HEALTH AND SAFETY PLAN
for

SPECTRA ENERGY PIPELINE
NEW JERSEY/NEW YORK EXPANSION PROJECT
LINDEN, NEW JERSEY TO MANHATTAN, NEW YORK

TRC Job No. 168217

Prepared by:

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For use by:

TRC Companies, Inc.
Employees Only

October 2010

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SPECTRA ENERGY PIPELINE
NEW JERSEY/NEW YORK EXPANSION PROJECT
LINDEN, NEW JERSEY

Approved by: ___________________________________ Date:______________
Daniel A. Nachman
Senior Project Manager

Approved by: ___________________________________ Date:______________
Christopher Hoen
Health and Safety Officer

This Health and Safety Plan (HASP) must be read and signed by all TRC personnel at site.

I have reviewed this HASP and TRC Solution's corporate HASP. I agree to abide by the requirements of these HASPs.

_____________________________________ ___________________
Signature Date

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1.0 INTRODUCTION

TRC Companies, Inc. (TRC), on behalf of Spectra Energy Corporation (Spectra), has prepared this Health and Safety Plan (HASP) to be implemented at the Spectra Energy Pipeline Project ("the site"), located in Linden, Bayonne and Jersey City New Jersey and Staten Island and Manhattan, New York (Figure 1).

The purpose of the HASP is to establish requirements for protecting the health and safety of personnel from possible exposure to potentially hazardous substances during the pipeline expansion project. This HASP has been developed to establish the health and safety procedures required to minimize any potential risk to personnel performing certain activities at the site. This HASP is written to meet the requirements of all applicable federal, state and local health and safety regulations, including 29 CFR 1910.120 based on current knowledge regarding the specific chemical and physical hazards that are known or anticipated at the site.

The provisions of this HASP apply to all on-site personnel and visitors who may potentially be exposed to health and/or safety hazards related to specific activities at the site. All activities will be conducted in accordance with this plan. Personnel and visitors who cannot or will not comply with this HASP will be excluded from on-site activities.

Subcontractors to TRC must prepare their own HASP related to their specific on-site assignments. The subcontractor's HASP must be at least as protective as TRC Solution's corporate HASP and site-specific HASPs. The subcontractors are solely responsible for preparing, implementing and enforcing their own HASP. In addition, the subcontractor is responsible for obtaining setup and maintaining the air monitoring equipment, and will determine when upgrades in personnel protection and/or dust suppression measures will be implemented. The subcontractor is also solely responsible for complying with all applicable OSHA requirements and all other federal, state and local safety requirements.

Daily safety meetings will be held at the start of each shift to ensure that all personnel understand site conditions and operating procedures, that personal protective equipment (PPE) is used correctly, and that worker health and safety concerns are addressed. A job safety analysis (JSA) sheet will be filled out and at the conclusion of each daily safety meeting and will remain on file for the duration of the project (Appendix A).

2.0 EMERGENCY INFORMATION

If a medical emergency occurs, the appropriate emergency telephone numbers are listed below. For non-life threatening emergencies, Immedicenters will be utilized if distance and time permit. For life threatening emergencies, a hospital should be used. Directions to the nearest hospitals are detailed below.

Due to the large geographical area covered during this project, multiple hospitals along the pipeline expansion route have been identified. An additional emergency list is provided in Appendix B.

ANY SERIOUS EMERGENCY - DIAL 911

Linden, NJ:
Trinitas Regional Medical Center
225 Williamson Street 908-994-5422 (emergency no.)
Elizabeth, NJ 07060-3361 908-994-5000 (general no.)

Directions to Trinitas Regional Medical Center Hospital (1.3 miles,5 minutes)
1. From Park Avenue South turn right onto US 1&9 North (0.75 mi)
2. Left onto South Broad Street
3. Right onto South Street and destination will be on the left
Road map to the hospital is on Figure 2 with driving directions.

Staten Island, NY:
Staten Island University Hospital
475 Seaview Avenue (718) 226-9000 (emergency no.)
Staten Island, NY 10305

Directions from Western Avenue to Staten Island University Hospital (9.9 miles, 15 minutes)
1. Head southwest on Western Ave toward Goethals Rd N (0.6 mi)
2. Merge onto I-278 E via the ramp on the left to Staten Is Expy/Verrazano Br. (6.6 mi)
3. Take exit 15 for Lily Pond Ave toward S Beach/Bay St. (0.3 mi)
4. Turn right at Lily Pond Ave (0.4 mi)
5. Lily Pond Ave turns slightly right and becomes Father Capodanno Blvd. (1.5 mi)
6. Turn right at Seaview Ave and destination will be on the right (0.6 mi)
Road map to the hospital is on Figure 3 with driving directions.

Bayonne, NJ:
Bayonne Medical Center
29 East 29th Street (201) 858-5000 (emergency no.)
Bayonne, NJ 07002-4695 (201) 858-5257 (general emergency no.)

Directions from Port Terminal Blvd to Bayonne Medical Center (1.4 miles, 4 minutes)
1. Head west on Port Terminal Blvd toward Access Rd. (0.9 mi)
2. Turn left at NJ-440 S (0.1 mi)

3. Turn right at E 32nd St. (0.1 mi)
4. Take the 2nd left onto Avenue E (0.2 mi)
5. Turn right at E 29th St. and destination will be on the right (430 ft)

Road map to the hospital is on Figure 4 with driving directions.

Jersey City, NJ:
Jersey City Medical Center
101 Jersey Avenue (201) 915-2000 (emergency no.)
Jersey City, New Jersey

Directions from Grand Street to Jersey City Medical Center (0.3 miles, 2 minutes)
1. Head east on Grand St toward Jersey Ave. (0.2 mi)
2. Take the 1st right onto Jersey Ave. and destination will be on the right (486 ft)

Road map to the hospital is on Figure 5 with driving directions.

Manhattan:
Beth Israel Medical Center
317 East 17th Street (212) 420-2840 (emergency no.)
New York, NY 10011

Directions from West Street to Beth Israel Emergency Room (1.8 miles, 7 minutes)
1. Head Northeast on Bloomfield St. (0.3mi)
2. Turn left at 11th Ave./New York 9A North (0.2 mi)
3. Turn right on West 14th St. (1.2 mi)
5. Turn left on 1st Ave (0.1 mi)
6. Take the 3rd left onto East 17th St.

Road map to the hospital is on Figure 6 with driving directions.

Police Emergency	911
Fire Emergency	911
Rescue Squad	911
Emergency Management	(908) 226-7718
Fire	(908) 226-7715
Police	(908) 226-7677
N.J. Poison Control Center	(800) 962-1253
National Response Center and Terrorist Hotline	(800) 424-8802
American Association of National Poison Control	(800) 222-1222
Poison Control Center	(800) 962-1253
National Poison Control Center	(800) 942-5969
CMA Chemical Referral Center	(800) 262-8200
Center for Disease Control	(800) 311-3435
Utility Mark-Out	(800) 272-1000
Pesticide Information Center	(800) 845-7633
AT&F (Explosives Information)	(800) 424-9555
US DOT	(202) 366-0656 (Day) (202) 426-2075 (Hotline)

If drilling/excavating:

PSE&G Electric Company (emergency)	1-800-350-7734
Elizabethtown Gas Company (emergency)	1-800-492-4009
Verizon Telephone	(732) 548-9376
New Jersey American Water Company	1-800-272-1325
United Water New Jersey	1-800-422-5987
Middlesex County Water Company (emergency)	(732) 634-1500

Emergency telephone numbers will be conspicuously posted on site (if applicable).

Each TRC vehicle is equipped with an ABC-type fire extinguisher, first aid kit, bee and wasp spray, eyewash bottle, MSDS and a copy of TRC Solution’s corporate HASP.

When a rental vehicle is used, please take the rental vehicle HASP kit, which includes an ABC-type fire extinguisher, a first aid kit, bee and wasp spray, eyewash bottle, and a copy of TRC Solution’s corporate HASP.

2.1 Adverse Weather Conditions

In the event of adverse weather conditions, the Health and Safety Officer (HSO) will determine if work can continue without compromising the health and safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for cold stress and cold-related injuries
- Potential for heat stress and heat-related injuries
- Treacherous weather-related working conditions
- Limited visibility
- Potential for electrical storms
- Weather conditions that render personal exposure monitoring equipment inoperative

2.2 Chain of Command

Key Field Personnel

Following are the key field personnel who are involved with the activities of this project. This will be updated if there are any changes in the organization that would affect this project.

TRC Project Manager	Site Safety Officer	Field Supervisor	Field Personnel
Dan Nachman	Trish Ward	Trish Ward	To be added at the time the Site Characterization is implemented

2.3 TRC Contacts

In the event of problems that require notification, the following contacts are listed in order of priority:

Name:	Patricia Ward, Associate Project Manager TRC Companies, Inc.	(973) 564-6006. Ext. 226 (work) (973) 600-2446 (cell)
Name:	Daniel Nachman, Vice President TRC Companies, Inc.	(973) 564-6006, Ext. 269 (work) (973) 715-9045 (cell)
Name:	Chris Hoen, Health & Safety Officer TRC Companies, Inc.	(973) 564-6006, Ext. 204 (work)
Name:	Ken Siet, Associate TRC Companies, Inc.	(973) 564-6006, Ext. 217 (work) (973) 715-8449 (cell)

2.3.1 Additional Contacts

Name	Company	Telephone Number

2.4 Responsibilities

Responsibilities for implementing safe work practices and specifically the requirements of this HASP for TRC personnel are described below.

2.4.1 Project Manager

The Project Manager is responsible for controlling all technical work in an environmentally safe manner, assuring that operational hazards are minimized and implementing this HASP during all project task elements. Some specific responsibilities include but are not limited to:

(1) Verifying that all personnel involved with this project have a copy of this HASP, have read and understand the HASP, and have completed the HASP sign-off sheet.

(2) Assuring that all personnel involved with this project have attended a briefing regarding the contents of the HASP and site-specific hazards prior to performing work.

(3) Determining that sufficient PPE, air monitoring and equipment as required by this HASP are available.

(4) Assuring that all contractor personnel submit documentation of employee participation in medical, training and drug & alcohol programs.

(5) Maintaining a high level of health and safety consciousness among the field personnel.

2.4.2 Health and Safety Officer (HSO)

The Health and Safety Officer is responsible for the preparation, interpretation, and modification of the HASP. Some specific duties include but are not limited to:

(1) Advising the Project Manager and field personnel on matters relating to health and safety.

(2) Recommending appropriate PPE and air monitoring instrumentation to protect personnel from site hazards.

(3) Conducting field audits, if deemed necessary, to monitor the effectiveness of the HASP and to assure compliance with it.

(4) Performing personal exposure monitoring where required and, where deemed necessary, to determine the adequacy of protective measures and PPE specified by this HASP.

(5) Maintaining contact with the Project Manager and field personnel to regularly evaluate site conditions and any new information that might require modifications to the HASP.

(6) Working with the Project Manager to ensure that sufficient PPE is available onsite.

(7) Conducting briefing meetings, when necessary, to apprise personnel of the contents of the HASP and site hazards.

(8) Conducting accident/incident investigations and preparing accident/incident investigation reports along with the appropriate operations personnel.

2.4.3 TRC Site Safety Officer (SSO)

The Site Safety Officer is responsible for ensuring the Health & Safety guidelines are followed, in addition to monitoring for airborne contaminants when necessary and evaluating new hazards and operation changes. The Site Safety Officer has the authority to correct all noncompliance situations immediately and to stop work in cases of immediate danger. Specific responsibilities include but are not limited to:

(1) Obtaining the air monitoring instrumentation required and conducting the necessary air monitoring.

