are emergency notification means available (radio, telephone)?				
Is a first-aid kit immediately available?				
Is the first-aid kit adequately stocked?				
Is there a proper sanitation facility on site?				
DOCUMENTATION AND RECORDKEEPING				
Are only personnel listed and approved in the HASP on site?				
Are all personnel properly trained? (Check company-issued wallet cards.)				
Is the daily field log kept by the Site Manager?				
Are levels of PPE recorded?				
Are contaminant levels recorded?				
Are site surveillance records kept by HSS?				
Is a copy of current fit test records on site?				
Are calibration records maintained for air monitoring equipment?				
Are accident / incident forms on site?				
Are field team review sheets signed?				
Are additional hospital route directions available?				
Is the visitors' logbook being accurately maintained?				
Are MSDSs available for all chemicals on site?				
Are HASP revisions recorded?				
Is the first-aid kit inspected weekly?				
Are daily safety meetings held?				
Are emergency procedures discussed during safety meetings?				

Health and Safety Inspection Form

	YES	NO	N/A	COMMENTS
EMERGENCY RESPONSES				
Is a vehicle available on site for transportation to the hospital?				
Are fire extinguishers on site and immediately available at designated work areas?				
Is at least one person trained in CPR and first aid on site at all times during work activities?				
Do all personnel know who is trained in CPR / first aid?				
PERSONAL PROTECTIVE EQUIPMENT (PPE)				
Is proper PPE being worn as specified in HASP?				
Level of PPE being worn.				
Is PPE adequate for work conditions?				
If not, give reason.				
Upgrade/downgrade to PPE level.				
Does any employee have facial hair that would interfere with respirator fit?				
If yes, willing to shave, as necessary?				
Fit-tested within the last year? (Documentation present)				
If Level B, is a back-up / emergency person suited up (except for air)?				
Does the HSS periodically inspect PPE and equipment?				
Is the PPE not in use properly stored?				
Is all equipment required in the HASP on site?				
Properly calibrated?				
In good condition?				
Used properly?				
Other equipment needed?				
List.				
Is monitoring equipment covered with plastic to minimize contamination?				
PERSONNEL AND EQUIPMENT DECONTAMINATION				
Is the decontamination area properly designated?				
Is appropriate cleaning fluid used for known or suspected contaminants?				
Are appropriate decontamination procedures used?				
Are decontamination personnel wearing proper PPE?				
Is the equipment decontaminated?				

	YES	NO	N/A	COMMENTS
PERSONNEL AND EQUIPMENT DECONTAMINATION (continued)				
Are sample containers decontaminated?				
Are disposable items replaced as required?				
WORK PRACTICES				
Was proper collection and disposal of potentially contaminated PPE performed?				
Was proper collection and disposal of decontamination fluid performed?				
Is water available for decontamination?				
Is the buddy system used?				
Is equipment kept off drums and the ground?				
Is kneeling or sitting on drums or the ground prohibited?				
Do personnel avoid standing or walking through puddles or stained soil?				
Are work zones established?				
If night work is conducted, is there adequate illumination?				
Is smoking, eating, or drinking in the exclusion or CRZ prohibited?				
To the extent feasible, are contaminated materials handled remotely?				
Are contact lenses not allowed on site?				
Is entry into excavations not allowed unless properly shored or sloped?				
Is a competent person on site during excavation?				
Are all unusual situations on site listed in HASP?				
If not, when?				
Action taken?				
HASP revised?				
CONFINED SPACE ENTRY				
Are employees trained according to 1910.146 – Confined Space Entry?				
Are all confined spaces identified? If not, list:				
Is all appropriate equipment available and in good working order?				
Is equipment properly calibrated?				
Are confined space permits used?				
Are confined space permits completely and correctly filled out?				

*N/A = Not Applicable

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Appendix D-12

Daily Safety Meeting Log

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Daily Safety Meeting Log

Project:	**Location:**
Date / Time:	**Activity:**
1. Work Summary	
2. Physical / Chemical Hazards: Has JSA been reviewed/modified to address changing conditions?	
3. Protective Equipment/Procedures	
4. Emergency Procedures	
Is there anyone with any medical conditions that they would like the team to know about? For example: Medic Alert, Allergic to bee stings, nitro for chest pains, etc.	
Location of medical equipment: fire extinguishers, first aid kit, route to hospital, auto-injectors, etc.	
5. Signatures of Attendees	