(2) Verifying that all PPE and other health and safety equipment is in proper working condition.

(3) Upgrading and downgrading PPE as specified in the HASP. Only the SSO, with the consent of the Health & Safety Officer can downgrade to a lower level. Changes will be made in writing.

(4) Notifying the Project Manager and Health & Safety Officer of all noncompliance and dangerous situations.

(5) Supervising and monitoring the safety performance of all field personnel to ensure required safety and health procedures are followed and correct any deficiencies.

(6) Reporting all accidents/incidents to the Health & Safety Officer.

(7) Initiating emergency response procedures.

2.4.4 TRC Field Team Manager

The Field Supervisor is responsible for the field operations needed to complete the project. Some specific responsibilities include but are not limited to:

(1) Reading and understanding the HASP and completing the HASP sign-off sheet.

(2) Ensuring all equipment needed for the project is available and properly maintained.

(3) Communicating newly identified hazards or noncompliance issues with the Project Manager, Health & Safety Officer and the Site Safety Officer.

(4) Ensuring field personnel have received the necessary training and Health & Safety briefings before work begins. Conducting a Tailgate Safety Briefing each day before fieldwork is started and review emergency procedures. A copy of the JSA is included in Appendix A.

(5) Correcting any deficiencies regarding health, safety or operating procedures.

(6) Reporting any injuries and illnesses to the Project Manager and the Company Health & Safety Officer.

(7) Stopping work in cases of immediate danger.

2.4.5 Field Personnel (FP)

All field personnel are responsible for following the Health & Safety procedures specified in this HASP and work practices specified in applicable operating procedures. Some specific responsibilities include but are not limited to:

(1) Reading and understanding the HASP and completing the HASP sign-off sheet.

(2) Reporting all accidents, incidents, injuries, illnesses or near misses to the Field Supervisor.

(3) Complying with the requests of the Site Safety Officer.

(4) Immediately communicating newly identified hazards or noncompliance issues to the Field Supervisor or Site Safety Officer.

(5) Stopping work in cases of immediate danger.

3.0 ACCIDENT/EMERGENCY PROCEDURES

3.1 Injuries

A first aid kit will be on site during all work activity. In the case of an accident, first aid procedures shall be implemented. At least one member of the on-site field team will be CPR and First Aid-trained to handle minor injuries. All accidents need to be reported to TRCs HSO by completing the Accident Reporting Form in Appendix C. Near loss incidences need to be reported to TRCs HSO by completing the Near Loss Investigation Form in Appendix C.

The Site Safety Officer (SSO) will immediately be notified of an accident. Subsequently, the project manager and the Company Health and Safety Officer will also be informed. An accident report will be completed to evaluate the nature of the accident and provide suggestions to remove or modify the existing hazard. The report will list procedures to help prevent the occurrence of similar accidents.

For life threatening situations, dial 911.

Personal Injury

If an injury occurs due to an accident or exposure to a hazardous substance, the SSO will be immediately notified. The SSO will be given all appropriate information concerning the nature and cause of the injury so that treatment preparation can be initiated. The Project Manager will investigate the cause and make any necessary changes in work procedures.

3.2 First Aid Procedures

3.2.1 Site-Specific Procedures

The following material provides Site-specific first aid procedures. Exposure incidents resulting in injury or illness or which may occur in an emergency situation involving unprotected employees will be followed-up with a medical examination.

AFTER DIALING 911 and the necessary information has been given to the emergency personnel, regardless of the nature of the accident or medical problem, you should try to handle the situation as follows:

Determine if the scene is safe - DO NOT ENTER IF SCENE IS NOT SAFE
Use Body Substance Isolation (BSI)*
Wear gloves always and mask, goggles and gown where appropriate - PROTECT YOURSELF

* BSI is a practice of isolating all body substances (blood, urine, feces, tears, etc.) of individuals undergoing medical treatment, particularly emergency medical treatment of those who might be infected with illnessess such as HIV, or hepatitis so as to reduce as much as possible the chances of transmitting these illnesses. BSI is similar in nature to universal precautions, but goes further in isolating substances not currently known to carry HIV.

Determine the victim's condition:

1. Breathing?
2. Bleeding?
3. Conscious?
4. What happened?

Call for an ambulance (or be sure someone else has called). Remember, nothing you do should delay the summoning of professional help. Begin treatment. Always treat the most severe (life-threatening) problems first.

Generally, follow this order:

1. Airway
2. Respiratory Arrest or Cardiac Arrest (both respiratory and Cardiac Arrest).
3. Major bleeding
4. Most Severe wound
5. Shock
6. Other

A good way to remember the key part of the sequence is to follow the alphabetical order. That is, to treat the A,B,C's.

A - Airway
B - Breathing
C - Circulation (severe bleeding, check for pulse).

3.2.2 First Aid for Specific Injuries

A. Pain:

Pain is a message from your body that something is wrong. Any time a person feels prolonged, severe pain, pay attention. Get medical help.

Chest pain may be a symptom of a heart attack.

Abdominal pain may be a symptom of appendicitis or any of several medical crises.

Severe head pain unattached to a fall or injury may be symptoms of stroke or of an aneurysm - a ruptured blood vessel - in the brain. People may suffer pains in the chest, abdomen or head that are of no serious consequence whatever, but if the pain is severe and prolonged, seek medical help.

B. Unconsciousness (Medical Without Trauma):

The cause of unconsciousness may or may not be obvious. If this is the result of a fall, for example, the cause is clear; but often there is no immediate identifiable reason for unconsciousness.

SYMPTOMS

Every patient will not show all the possible symptoms for a given condition. This does not mean that the conditions do not exist. Also, you cannot be sure a condition does exist by the presence of only one symptom. Generally, you should suspect a problem when several of the appropriate symptoms are present in combination. There are exceptions. The most important of these is chest pain. Severe chest pain, whether alone or in combination with other symptoms, must be taken as a sign of a possible heart attack.

FIRST AID

1. Check the victim's breathing and pulse. If breathing has stopped, begin artificial ventilation. If breathing has stopped and there is no pulse, begin CPR.
2. Should the patient vomit, sweep it all out with your fingers. Be sure that the airway is open and clear. USE GLOVES.
3. Keep the patient warm.
4. Do not try to give an unconscious person anything to eat or drink. The patient has no control over swallowing and might choke on or aspirate anything you put in his or her mouth.
5. Do not move the patient unless there is an immediate danger.
6. Even if the victim recovers consciousness, medical attention is necessary to determine the cause of unconsciousness. A serious condition may underline the episode.

Adult CPR Summary:

The steps of one-operator CPR (adult victim):

1. Check for responsiveness.
2. Turn victim on his back as a unit, call for help.
3. Open the airway.
4. Look, listen, and feel for breathing.
5. Give two full breaths, at 1.5 seconds per breath.
6. Check the carotid pulse. Once you have determined that the victim is in cardiac arrest, get someone to call the ambulance. If you are alone you will have to call for help and begin CPR.
7. Bare the chest.
8. Find the landmark and position your hands correctly on the chest.
9. Give 15 chest compressions, at the rate of 80-100 compressions per minute at a depth of 1.5 to 2 inches.
10. Open the airway and give 2 ventilations.
11. Continue alternating, 15 compressions and 2 ventilations until help arrives.
12. Every few minutes, after ventilation, stop CPR and check for the presence of a pulse. If none is present, continue CPR.

The steps of two-operator CPR (adult victim):

1. Check for responsiveness.
2. Turn victim on his back as a unit, call for help.
3. Person 1 opens the airway.
4. Person 1 looks, listens, and feels for breathing.
5. Person 1 gives two full breaths, at 1.5 seconds per breath.
6. Person 1 checks the carotid pulse. Once you have determined that the victim is in cardiac arrest, get a third person to call 911. If a third person is not available, do one person CPR while the Person 2 calls 911.
7. Person 2 bares the chest.
8. Person 2 finds the landmark and position your hands correctly on the chest.
9. Person 2 gives five chest compressions at a rate of 80 to 100 per minute and at a depth of 1.5 to 2 inches.
10. Person 1 opens the airway and gives 1 slow breath for about 1.5 seconds.

11. This sequence then continues until help arrives. Use same rhythm as for one person CPR (i.e. One and two and three and four and five. Breath)
12. Peron 1 can check the effectiveness of the compressions by feeling for the carotid pulse while Person 2 provides compressions. If none is present continue CPR. Note that sometimes a carotid pulse may not be felt even though compressions are effective.
13. After the first minute of compressions and every few minutes thereafter, Person 1 checks for a pulse to determine if circulation has returned. Person 1 says, Pulse Check and Person 2 stops compressions after the fifth compression. The pulse is checked for 5 seconds. If there is no pulse, continue CPR, starting with compressions.

3.2.3 Chemical Exposure

A. Eyes:

If any substance comes in contact with the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with any chemicals.

SYMPTOMS

Redness, irritation, pain, impaired vision.

FIRST AID

1. Flush with water for at least 15 minutes. If both eyes are affected, hold open both eyelids!
2. If severe, evacuate victim to a hospital.

B. Dermal:

SYMPTOMS

Skin rash or burning sensation. Appearance of ulcers on the skin following repeated contact.

FIRST AID

1. Flush affected area with water for 15 minutes.
2. Cover with a clean dressing.
3. If chrome ulcers develop, seek medical attention.
4. Monitor victim for at least 24 hours.

C. Inhalation:

SYMPTOMS

Dizziness, nausea, lack of concentration, headache, irregular rapid breathing, weakness, loss of consciousness, coma. If a person breathes large amounts of vapors, move the exposed person to fresh air at once. Provide oxygen if available.

FIRST AID

1. Bring victim to fresh air. If victim is conscious, rinse eyes or throat, if irritated.
2. If severe (victim vomits, is very dizzy or groggy, etc.), evacuate to a hospital.

3. Be prepared to administer CPR (if heart stops) or artificial respiration (breathing has stopped) depending on situation.
4. Monitor victim for at least 48 hours.

D. Ingestion:

SYMPTOMS

Same as inhalation symptoms with stomach cramps.

FIRST AID

1. Evacuate victim to hospital.

3.2.4 Heat Exposure

A. Heat Stress Training

Awareness training is required for all persons working in hot environments (90°F wearing regular clothing or >70°F if wearing additional PPE over regular clothing) and should cover the signs and symptoms of heat stress and the ways to reduce the sources of heat stress. (See Training for heat stress in Appendix D)

B. Heat Stress Risk Factors

The level of heat stress an individual is exposed to depends not only on the environmental factors of temperature and humidity but also on the work effort, i.e., it depends on the type of task being performed and whether or not they are acclimatized to the hot environment.

Since measurement of deep body temperature is impractical for monitoring the workers' heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological responses to heat. At the present time, Wet Bulb Globe Temperature Index (WBGT) is the simplest and most suitable technique to measure the environmental factors. WBGT values are calculated by the following equations:

Outdoors with solar load: $WBGT = 0.7\ NWB + 0.2\ GT + 0.1\ DB$

Indoors or Outdoors with no solar load: $WBGT = 0.7\ NWB + 0.3\ GT$

Where: WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet Bulb Temperature
DB = Dry Bulb Temperature
GT = Globe Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry bulb thermometer.

Higher heat exposures that shown in Table I are permissible if the workers have been undergoing medical surveillance and it has been established that they are more tolerant at work in heat than the average worker. Workers should not be permitted to continue their work when their deep body temperature exceeds 100.4 degrees Fahrenheit.

Table 1
Permissible Heat Exposure Threshold Limit Values

(Values are given in degrees Fahrenheit]			
	Work Load		
Work- Rest Regimen	**Light**	**Moderate**	**Heavy**
Continuous work	86.0	80.1	77.0
75% Work, 25% Rest/Hour	87.1	82.4	78.6
50% Work, 50% Rest/Hour	88.5	85.0	82.2
25% Work, 75% Rest/Hour	90.0	88.0	86.0

PPE can contribute significantly to the overall heat load and can reduce the body's evaporative cooling ability.

C. Heat Stress Precautions

Work involving the use of special PPE worn over regular work clothes (impermeable PPE) must be reviewed by the next higher level of supervision at ambient workplace temperatures above 100^{o}F. Work in regular clothes at ambient temperatures above 110^{o}F must be reviewed by the next higher level of supervision (to be determined by each site).

If possible, schedule the work for nights or early mornings or another season. Where feasible, reduce the workload by shortening the work or changing the way tasks are performed.

Workers should be encouraged to drink water often, about every 20 minutes, during a hot job.

D. Monitoring Work Environment

Use dry bulk temperature for initial heat stress assessment. Contact H&S Coordinator for additional monitoring if unusual conditions exist (e.g., high humidity/steam areas, absence of wind movements, etc).

E. Heat Related Illnesses

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, movement) to fatal. Standard reference books should be consulted for specific treatment. However, a heat stress casualty prevention plan is included as Appendix D.

1. Heat Stroke:
The person's temperature control system that causes sweating stops functioning correctly. Brain damage and death may occur if temperature is not brought down.

SYMPTOMS

a. Sudden onset dry, hot and flushed skin.
b. Body temperature reaching 105 to 106 degrees or higher.
c. Dizziness/nausea/headache.
d. Muscle twitching, growing into convulsions.
e. Breathing deep at first, later shallow and even almost absent.
f. Full and fast pulse.
g. Early loss of consciousness.
h. Dilated pupils.

Refusing water, vomiting, and changes in symptoms indicate that the victim's condition is getting worse.

FIRST AID

When providing emergency care for a heat stroke, remember that this is a true emergency. EMS contact and transportation to a medical facility should not be delayed. Remove the patient to a cool environment if possible, and remove as much clothing as possible. Assure an open airway. Reduce body temperature promptly by dousing the body with water, or preferably wrapping in a wet sheet. If the victim is conscious, give cool water to drink. If cold packs are available, place them under the arms, around the neck, at the ankles, or any place where blood vessels that lie close to the skin can be cooled. Protect the patient from injury during convulsions, especially from tongue biting.

Immediately cool body if temperature has reached 105^{o}F by removing clothing and sponging body with alcohol or cool water, or placing in tub of cold water until temperature is lowered sufficiently (102^{o}F). Stop cooling and observe for 10 minutes. Fanning increases evaporation and further cools the body. Placing person in cold water more effectively cools the body but it could result in harmful overcooling, so it must be done under medical supervision. Once temperature remains lowered, dry victim off. Use fans or air conditioning, if available. Do not give coffee, tea, or alcohol. Contact EMS to transfer to medical facility.

2. Heat Exhaustion:
Heat exhaustion occurs in individuals working in hot environments; this disorder may be associated with heat cramps. It is brought about by the pooling of blood in the vessels of the skin. The heat is transported from the interior of the body to the surface by the blood. The skin vessels become dilated and a large amount of blood is pooled in the skin. The blood pooled in the lower extremities when in an upright position, may lead to an inadequate return of blood to the heart and eventually to physical collapse.

Heat exhaustion is a result of over exertion in hot or warm weather. It is very likely on-site, due to chemical protective suits, boots, gloves, aprons, Tyveks, and SCBAs, even if ambient temperatures are mild.

SYMPTOMS

a. Pale, clammy skin.
b. Profuse perspiration.
c. Site-specificized weakness.
d. Headache.
e. Nausea/dizziness/weak pulse, rapid, and usually shallow breathing.
f. Decreased attention span and capability.
g. Glassy eyes.

FIRST AID

(1) Get into shade or cooler place.
(2) Immediately remove any protective clothing especially butyl rubber.
(3) Victim should sip salt water (1 tsp. per glass) half glass per hour or electrolytic drink (Gatorade).
(4) Victim should lie down with feet raised.
(5) Fan and cool with wet compresses.
(6) Get prompt medical attention.
(7) Victim should rest for few days.

PREVENTION

(a) If possible, schedule work for early morning or evening during warm weather.
(b) Work in shifts, limit work time of personnel and follow with frequent breaks.
(c) Have cool liquids within the decontamination reduction zone to help replace body fluids.
(d) Personnel should continuously monitor each other for signs of heat stress.

3. Heat Cramps:

Heat cramps usually affect people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps of the leg and abdominal muscles. Heat cramps may result from drinking iced water or other drinks either too quickly or in too large a quantity.

SYMPTOMS

The symptoms of heat cramps are as follows:

a. Muscle cramps in legs and abdomen.
b. Pain accompanying cramps.
c. Faintness.
d. Profuse perspiration.

FIRST AID

To provide emergency care for heat cramps, remove the patient to a cool place. Give him/her sips of liquids such as "Gatorade" or its equivalent. Apply manual pressure to the cramped muscle. Remove the patient to a hospital if there is any indication of a more serious problem.

4. Heat Rashes:

Heat rash appears as red blotches or spots. Move person to cool environment.

3.2.5 Cold Exposure

Awareness training is required for all persons working in cold environments should cover the signs and symptoms of cold stress and the ways to reduce the sources of cold stress. (See Training for cold stress in Appendix E)

A. Frostbite:

Frost bite is a localized injury, resulting from a freezing of tissue. It is most common to the fingers and toes due to reduced circulation in the extremities and on the face and ears as they are most commonly exposed (uncovered) to the weather.

For frostbite to occur, there must be subfreezing temperatures. It is most prevalent in very cold temperatures or when cold temperatures are extended by the wind.

SYMPTOMS

a. Pre-Frostbite. Affected area feels painfully cold, but usually flushed (red-rosy) in color.
b. First Degree Frostbite (Frost Nip). Crystallization in superficial tissues. Affected area no longer feels cold, and is completely numb. Skin coloration is a small white grayish-yellow waxy patch. Immediate treatment will completely reverse the condition with no ill effects.
c. Second-Degree (Deep) Frostbite. A deep freezing of the fluids in the underlying soft tissues. Symptoms and treatment are the same as above. Usually results in a death of tissue, blistering, black skin, loss of toes, etc. with possible complication from gangrene.

FIRST AID

(1) Cover and protect the affected part.
(2) Provide extra clothes.
(3) Bring indoors as soon as possible.
(4) Give warm drink.
(5) Rewarm frozen part quickly by immersing in warm water (if thawed and refrozen, warm at room temperature).
(6) DO NOT RUB - causes tissue death.
(7) DO NOT APPLY direct heat.
(8) DO NOT break blister.
(9) DO NOT allow to walk after feet thaw.
(10) Discontinue warming as soon as part becomes flushed.
(11) Exercise thawed part.
(12) Separate fingers and toes with sterile gauze.
(13) Elevate frostbitten parts.
(14) Seek medical attention because of the chance of infection or gangrene.

For all frostbite - rapid rewarming (thawing) as soon and as quickly as possible - is the preferred treatment. DO NOT warm tissue that will only be refrozen, or warm feet if they are to be walked upon. Second-degree frostbite requires medical attention and the victim should not be re-exposed to the cold.

PREVENTION

a. Fatigue, cigarettes, alcohol, lack of food and drink, clothing that restricts circulation, and any other factors that reduce circulation will contribute to frostbite.
b. Properly insulate all body parts. Extreme cold may require a face mask. Use insulated gloves and boots.
c. Winds and wetness will accentuate frostbite. Keep dry and do not expose skin to the wind.
d. Be observant of each other. Look at ears, rosy cheeks, etc. Often, the victim does not realize he/she has frostbite.

B. Hypothermia:

Hypothermia is a systematic lowering of the body temperature. Extreme cases (core temperature below 90°F) result in death of the victim. Hypothermia is the most common cause of death for persons involved in outdoor/wilderness sport activities. It does not require freezing temperatures and, in fact, can occur in ambient temperatures as high as 70°F. Wind and wetness generally accentuate hypothermia due to the enhanced cooling. Typical Hypothermia conditions are a rainy, windy day with 50°F ambient air temperatures.

SYMPTOMS

a. First Stage: goose bumps, shivering, feeling chilly.
b. Second Stage: violent shivering, blue lips, pale complexion, feeling extremely cold.
c. Third Stage: no longer feel cold, lack of coordination, mild unresponsiveness, drowsiness, stumbling.
d. Fourth Stage: failing eyesight, victim barely responsive, cannot speak, barely able to or cannot walk.
e. Fifth Stage: COMA AND RAPID DEATH.

FIRST AID

For all levels - remove wet, frozen or restrictive clothing. Dry victim. Rewarming should be via an external heat source which completely envelopes the victim - a warm vehicle, a warm room or sauna, a tub of warm water, by placing the victim in a sleeping bag with another person(s), etc. - and not a source of radiant heat which will warm only one side of the victim. Be prepared to administer CPR. DO NOT give the victim alcohol.

a. First Stage: Put on his/her, shirt, additional clothing, wind breaker, etc. Eat and drink. Exercise on tense muscles.
b. Second Stage: Same as above, only more so. Warm sweet drinks and rewarm, if possible. In hypothermia beyond Second Stage, the victim can no longer warm himself/herself and must have an external heat source.
c. Third Stage: Rewarming, give warm food and drink.

d. Fourth Stage: Remove wet or cold clothing and gradually rewarm victim so that blood trapped in extremities is rewarmed before it is circulated back into inner body to prevent after-drop. After-drop is a further lowering of the body core temperature which results from recirculation of cold blood. Avoid hot, radiant heat sources which will warm surface blood before inner blood has been warmed. DO NOT give warm drinks which fool the body internally into feeling it is warm. Fourth Stage hypothermia victims are best treated by supervised, experienced medical help, as complication can cause death. Place victim in warm vehicle and evacuate immediately to a medical facility.

e. Fifth Stage: Dial 911 - let ambulance transport!! Gradual rewarming, but requires sophisticated medical help to prevent death from after shock (a recirculate of chilled blood causing heart fibrillation).

PREVENTION

a. Wear proper clothing which will insulate the body, keep it dry and break the wind.
b. Cover the head, neck, wrists and ankles in particular, as heat loss is most prevalent from these points.
c. Eat and drink warm fluids. Avoid eating snow.
d. Keep active to raise body temperature.
e. Avoid fatigue, alcohol and smoking.
f. Beware of team members' conditions and note symptoms.

Sampling will be conducted near water bodies and thus results in unique potential physical hazards.

Under no circumstances will team members enter water bodies without protective clothing such as rubber boots or waders. At least one person will remain on shore as a lookout.

When the water temperature is below 45 ^{o}F, hypothermia is a serious risk. A person can lose feeling in the extremities within 5 minutes. All field staff members should be familiar with cold water survival techniques or should receive training from an American Red Cross-certified swimming instructor in cold water survival techniques when site conditions warrant such knowledge. If a team member falls into cold water, he or she should not remove any clothing while in the water because clothing provides additional insulation. Although clothing creates an added drag while swimming, the insulation outweighs the disadvantage of the additional drag. Each team member should carry a wool hat to place on his or her head in case he or she falls into the water. A wool hat, even when wet, provides good insulation for the head, where a large amount of body heat is lost.

The water temperature may be relatively cold. Immersion in water speeds the loss of body heat and can lead to hypothermia. Hypothermia is the abnormal lowering of internal body temperature. If the boat capsizes it will likely float on or just below the surface. To reduce the effects of hypothermia, get in or on the boat. Try to get as much of your body out of the water as possible. If you can’t get in the boat a personal floating device will enable you to keep your head out of the water. This is very important because about 50% of body heat loss if from the head.

In addition to water related hazards, potential contaminants may exist in the sediments and surface water to be sampled. Descriptions, exposure levels, first aid and other pertinent information concerning the primary contaminants of concern can be reviewed in Section 3.0 and Appendix F and Attachment 1.

3.2.6 Burns

Burns can be caused by heat or chemicals. Whether a burn is an emergency or not depends on the depth of the burn, how much of the body area it covers, and/or what part of the body is involved. Burns are normally classified by the amount of damage done.

A. First-Degree Burns:
DIAL 911

SYMPTOMS

First degree burns affect only the topmost layer of skin. They usually involve redness, mild swelling, and pain.

FIRST AID

They are best treated by bathing the burn area with cold water - or applying cold compresses, the sooner the better for about 20 to 30 minutes, followed by mild Vaseline type ointment dressing. They are uncomfortable, but they heal quickly. Generally, first degree burns are not serious. If they involve more than a small area of skin, however the victim should see a doctor.

B. Second-Degree Burns:
DIAL 911

SYMPTOMS

Second degree burns are more serious because they affect deeper layers of skin. They are also much more painful than first-degree burns. Second-degree burns will appear red or molted, blistering will occur, there will be swelling and the surface of the skin may appear wet. This is because plasma is being lost through the damaged skin. If much plasma is lost, the victim will go into shock.

FIRST AID

1. Stop the burning process.
2. Remove any jewelry (retains heat and can cut off circulation if swelling occurs.)
3. If a small area of an arm, hand or foot is involved: Place the burned part in cold water. This will help alleviate pain.
4. If other: First cover the burn with a clean cloth that has been immersed in cold water. Later the burn should be covered with a dry cloth or a clean sheet.

There are a couple of "don'ts" when treating second-degree burns:

1. Do not break blisters or remove pieces of skin.

2. Do not use anything but water on the burn.
3. Do not use any overabundance of cold water as shock and chills may result. Apply cold cloths only to painful but relatively small areas - not to exceed 10% of the body surface.

C. Third-Degree Burns:
DIAL 911

SYMPTOMS
Third-degree burns destroy all layers of skin, extending at least to the subcutaneous (under the skin) tissues. They may cause damage to muscle tissue. Sometimes the depth of the burn can extend to the bone. The burn will appear white or charred and muscle or bone may be visible.

Any third-degree burn must be considered an emergency requiring an ambulance and transport to the hospital emergency department. Call for help.

FIRST AID
1. Cover the burn with a clean, dry cloth or sheet.
2. Don't attempt to remove pieces of clothing that adhere to the wound, and don't put anything else on the burned area.
3. If burns are of the face, have the victim sit-up. Watch for any difficulty in breathing. Severe facial burns may indicate that the victim has inhaled superheated air, causing burns of the respiratory tract. These burns may cause swelling, severe enough to obstruct the airway. If there is trouble breathing, keep the airway open and provide artificial ventilation if needed.

D. Chemical Burns:
DIAL 911

FIRST AID
Chemical burns of the skin should be treated by thoroughly rinsing and flooding the area with cold water for at least 15 minutes. The watering should be done with a hose or shower, and the victim’s clothes should be removed. Be careful not to get any of the chemical on yourself.

If the chemical is powder, brush away the excess powder before you begin washing. Be sure to use a cloth or a towel when brushing away the chemical; avoiding contact with chemical.

Chemical burns of the eyes are particularly serious and can result in the loss of sight. The eyes, eyelid and face should be washed for at least 15 minutes in cool water. Pour water from the inner corner of the eye outward, holding the eyelid open if necessary. If only one eye is affected be careful not to let the chemical wash into the unaffected eye. Treatment should continue until help arrives.

3.2.7 Decontamination

The decision whether or not to decontaminate a victim will be made by the HSC or supervisory level based on the type and severity of the illness or injury and the nature of the contaminant. For some emergency victims, immediate decontamination may be an essential part of life saving first aid. For others, decontamination may aggravate the injury or delay life saving treatment. If decon does not interfere with essential treatment, it will be performed.

a. If decontamination can be done: wash, rinse, and/or cut off protective clothing and equipment.
b. If decontamination cannot be done: wrap the victim in blankets, plastic or rubber to reduce contamination of other personnel. Alert emergency and off-site medical personnel to potential contamination; instruct them about specific decontamination procedure(s) if necessary. Send along site personnel familiar with the incident.

3.3 Major Injuries Requiring Hospital Assistance

If personnel require emergency attention, dial 911. In addition, the appropriate emergency telephone numbers are listed in Section 2.0 and Appendix B and directions to the hospitals from along the project route are included on Figures 2 through 6.

4.0 GENERAL SITE BACKGROUND AND SPECIFIC SCOPE OF WORK

Spectra plans to build a pipeline from Linden, New Jersey to Staten Island, New York, and from there through Bayonne and Jersey City, New Jersey, crossing the Hudson River and terminating in Manhattan, New York. The pipeline route traverses areas with long histories of industrial, commercial and residential development, with discrete tracts of open lands, primarily wetlands. Large portions of the proposed route were formerly low lying and marshy areas that were filled in and converted to "made land" in the 19th and 20th centuries.

Due to the industrial history of the area, the land and ground water have been impacted with a broad suite of chemicals. The contaminants that may be present at the properties to be studied include:

- Volatile organic compounds (VOCs) - including those present in petroleum products (such as benzene, toluene, ethylbenzene and xylenes) and chlorinated solvents (such as trichloroethylene, tetrachloroethylene, and trichloroethane).
- Polynuclear aromatic hydrocarbons (PAHs)– typically found in petroleum fuels, asphalt and coal
- Pure petroleum products, such as gasoline, fuel oil and other liquids and tars
- PCBs
- Pesticides
- Metals, including lead, arsenic, cadmium, and chromium.

In addition to the chemicals associated with past and present industrial practices, the material that was used to fill in marshy areas often contained contaminants, due to the use of coal cinders and ash, construction debris, and other waste materials as fill. Typical contaminants associated with this historic fill include PAHs and metals.

Several properties in Bayonne and Jersey City have been filled with the residue from the refining of chromate ore in the early 20th century. These properties present additional concerns with respect to potential exposure to hexavalent chromium and other associated metals.

This HASP contains information for the following tasks that TRC is expected to conduct at the site:

(1) General survey activities
(2) Wetland delineations
(3) Cultural Resource Investigations
(4) Surface Soil Sampling
(5) Test Pit Excavation/Subsurface Soil Sampling
(6) Subsurface Drilling/ Soil and Ground Water Sampling
(7) Surface Water Sampling
(8) Sediment Sampling
(9) Biota Sampling

All work shall be performed in accordance with applicable local, state, and federal regulations.

RELEASE HISTORY

_____ No evidence of soil contamination
__X__ Suspected or known soil contamination
__X__ Suspected or known ground water contamination

EVALUATION OF HAZARDS (Check all appropriate)

Existing information for site:
__X__ Detailed __X__ Preliminary _____ Sketchy _____ None

Hazardous/Contaminated Material Form(s):
__X__ Solid __X__ Liquid __X__ Sludge _____ Gas _____ Vapor

Containment Type(s):
_____ Drum __X__ Tank _____ Pit __X__ Debris
_____ Pond __X__Lagoon

Hazardous Material Characteristics:
__X__ Volatile _____ Corrosive _____ Reactive _____ Radioactive
_____ Ignitable __X__ Toxic __X__ Unknown _____ Other: ________________

Routes of Exposure:
__X___ Oral ___X___ Dermal ___X___ Eye ___X___Respiratory

4.1 Potential Health and Safety Hazards

Lighting - Work areas must have adequate lighting for employees to perform work and identify hazards, (5-foot candles minimum comparable to a single 70 to 100 watt bulb). Personnel should carry flashlights in all normally dark areas for use in the event of a power failure. Applicable OSHA standards for lighting, 29 CFR 1910.120 (m), shall apply.

Electrical Power - All electrical power must have a ground fault circuit interrupter as part of the circuit. All equipment must be suitable and approved for the class of hazard. Relevant OSHA standards for electrical safety, 29 CFR 1926 (k), shall apply.

Utilities – Overhead and underground utility hazards shall be identified and/or inspected prior to conducting operations involving potential contact. A minimum of 10-foot clearance should be maintained from overhead power lines. A geophysical survey or Hand /soft dig to the appropriate depth, if applicable.

Under Ground Utilities (gas, water, sewer, cable, phone and electric or process related) as per N.J.S.A 48:2-73, N.J.A.C. 14:2-4.1 and in compliance with OSHA regulation 1926.651, no ground intrusive work is to commence without a current under ground utility mark out. The One-Call Underground Utility Damage Prevention System (1-800-727-1000) must be notified not less than 3 full business days before and not more than 10 business days prior to beginning of an excavation or demolition. One Call Market Ticket Confirmation Number(s) will be recorded in the HASP or attached to the HASP that is kept at the site.

Fire Protection/Fire Prevention - Operations involving the potential for fire hazards shall be conducted in a manner to minimize the risk. Non-sparking tools and fire extinguishers shall be used or available as appropriate. Sources of ignition shall be removed. When necessary, explosion-proof instruments and/or bonding and grounding will be used to prevent fire or explosion.

Excavations/Cave-ins – OSHA requires that all excavations which could potentially expose cave-ins shall be protected by sloping or benching the sides of the excavation, supporting the sides of the excavation, or placing a shield between the side of the excavation and the work area. Relevant OSHA standards for trenches, test pits and excavations is included in Appendix F.

Eye Wash Protection - All operations involving the potential for eye injury, splash, etc., must have approved eye wash units locally available as per 29 CFR 1910.151 (c).

Noise Hazards/Hearing Protection - Acoustic hazards may be present during soil excavation or drilling activities. When a noise level prevents conversation in a normal voice at a distance of 3 feet, use proper National Institute of Occupational Safety and Health (NIOSH)-approved hearing protection. Personnel will wear hearing protection to avoid the damaging effects of high noise levels that destroy the ability to hear and create a stressful environment. Proper hearing protection such as earplugs or ear muffs must be worn by all personnel around large machinery such as drill rigs and backhoes, or sources associated with the work site, such as vehicles. Noise levels in the work areas that potentially meet or exceed an 8-hour time-weighted average (TWA) of 85 decibels (dBA), will be evaluated by the SSO to ensure proper protection is implemented. The hearing protection must provide a sufficient reduction in the noise exposure to be below 85 dBA.

Walkways, etc.- Damaged and deteriorated buildings often contain unguarded walkways, doors, etc. where a fall potential exists. These must be guarded and/or posted to prevent employee use or passage. Areas where work will not be performed will be closed off and posted. Applicable OSHA standards for walkways, stairways, etc., 29 CFR 1926.500, shall apply.

High or elevated work - All work over four feet in elevation or where a fall potential exists will be performed using appropriate ladders or step stools and/or fall protection (i.e. body harness and lifeline).

All fall protection equipment will be visually inspected for defects prior to each use. If there is evidence of excessive equipment wear or deterioration or if mechanical malfunction is detected, the item will be removed from service and discarded or repaired in accordance with manufacturer’s instructions. Equipment should be inspected using the Inspection and Maintenance Guide provided and/or the manufacturer’s instructions.

Personnel requiring the use of fall protection equipment will employ the "Buddy System" or have an observer to render assistance if required.

All personnel exposed to fall hazards shall receive fall protection training.

Use of Portable Ladders
The proper ladder must be selected for the task. General rules include the following:

- The ladder chosen must be long enough to provide access to the work area without necessitating standing on the top two steps of a stepladder or the top three rungs of a straight ladder;
- Ladders must be placed on level surfaces. Although ladder feet or shoes provide an important measure of safety, they cannot compensate for uneven ground unless they are designed with adjustable feet;
- Do not use a metal ladder when working on or near electrical equipment;
- The top two steps and platform of a stepladder shall not be used, and the top three rungs of a straight ladder shall not be used;
- Do not over-reach, jump or slide a ladder while on it. Ladders shall not be moved, shifted, or extended while occupied;
- Always face the ladder and use both hands while ascending or descending;
- The top two steps and platform of a stepladder shall not be used and the top three rungs of a straight ladder shall not be used;

To maintain their service life and high performance, all belts and harnesses should be inspected frequently. Visual inspection before each use should become routine, and also a routine inspection by a competent person. If any of the conditions listed below are found the equipment should be replaced before being used.

Harness Inspection

1. *Belts and Rings:* For harness inspections begin at one end, hold the body side of the belt toward you, grasping the belt with your hands six to eight inches apart. Bend the belt in an inverted "U." Watch for frayed edges, broken fibers, pulled stitches, cuts or chemical damage. Check D-rings and D-ring metal wear pads for distortion, cracks, breaks, and rough or sharp edges. The D-ring bar should be at a 90 degree angle with the long axis of the belt and should pivot freely.

   Attachments of buckles and D-rings should be given special attention. Note any unusual wear, frayed or cut fibers, or distortion of the buckles. Rivets should be tight and unremovable with fingers. Body side rivet base and outside rivets should be flat against the material. Bent rivets will fail under stress.

2. *Inspect frayed or broken strands.* Broken webbing strands generally appear as tufts on the webbing surface. Any broken, cut or burnt stitches will be readily seen.

3. *Tongue Buckle:* Buckle tongues should be free of distortion in shape and motion. They should overlap the buckle frame and move freely back and forth in their socket. Rollers should turn freely on the frame. Check for distortion or sharp edges.

4. *Friction Buckle:* Inspect the buckle for distortion. The outer bar or center bars must be straight. Pay special attention to corners and attachment points of the center bar.

Lanyard Inspection

When inspecting lanyards, begin at one end and work to the opposite end. Slowly rotate the lanyard so that the entire circumference is checked. Spliced ends require particular attention. Hardware should be examined under procedures detailed below.

Hardware

1. *Snaps:* Inspect closely for hook and eye distortion, cracks, corrosion, or pitted surfaces. The keeper or latch should seat into the nose without binding and should not be distorted or obstructed. The keeper spring should exert sufficient force to firmly close the keeper. Keeper rocks must provide the keeper from opening when the keeper closes.

2. *Thimbles:* The thimble (protective plastic sleeve) must be firmly seated in the eye of the splice, and the splice should have no loose or cut strands. The edges of the thimble should be free of sharp edges, distortion, or cracks.

Lanyards

1. *Steel Lanyards:* While rotating a steel lanyard, watch for cuts, frayed areas, or unusual wear patterns on the wire. The use of steel lanyards for fall protection without a shock-absorbing device is not recommended.

2. *Web Lanyard:* While bending webbing over a piece of pipe, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Due to the limited elasticity of the web lanyard, fall protection without the use of a shock absorber is not recommended.

3. *Rope Lanyard:* Rotation of the rope lanyard while inspecting from end to end will bring to light any fuzzy, worn, broken or cut fibers. Weakened areas from extreme loads will appear as a noticeable change in original diameter. The rope diameter should be uniform throughout, following a short break-in period. When a rope lanyard is used for fall protection, a shock-absorbing system should be included.

Heat Stress - When the temperature exceeds 70°F and personnel are wearing PPE, a heat stress monitoring program shall be implemented as appropriate. Employees shall have access to break periods and drinking water as necessary. Heat stress is discussed in detail in Appendix D.

Cold Stress - Awareness training is required for all persons working in cold environments should cover the signs and symptoms of cold stress and the ways to reduce the sources of cold stress. Cold stress is discussed in detail in Appendix E.

Biological Hazards – Awareness of these hazards including exposure to poisonous plants, insect bites, animals, etc. is required. Wear light color clothing or Tyvek and insect repellant. During the conduct of Site operations, wild animals such as rats, stray dogs or cats, raccoons, and other rodents may be encountered. Workers will use discretion and avoid all contact with wild animals. Biological Hazards are included in detail in Appendix H.

Physical Hazards - Sources of physical injury (cuts, abrasions, punctures, etc.) will be removed to a safe area as designated by the SSO.

Confined Space - Confined space work and radiation hazards are not anticipated at this time. Should these or other hazards arise, either known or suspected, consult the HSO.

Use of Heavy Equipment and Safe Drilling Practicies - Contact with overhead electric lines and other overhead objects, position rig to avoid overhead utility lines by distance defined by voltage and local regulations. Use spotter when raising mast to confirm clearance of overhead lines and other obstructions. For stability of drill rig/operating equipment, ensure area is clear of free standing water. Avoid positioning rig on soft or uneven ground. For moving equipment, wear appropriate PPE including hard hat, properly sized gloves, and steel-toed boots. Stay clear of rotating auger or direct push equipment.

Hazard Identification/Ranking (based on task and contaminant)

Task: Surface Soil Sampling	Low____	Medium_X__	High___
Task: Subsurface Soil and Ground Water Sampling	Low_____	Medium_X_	High___
Task: Surface Water Sampling	Low_____	Medium_X_	High___
Task: Sediment Sampling	Low_____	Medium_X_	High___
Task: Biota Sampling	Low_X_	Medium___	High___

Hazard Assessment: The site activities will require field personnel to work in woody, undeveloped areas. In addition, TRC personnel will be working in some areas with media potentially contaminated with elevated concentrations of PCBs, PAHs, pesticides and metals.

SITE-SPECIFIC HAZARD ASSESSMENT

The following is a hazard evaluation of the potentially physical, chemical and biological hazards at the site for each task. No radiological hazards are expected at this site. Preceding this hazard evaluation is an evaluation of the chemical to be brought on-site.

Surface and Subsurface Soil Sampling, Ground Water Sampling and Test Pit Excavation

POTENTIAL HAZARD	**ANTICIPATED RISK**
Inhalation of Dusts	low to moderate, keep soils wet to reduce dust, if dusty conditions
Inhalation of Volatile Contaminants	low to moderate, perform air monitoring
Ingestion of Contaminants	low to moderate, use PPE to avoid contact; use washing facilities
Skin and Eye Contact with Contaminants	low to moderate, use PPE to avoid contact; use washing facilities
Working with/near Heavy Equipment	low, wear safety vests and stay away from

	swing radius of equipment
Excavation Hazards	moderate, avoid standing near the perimeter of the excavation and do not enter the excavation if >4 feet
Noise Exposure	moderate, use hearing protection
Tripping Hazards	low, avoid hazards, employ good house keeping
Heat Stress	depends on ambient temperature, drink fluids, monitor heart rate
Cold Exposure	depends on ambient temperature, wear warm clothing, if clothing gets wet, remove and replace with dry clothing
Biological Hazards	moderate, identify nearby toxic plants and be aware of stray animals
Flammable Hazards	low, use LEL meters, ventilate/purge areas with LEL readings >10%
Electrical Hazards	low to moderate; markout utilities, be aware of overhead powerlines and maintain a safe distance; use ground fault circuit interrupters on portable power tools
Traffic Hazards	high, wear safety vests, stay away
Lighting Hazards	low, ensure proper illumination

Sediment, Surface Water and Biota Sampling

Ingestion of Contaminants	low to moderate, use PPE to avoid contact; use washing facilities
Skin and Eye Contact with Contaminants	low to moderate, use PPE to avoid contact; use washing facilities
Tripping Hazards	low, avoid hazards, employ good house keeping
Heat Stress	depends on ambient temperature, drink fluids, monitor heart rate
Cold Exposure	depends on ambient temperature,

	wear warm clothing, if clothing gets wet, remove and replace with dry clothing
Slips, Trips and Falls	moderate to high, wear personal floatation device within 15 feet of water body
Biological Hazards	moderate, identify nearby toxic plants and be aware of stray animals
Traffic Hazards	high, wear safety vests, stay away
Lighting Hazards	low, ensure proper illumination

CHEMICAL HAZARDS

The following is a list of the chemicals to be brought on-site and used by TRC personnel:

X Acetone (1L) for decontamination
X Hexane (1L) for decontamination
X 10% Nitric Acid (HNO3) (1L) for decontamination
X Gasoline (5gal) for generators
X 10% Sulfuric Acid (H_2SO_4) (<5ml) for sample preservation
X 10% Hydrochloric Acid (HCL) (<5ml) for sample preservation
X Isobutylene (17L) for PID calibration
X Methanol (<10ml) for sample preservation

ACCEPTED EXPOSURE LIMITS FOR CHEMICALS TO BE USED ON-SITE

The following is a list of the accepted exposure limits of those substances outlined in Chemicals to be used on Site, with concentrations in parts per million (ppm):

Chemical	**PEL-TWA**	**PEL-STEL**	**TLV-TWA**	**TLV-STEL**	**A1**	**A2**	**Skin**	**Ceiling**
Acetone	1000	NA	500	750	No	No	Yes	NA
Hexane	500	NA	500	1000	No	No	Yes	NA
Gasoline	NA	NA	300	500	No	No	Yes	NA
Nitric Acid*	2	4	2	4	No	No	Yes	NA
Hydrochloric Acid*	5	NA	NA	2	No	No	Yes	5
Hydrogen Sulfide	20	NA	10	15	No	No	---	20
Methanol	NA	NA	200	250	No	No	Yes	NA

***** Diluted to 10%

NOTES:

PEL-TWA	OSHA, Permissible Exposure Limit-Time Weighted Average
PEL-STEL	OSHA, Permissible Exposure Limit-Short Term Exposure Limit
TLV-TWA	ACGIH, Threshold Limit Value-Time Weighted Average
TLV-STEL	ACGIH, Threshold Limit Value-Short Term Exposure Limit
A1	ACGIH, Known Human Carcinogen
A2	Suspected Human Carcinogen
Skin	Refers to the potential overall exposure through skin absorption, including mucous membranes and eye, either airborne or through direct contact with the substance
Ceiling	ACGIH, the concentration that should not be exceeded during any part of the working exposure.

NA = Not Available

Information based on the *ACGIH's 2004 TLVs and BEis* and *NIOSH 1997 Pocket Guide to Chemical Hazards.*

Material Safety Data Sheets are provided for each possible chemical to be brought on-site are found in Appendix E.

CHEMICALS COMMONLY BROUGHT ON SITE					
Substance	**Route of Entry**	**Exposure Symptoms**	**Treatment**	**8-Hour TWA**	**STEL & IDLH**
Acetone	Inhalation Ingestion Skin/Eye Contact	Eye/nose/throat irritation, headache, dizziness, central nervous system depression, dermatitis.	Eye: Immediately wash eyes Skin: Immediately flush skin with soapy water. Breath: Move to fresh air, perform mouth to mouth resuscitation if necessary. Swallow: Get medical attention immediately.	250 ppm	STEL: 750 ppm IDLH: 2500 ppm
Hexane	Inhalation Ingestion Skin/Eye Contact	Eye, nose, and throat irritation, light headedness. Nausea, headache, peripheral neuropathy, numbness. Muscle weakness, dermatitis, giddiness, chemical pneumonia	Eye: Immediately wash eyes. Skin: Immediately flush skin with soapy water. Breath: Move to fresh air, perform mouth to mouth resuscitation if necessary. Swallow: Get medical attention immediately.	50 ppm	IDLH: 1100 ppm
Gasoline	Inhalation Absorption Ingestion Skin/Eye Contact	Eye/skin/ mucous membrane irritation, dermatitis, headache, fatigue, blurred vision, dizziness, slurred speech, confusion, convulsions, chemical pneumonia, possible liver/kidney damage, carcinogenic.	Eye: Immediately wash eyes. Skin: Immediately flush with soapy water. Breath: Move to fresh air, perform mouth to mouth resuscitation if necessary. Swallow: Get medical attention immediately.	300 ppm	STEL: 500 ppm

CHEMICALS COMMONLY BROUGHT ON SITE					
Substance	**Route of Entry**	**Exposure Symptoms**	**Treatment**	**8-Hour TWA**	**STEL & IDLH**
Nitric Acid	Inhalation Ingestion Skin/Eye Contact	Eye/skin/mucous membrane irritation, delayed pulmonary edema, pneumontis, bronchitis, dental erosion.	Eye: Immediately wash eyes. Skin: Immediately flush with soapy water. Breath: Move to fresh air, perform mouth to mouth resuscitation if necessary. Swallow: Get medical attention immediately.	2 ppm	STEL: 4 ppm IDLH: 25 ppm
Hydrochloric Acid	Inhalation Ingestion Skin/Eye Contact	Nose/throat/larynx irritation, coughing, choking, dermatitis, eye/skin burns	Eye: Immediately wash eyes. Skin: Immediately flush with soapy water. Breath: Move to fresh air, perform mouth to mouth resuscitation if necessary. Swallow: Get medical attention immediately.	5 ppm	STEL: 2 ppm IDLH: 50 ppm
Hydrogen Sulfide	Inhalation Skin/Eye Contact	Eye/respiratory system irritation, apnea, coma, convulsions, conjunctivitis, photosensitivity, corneal vesiculation, dizziness, headache, fatigue, irritability, insomnia, gastrointestinal disturbance.	Eye: If eye tissue is frozen seek medical attention immediately, otherwise immediately wash eyes. Skin: Seek medical attention immediately, DO NOT rub or flush affected area. Breath: Move to fresh air, perform mouth to mouth resuscitation if necessary.	10 ppm	STEL: 15 ppm IDLH: 100 ppm

CHEMICALS COMMONLY BROUGHT ON SITE					
Substance	**Route of Entry**	**Exposure Symptoms**	**Treatment**	**8-Hour TWA**	**STEL & IDLH**
Methanol	Inhalation Absorption Ingestion Skin/Eye Contact	Eye/skin/upper respiratory system irritation, headache, drowsiness, dizziness, vertigo, light headed, nausea, vomit, visual distortion, optic nerve damage, blindness, dermatitis.	Eye: Immediately wash eyes. Skin: Immediately flush with soapy water. Breath: Move to fresh air, perform mouth to mouth resuscitation if necessary. Swallow: Get medical attention immediately.	200 ppm	IDLH: 6000 ppm

5.0 CONTAMINANTS OF CONCERN

Overview of Contaminants of Concern

The primary contaminants that have been identified in site soils, sediment, ground water and surface water are listed below. In addition, the exposure limits, potential exposure routes and toxic characteristics are also included. Material Safety Data Sheets (MSDS) are provided for each contaminant of concern and are found in Appendix E; and the available National Institute for Occupational Safety and Health (NIOSH) pocket guide sheets are included in Attachment 1.

Contaminant	**Max Conc. (ppm)**	**Media**	**TWA**		**IDLH**	**Exposure Routes**	**Toxic Characteristics**
			PEL-	**REL-**			
Volatile Organic Compounds	NA						
Polycyclic Aeromatic Hydrocarbons	NA						
Polychlorinated Biphenyls	NA						
Chromium Slag	NA						

Inh = Inhalation
Con = Contact
NA = Not Available
Abs = Absorption via skin or eyes
A = Acute
Ing = Ingestion
C = Chronic

No data available at this time. HASP revisions will occur after data is acquired.

6.0 SITE CONTROL MEASURES

Work zones will be established based on the existing site data described in the Investigation Workplan to prevent or minimize exposure of unauthorized personnel to hazards by establishing boundaries to reduce migration of contaminants from designated work areas covered by the HASP into clean areas. A three-zone approach will be used for field activities covered under this HASP. The zones will be identified during safety briefings and may be clearly marked by traffic cones, caution tape, barricades, signs, or other means. These zones are designated as the Support Zone, the Contamination Reduction Zone (CRZ), and the Exclusion Zone. The designated zones applied to the site on a large scale are shown on Figure 3. The three Zones are duplicated to facilitate the site work to be conducted on both sides of Bound Brook (which transects the Woodbrook Road site). Access to work areas in the Exclusion Zones will be accomplished through CRZs and Support Zones to be established inside the two site entrance gates on Woodbrook Road prior to commencement of RI/FS Workplan activities. The Support Zone and CRZs are located away from the landfill material and areas of known contamination; the Exclusion Zones envelop the areas of the site that contain historic fill material that include contaminated disposal areas.

6.1 Support Zone

The Support Zone is the clean area in which the possibilities of encountering hazardous materials or conditions are minimal. Therefore, personal protective and respiratory equipment are not necessary. Inside the Support Zone, the following will be available: an effective means of communication, first-aid supplies, fire extinguisher, drinking water, and other appropriate support facilities. The support Zone shall also serve as the main point of contact for the visitor check-in and initiation of emergency services when necessary.

6.2 Contamination Reduction Zone

The CRZ is the area where equipment and personnel are decontaminated before leaving the Exclusion Zone. Personnel will remove and/or decontaminate PPE and place it in appropriate containers. Site vehicles and equipment will also be decontaminated in the CRZ. The CRZ will consist of a temporary decontamination area, a means of washing protective equipment, site equipment; containers for liquids, solids, and PPE; first-aid supplies; an eyewash kit; and a fire extinguisher. Eating, drinking, chewing gum or tobacco, smoking, or any proactive that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the CRZ.

Personnel performing decontamination operations will be provided with appropriate personal protection equipment, including face shield, rain suits or chemical resistant PPE as needed, water/chemical resistant boot covers, gloves and hearing protection.

6.3 Exclusion Zone

The Exclusion Zone includes the designated work activities at the site. Only authorized, trained, and qualified personnel with the appropriate personal protective equipment shall be admitted into the Exclusion Zone.

Work activities within the Exclusion Zone pose the greatest possibility of exposure to personnel and equipment. The Project Manager and SSO shall be responsible for controlling the access points and keeping bystanders and unauthorized personnel to a minimum. The Exclusion Zone will be clearly marked with flagging, barricade tape, traffic cones, or other signals to limit access.

Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the Exclusion Zone.

6.4 Work Zone Control

Work zone layouts and locations will be established by the SSO at the time of the work and may be marked with barrier tape, barrier ribbon, or other suitable warning devices, where necessary.

7.0 DELINEATION OF WORK AREAS AND DECONTAMINATION PROCEDURES

7.1 Local Work Areas

The site work anticipated during implementation of the Investigation Workplan includes test borings, test pit excavations, and soil, ground water, sediment and surface water sample collection. Associated tasks may include site inspections, utility markout and equipment/personnel decontamination, as needed during the Investigation Workplan implementation. These tasks will generally be conducted within the work zones as outlined in Section 6.0. However, local work areas will be established in accordance with the appropriate PPE Level at each sample collection site, around the sample location and any associated heavy equipment to be included in the sampling operations (e.g., drill rig, backhoe). Air-quality monitoring results and contaminant characteristics govern the level of personal protection equipment (PPE) required for each specific task and for local work areas at the site. Levels of protection will be upgraded as necessary. PPE Levels are defined in Section 10.0.

7.2 Level D Area

All personnel entering Level D areas are required to wear Level D personal protection.

Decontamination procedures prior to leaving Level D areas consist of brushing loose soil from clothing and equipment, washing equipment and protective clothing with mild detergent and water. Disposable gloves, paper towels and Tyvek suits will be discarded in the trash receptacles provided within these areas. Drill rigs will be brushed clean of gross contamination before proceeding to the heavy equipment cleaning zone.

Upon completion of project work, all sampling equipment will be decontaminated with soap and water prior to transport off-site.

Wastes generated in Level D areas will be bagged and disposed of on site without any additional restrictions.

7.3 Level C Area

Entry to Level C areas will be provided only to those persons wearing Level C personal protection.

Level C areas will be divided into a work zone and a decontamination zone. When exiting the work zone, workers enter the decontamination zone, which will be covered with a plastic liner to contain wash solutions and contaminated soil. Instruments, sample containers and reusable equipment will be placed on a plastic covered table. The workers will then decontaminate their protective clothing. Disposable items will be discarded in trash receptacles that will be moved to the heavy equipment cleaning area.

Liquid wastes generated in Level C restricted areas will be containerized and removed. Dry materials such as suits and gloves will be placed in garbage bags disposed of on site.

7.4 Level B Area

Entry to level B areas will be provided only to those persons wearing level B personal protection. Procedures are same as for Level C.

7.5 Decontamination

Decontamination will be conducted in accordance with the NJDEP Field Sampling Procedures Manual (2005) and USEPA's August 11, 1994 SOP No. 2006, "Sampling Equipment Decontamination". Proper decontamination is required for all personnel before leaving the site. A decontamination area shall be designated within the Contamination Reduction Zone prior to the implementation of field activities and shall be cordoned off to restrict unauthorized personnel. The decontamination will be accomplished through a systematic procedure of cleaning and removing personal protective equipment (PPE). Contaminants can adhere to the surface of PPE or permeate PPE material. It is important to avoid bodily contact with contaminated material, and to prevent contamination of the Support Zone. All contaminated material that becomes attached to clothing or equipment must be removed and/or neutralized in either the exclusion Zone or the Contamination Reduction Zone. PPE decontamination will include the following: washing of boots (or the removal and disposal of boot covers); washing, removal and disposal of disposable coveralls (or protective suits); removal and disposal of outer and inner gloves and finally, washing of hands, arms and face prior to leaving the site. Disposable PPE will be carefully removed and placed in plastic bags and sealed. When reusable personal protective equipment is worn, it must either be decontaminated on site. After cleaning, the reusable protective equipment will be sealed in plastic bags for return shipment.

All non-disposable equipment involved in field sampling activities will be decontaminated prior to and after sampling. Equipment leaving the Site will also be decontaminated. Alconox and water wash will be used to remove all visible particulate matter and residual oils and grease. This may be preceded by using high pressure water or steam to facilitate residual removals. All heavy equipment (e.g., backhoe, drilling equipment) will be steam cleaned prior to and after use. Well screens and riser pipe will also be steam cleaned to remove any cutting oils and staged on clean plastic sheeting prior to installation. Pressurized steam will be used to remove all visible excess material from augers, rods, drill bits, the back of the drilling rig, and other parts of the rig which contact augers, rods, and split-spoons.

Field instrumentation (such as interface probes, water quality meters, etc.) will be decontaminated between sample locations by rinsing with deionized water. If visible contamination still exists on the equipment after the rinse, an Alconox detergent scrub will be added, and the probe thoroughly rinsed again.

Non-disposable sampling equipment, including the pump, support cable and electrical wires in contact with the sample, must be decontaminated thoroughly each day before use and after each well is sampled. For pumps, it is strongly recommended that non-disposable sampling equipment, including the pump, support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use. All non-dedicated sampling equipment (e.g., pumps, tubing) must be decontaminated after each well is sampled.

Sampling equipment will be decontaminated with soap and water, an acid rinse if metals are a concern in that particular area, followed by a water rinse using distilled water, then a solvent rinse, either acetone or hexane to remove trace organics. Once the solvent completely evaporates, then a final distilled water rinse will be performed prior to transport off-site. The sampling equipment will be decontamination in accordance with the procedures outlined in the USEPA's August 11, 1994 SOP No. 2006, "Sampling Equipment Decontamination" as summarized below:

1. Physical removal
2. Non-phosphate detergent wash
3. Tap water rinse
4. Distilled/deionized water rinse
5. 10% nitric acid rinse
6. Distilled/deionized water rinse
7. Solvent rinse (pesticide grade)
8. Air dry
9. Distilled/deionized water rinse

Personnel directly involved in equipment decontamination will wear appropriate protective clothing, as stated in the HASP. Used personal protective equipment (PPE) will be disposed of in new USDOT-approved drums classified as 1A1/Y 340/S or equivalent lined with a 6-millimeter liner. The drums will be labeled with a unique drum number and a TRC I.D. sticker. The drums will be staged in a designated area and will be disposed of by TRC. All waste handling will be in accordance with all applicable federal and state regulations.

7.5.1 Emergency Personnel Decontamination

Should workers be splashed with hazardous contaminants, the worker will immediately be escorted to the field decontamination station and be decontaminated as follows.

1. Removal of all contaminated clothing.
2. Wash off under pressurized shower (15 minutes).
3. Remove all wet clothing.
4. Cover with blanket or (if injury is not serious) dress in clean/dry clothing.
5. Transport worker to hospital if necessary.

7.6 Fire Fighting Equipment

A Type ABC Fire Extinguisher will be carried in all vehicles.

7.7 Physical Hazards

All personnel in the vicinity of the operating machinery are required to exercise caution during operation of the machinery, wear hard hats, safety glasses with side shields, hearing protection and steel-toed footwear.

All personnel shall observe the location of overhead and underground hazards. In general, slip, trip and fall hazards will be present during the course of the site work.

8.0 STANDARD OPERATING PROCEDURES

8.1 Hazard Communication

Hazard communication ensures that potential hazards associated with chemicals in the workplace are known and that relevant health and safety information is transmitted to employer and employee. The transmittal of hazard information is accomplished by a hazard communication program which includes container labeling and other forms of warning, material safety data sheets and employee training.

8.2 Material Safety Data Sheet (MSDS)

MSDS provide the worker with valuable information. A MSDS for each contaminant of concern at the site is provided in Appendix F.

8.3. Site/Safety Operating Procedures

1. Always observe the buddy system. Never enter or exit a site alone, and never work alone in an isolated area. Never wander off by yourself.

2. Always maintain line-of-sight.

3. Practice contamination avoidance. Never sit down or kneel, never lay equipment on the ground, avoid obvious sources of contamination such as puddles, and avoid unnecessary contact with on-site objects.

4. No eating, drinking, or chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in all work areas.

5. In the event PPE is ripped or torn, work shall stop and PPE shall be removed and replaced as soon as possible.

6. Be alert to any unusual changes in your own condition; never ignore warning signs. Notify SSO as to suspected exposures or accidents.

7. In an emergency, dial 911. A vehicle will be readily available for emergency use. All personnel going on site shall be familiar with the most direct route to the nearest hospital.

8. In the event of direct skin contact, the affected area shall be washed immediately with soap and water.

9. Copies of this HASP shall be readily accessible.

10. Note wind direction. Personnel shall remain upwind whenever possible during on-site activities.

11. Never climb over or under refuse or obstacles. Use safety harness/safety lines when sampling lagoons, streambeds, and ravines with steep banks. A life vest will be used when within five feet of water.

12. Hands and face must be thoroughly washed before eating, drinking, etc.

13. Any modifications (downgrading) to this safety plan MUST be approved by the HSO.

14. Check portable first aid kit and eyewash equipment daily.

15. No jewelry on site.

16. No facial hair that may break a respirator to face seal is allowed on personnel required to wear respiratory protective equipment.

17. Medicine and alcohol can potentiate the effects from exposure to toxic chemicals, and decrease safety alertness.

18. Hot or cold weather can cause physical discomfort, loss of efficiency, stress, and personal injury.

19. Horseplay is prohibited in all areas.

20. In general, slip, trip and fall hazards will be present during the course of the site work.

Additional Site Safety and Survey Procedures are included in Appendix J.

9.0 WORK REQUIREMENTS ON OR ALONG EXISTING SPECTRA RIGHT-OF-WAYS

Special Instructions and Conditions:

1. Emergency Response and Emergency Evacuation procedures must be submitted to Spectra and reviewed with on site employees
2. Emergency contact sheet should be prepared and provided to personnel in the field. (i.e. driving directions to hospital, police department, etc.)
3. Means and method of the work being performed
4. If applicable, subcontractors performing the work
5. If applicable, subcontractors' Health and Safety Plan

Field personnel shall at all times comply with Spectra Energy's EHS program, including Spectra's Minimum Control Standards (Appendix K) and if requested by Company, shall submit to the Spectra Energy Representative a Job Safety Analysis ("JSA") form and a Project Specific Safety Plan.

10.0 GENERAL REQUIRED LEVELS OF PROTECTION

The following is a brief description of the PPE which may be required during various phases of the project. The U.S. EPA terminology for PPE will be used: Levels “A”, “B”, “C” and “D”. Respiratory protective equipment shall be approved by the National Institute of Occupational Safety and Health (NIOSH) and use shall conform to 29 CFR 1910.134 requirements. Each employer shall maintain a written respirator program detailing selection, use, cleaning, maintenance and storage of respiratory equipment. If requested, each employer may be required to provide the documentation necessary to indicate compliance with this regulation.

Level D protection:

(a)	Coveralls:	standard work uniform and/or Tyvek
(b)	Gloves:	latex and vinyl, (leather, as needed)
(c)	Boots:	steel-toed
(d)	Hard Hat	ANSI approved, as needed
(e)	Modifications:	ANSI approved safety glasses with side shields and hearing protection, as needed

Level C protection:

(a) Full-face, air-purifying respirator:

Cartridge type: Organic vapors/acid gases P100 filter (filter certified by NIOSH under 32 CFR Part 11 or Part 84)

(b)	Coveralls:	type	(1) Chemical-resistant coveralls (poly-coated Tyvek) must be used by personnel who will come into direct contact with contaminated soils or liquids.
(c)	Gloves:	type	(1) Nitrile or PVC gloves will be worn by personnel who come into direct contact with saturated soils and/or liquids. (2) Latex gloves may be worn by personnel who will come into incidental contact with contaminated soils or liquids.
(d)	Boots: type		Latex over steel-toe
(e)	Hard Hat		Yes _X_ No ___
(f)	Modifications:		Hearing protection, as needed

Level B protection:

(a) Positive-pressure, full-face, self-contained breathing apparatus (SCBA) or a tethered, cascade breathing system. In the case where an air-line or cascade breathing system is employed (in lieu of an SCBA), 5-minute escape cylinder is also required.

(b) Coveralls: type (1) CPF II or equivalent will be worn by personnel who come into incidental contact with contaminated soils and/or liquids. Clothing should be removed and replaced when contaminated.

(2) Poly-coated Tyvek; may be used by personnel who will not come into direct contact with contaminated soils or liquids.

If work entails handling of free-flowing liquids, a reevaluation of work practices and protective equipment will be conducted.

(c) Gloves: type (1) Nitrile gloves will be worn by personnel who come into contact with saturated soils and/or liquids.

(2) Latex/Nitrile gloves will be worn by personnel who will come into incidental contact with contaminated soils or liquids.

(d) Boots: type Latex over Steel-toe

(e) Hard Hat Yes_X_ No__

(f) Modifications: Hearing protection

Limitations of PPE:
PPE clothing ensembles designated for use during site activities have been selected to provide protection against contaminants at known or anticipated onsite concentrations and physical states. However, no protective garment, glove, or boot is entirely chemical-resistant, nor does any protective clothing provide protection against all types of chemicals. Permeation of a given chemical through PPE depends on the contaminant concentration, environmental conditions, physical condition of the protective garment, and resistance of the garment to the specific contaminant. Chemical permeation may continue even after the source of contamination has been removed from the garment.

All site personnel will use the following procedures to obtain optimum performance from PPE:

(1) when chemical-protective coveralls become contaminated, don a new, clean garment after each rest break or at the beginning of each shift; (2) inspect all clothing, gloves, and boots both before and during use for imperfect seams, non-uniform coatings, tears, and poorly functioning

closures; and (3) inspect reusable garments, boots, and gloves both before and during use for visible signs of chemical permeation, such as swelling, discoloration, stiffness, brittleness, cracks, any sign of puncture, and any sign of abrasion. Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above must be discarded.

It is the responsibility of the field supervisor to insure that all personnel and subcontractors are informed of the level of personal protection required in all work situations. Furthermore, it is the obligation of the SSO to see that proper equipment is worn and work rules are observed. All subcontractors are responsible for supplying their personnel with the necessary equipment.

Decontamination and Disposal

Personnel Decontamination Procedure:

Level B-	Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, tape removal, boot cover removal, outer glove removal, SCBA backpack removal, suit and hard hat removal, SCBA mask removal, inner glove removal, and field wash. Containerize disposable PPE in garbage bags.
Level C-	Segregated equipment drop, tape removal, boot cover removal, outer glove removal, (canister or mask change), rubber boot removal, splash suit removal, and inner glove removal. Containerize disposable PPE in garbage bags.
Level D-	Segregated equipment drop, tape removal, boot cover removal, outer grove removal, and inner glove removal. Containerize disposable PPE in garbage bags.

Modifications (specify):

In levels C and B, all equipment will be protected with a plastic covering and will be decontaminated at the site prior to leaving the site.

11.0 AIR MONITORING AND ACTION LEVELS

According to 29 CFR 1910.120 (h) air monitoring shall be used to identify and quantify airborne levels of hazardous substances and health hazards to determine the appropriate level of employee protection needed on site. Air monitoring will be conducted during the implementation of the RI/FS workplan.

Air monitoring at the site will consist of following types of monitoring.

Initial Monitoring – Air monitoring is initially conducted at a new work site to identify and evaluate potentially hazardous conditions that are previously uncharacterized.

Periodic Monitoring – Air monitoring is periodically repeated when hazardous atmospheres have the potential to develop during remediation activities. Examples of when this may occur are when work begins on a different portion of the site.

Perimeter Monitoring – Air monitoring is conducted to verify that designated “clean areas” (where upgraded levels of PPE are not required) remain free of airborne hazards.

Exposure Limits

The exposure limits used in this program are OSHA’s permissible exposure limits (PELs) as listed in 29 CFR Part 1910, Subparts G and Z. If a PEL does not exist for any particular substance, the exposure limits published in “NIOSH Recommendations for Occupational Health Standards” dated 1986 (incorporated by reference) will be used. If none are specified by NIOSH, the exposure limits specified by the American Conference of Governmental Industrial Hygienists (ACGIH) in their most current publications of “Threshold Limit Values and Biological Exposure Indices” will be used.

For those chemicals, such as benzene and lead, which have an individual OSHA standard written for a specific chemical, the “action level” prescribed in that standard will be used as the exposure limit where possible.

For substances which do not have published exposure limits as described above, the published literature and MSDS may be used as a guide for determining the proper level of protection.

Levels of protection will be upgraded as necessary based on action levels of the site-specific contaminant of concern. Only the Site Safety Officer, with the consent of the Health & Safety Officer can downgrade to a lower level. Changes will be made in writing

11.1 Air Quality Monitoring and Action Levels

The instruments and procedures that will be used for air monitoring activities to determine if the potential hazards identified in Section 5.0 are present are described below. These activities may not be necessary at every work location and may be modified at the discretion of the SSO. At a minimum, monitoring will include evaluations for combustible atmospheres, oxygen-deficient environments, and potentially hazardous vapor concentrations.

The Dust Exposure Calculation Worksheet is included in Appendix I. The permissible exposure limit (PEL) assumes the highest levels for each contaminant that would be found in airborne particulates simultaneously, as a worst case scenario for exposure to airborne contaminants. The resulting "Mixed Dust Action Level" is the airborne particulate PEL based on using a direct reading particulate dust monitor.

A dust exposure calculation worksheet should be prepared once a specific list of the contaminants of concern for this site is obtained. The action level for each contaminant of concern and the maximum soil concentration at the site will be used to determine the applicable dust exposure level. A dust monitoring equipment shall then be used at the site to ensure dust levels remain below the calculated Permissible Exposure Level (PEL).

Applicable Monitoring Equipment Calibration/Information

PID

A single calibration conducted prior to an activity will be considered acceptable for a period of use one day. If the reading deviates more than +15 percent from concentration of the calibration gas, the instrument requires maintenance.

CGI

The CGI measures the concentrations of a flammable vapor or gas in the air. The results are presented as a percentage of the lower explosive limit (LEL) of the calibration gas.

An oxygen level of 20.8% is necessary to sustain a normal breathing atmosphere. Action levels for atmospheric oxygen are 19.5%, indicating an oxygen deficient atmosphere, and 23.5%, indicating an oxygen rich atmosphere. It is important to note that an oxygen-rich atmosphere may create the potential for an explosive hazard. If oxygen levels fall below 19.5% or go above 23.5%, work will be discontinued.

The action level established for hydrogen sulfide is 5 parts per million (ppm). If concentrations meet or exceed 5 ppm for sustained readings of five minutes, work will be temporarily discontinued, workers will be moved to an area upwind, and the work area will be permitted to vent.

Miniram

The Miniram monitors for airborne particulates and dust. This real-time monitoring instrument is capable of sensing and measuring aerosol concentrations over the range of 0.01 to 100 mg/m^3.

RAM

The RAM monitors for airborne particulates and dust (real time aerosol monitor) capable of detecting a particle size range of less than 0.11 to 20 micrometers in diameter and a concentration range of 1 microgram/meter^3 to 200 milligrams/meter^3.

Drager Tube(s) and Pump

Drager Tubes are used for identification of a specific compound and its concentration.

The following information will be recorded daily by the SSO for each piece of monitoring equipment:

- Name and model number of the equipment
- Calibration information
- Field work to be performed
- Air monitoring results and monitoring locations
- PPE worn
- Accidents or incidents
- Unusual occurrences or personnel complaints

The presence of airborne contaminants will be evaluated through the use of direct-reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being employed in work areas at the site, and may be used as the basis for upgrading or downgrading levels of protection, at the discretion of the SSO.

Organic Vapors
A photoionization detector (PID) with a 10.6eV lamp will be used to monitor breathing zone concentrations of organic vapors. If necessary, Draeger Tubes will be used to determine the individual VOCs present. Monitoring for organic vapors will be conducted during all intrusive activities such as test pits and soil drilling. Calibration of the monitoring equipment will be performed daily before start-up of work. In addition, the frequency and use of both PIDs will be at the discretion of the SSO.

Airborne Dust
A mini-RAM dust detector (mini-RAM) or equivalent will be used to monitor levels of airborne dust in a work area where there is a potential to exceed the action levels as described in the table below. Monitoring for dust will be conducted during, but not limited to, all intrusive activities. Equipment calibration will be performed in accordance with manufacturer instructions.

Explosion Hazard/Hydrogen Sulfide/Oxygen/Carbon Monoxide
A multi-gas/combustible gas indicator will be used during all intrusive activities to monitor the possible presence of flammable gases or vapors. Equipment calibrations will be performed before start-up of work per manufacturer instructions. The alarm will be set to 10% of the LEL. If the monitoring instrument indicates the LEL is greater than 10%, >35 ppm carbon monoxide or >20 ppm hydrogen sulfide, personnel must leave the area. Personnel must not re-enter the area until the LEL is less than 10%, <35 ppm carbon monoxide or <20 ppm hydrogen sulfide.

Methane
A gas analyzer and extractor monitor will be used to monitor the presence of methane. Equipment calibrations will be performed before start-up of work per manufacturer instructions.

Methane is one of the primary gases at the landfill. ***Methane is explosive at concentrations between 5 and 15 percent by volume in air - the lower explosive limit (LEL) and the upper explosive limit (UEL), respectively***. If the monitoring instrument indicates that methane is greater than 5%, personnel must leave the area and allow the area to ventilate. Personnel must not re-enter the area until methane levels are below 5%.

PID	Combustible Gas Indicator2				Gas Analyzer	MiniRAM Airborne Dust3			Action
Organic Vapors[2]	O_2	LEL	CO	H_2S	CH_4	Exclusion Zone	Exclusion Zone Perimeter	Site Property Line	
Background	>19.5 and <23.5%	<10%	<25ppm	<1ppm	>5% (methane)	<0.368 mg/m^3	<0.18mg/m^3	<0.150mg/m3	Level D or modified D at the discretion of the SSO
>5 ppm and <50 ppm	--	>10% to <25%(1)	< 50	>1 and <10 ppm	--	>0.368 mg/m^3 (2)	>0.18mg/m^3	<0.150 mg/m^3 or visible dust	Upgrade to Level C[4] protection. (1) Continue work with Extreme Caution (2) Use a respirator with a P-100 filter cartridge
>50 ppm and <500 ppm	>19.5 or >23.5%	- -	>50 ppm	>20 ppm	--	>0.368 mg/m^3	>0.18mg/m^3	<0.150 mg/m^3 or visible dust	Suspend work in immediate area and notify SSO. Conduct air monitoring periodically to determine when and if work may be continued. Upgrade to Level B protection.
>500ppm	<19.5 or > 23.5%	>25%	--	--	> 5 to <15% (methane)	--	--	--	**POTENTIALLY HAZARDOUS ATMOSPHERE.** Immediately shut off all possible ignition sources and evacuate work area. Secure perimeter. Notify SSO. Monitor vapor concentrations from a distance until LEL remains below 10 % for at least 15 minutes.

Notes:

1. Combustible Gas Indicator that monitors gases will be used during field activities including all soil sampling and excavations and all well gauging and sampling. Action levels for gases are based on instantaneous readings. Continuous air monitoring will be performed during all phases of investigation activities.
2. Organic Vapors: Monitor organic vapors during all intrusive activities (all soil and sediment sampling and monitoring well installation). Action levels for organic vapors are based on 15-minute time-weighted average concentrations. If PID readings exceed background, an analysis for benzene should be performed using colorimetric tubes (Benzene 0.5c/Draeger tube or equivalent). If benzene readings greater than 0.5 ppm and less than 5 ppm, suspend work and institute engineering controls. If readings do not decrease, upgrade to Level C. If benzene reading is greater than 5 ppm, suspend work in immediate area and notify field supervisor. Conduct air monitoring periodically to determine when work may be continued.
3. Dust: Monitor airborne dust during excavation activities. The OSHA PEL for nuisance dust is 5 mg/m^3. Dust action levels for Exclusion Zone (0.368 mg/m^3) and Exclusion Zone Perimeter (0.18 mg/m^3) are based on 15-minute time-weighted average concentrations and take into consideration fill soil contaminant concentrations. Dust action level for Site property line (0.150 mg/m^3) is based on 24-hour average concentrations, NAAQS 40 CFR Part 50.
4. If colorimetric tubes (Benzene 0.5c/Draeger tube or equivalent) are not used, upgrade to Level B.
5. Must be quantitatively fit tested to upgrade to Level B.

12.0 MEDICAL SURVEILLANCE

Medical monitoring is required by OSHA as a means of monitoring worker exposure to certain toxic substances under 29 CFR 1910.120(f), OSHA's Hazardous Waste Operations and Emergency Response Standard.

The main purposes of the medical monitoring program for this project are to:

1. ensure that a worker's state of health will not be compromised by the activity tasks;

2. ensure that a worker is fit and capable to do the job, including the wearing of respiratory protection; and

3. establish a baseline in order to determine if a worker's health has been compromised by the activity tasks.

Physical Examination Documents

Employees whose work assignments require their presence at a hazardous work site are required to have a baseline medical evaluation prior to commencement of hazardous work activity. The baseline medical evaluation is performed by Dr. Thomas Pitocia, M.D, a licensed physician, of Millburn Medical Center, Assoicaties in Primary Care located at 25 East Willow Street, Millburn, New Jersey and consists of the following:

- Medical and Occupational History
- Physical Examination
- Pulmonary Function
- Urinalysis
- CBC (with differential and RCB) Chem 24 (SMAC)
- RBC Cholinesterase
- Urine Heavy Metal Panel
- Blood Lead with zinc protoporphyrin (zpp)
- Chest X-Ray (2-view)
- EKG (over 40 years of age)
- Audiometry

The annual medical evaluation consists of the following:

- Physical Examination and History
- Pulmonary Function
- Urinalysis
- CBC (with differential and RCB) Chem 24 (SMAC)
- RBC Cholinesterase
- Blood Lead with zpp
- EKG (Over 40 years of age)
- Audiometry

Additional tests which may be performed as part of the annual examination include the following:

- Cholinesterase - plasma
- Urine - heavy metal
- Blood - PCB
- Chest X-Ray (2-view)

Based upon this examination and a review of the employee's job description, the physician identifies any medical restrictions that would affect an employee's ability to safely perform his/her job. If no restrictions are imposed, the physician certifies the employees as capable of full participation in the work program.

If an employee suspects exposure to a toxic chemical or other hazard while performing project tasks, additional tests may be ordered immediately following the exposure period. Individuals are encouraged to discuss changes in their health status with the SSO, the Company Health and Safety Director and/or physician.

Access to Exposure and Medical Records

Instructions regarding the existence, location, availability of employee medical records shall be provided to the employee for all medical exams conducted as a result of their employment, and at least annually. Employee access to records shall be provided in a reasonable time, place and manner, but on no event later than fifteen days after the request is received.

Physical Examination and Respirator Approval

Medical clearance from a physician for the respirator type to be used is required for each employee before they are allowed to don respiratory protection. Additionally, each employer must select a respirator acceptable for use and that will provide the correct protection for the specific exposure. The employer is responsible for administering fit tests for all new respirators used by employees, and must administer training on a yearly basis.

Emergency First Aid

All accidents or near miss incidents will be dealt with in a manner to minimize further injury to the individual or others. In the event that an accident does occur, the following general procedures should be followed:

- First aid and other appropriate action shall be given by the qualified individual closest to the event.

- Contact hospital and arrange for ambulance if necessary.

- As soon as practicable, the incident shall be reported to the SSO and the Project Manager. The PM and the SSO, shall be responsible for making all decisions concerning treatment, and/or other appropriate action.

The accident investigation reports/forms as provided in Appendix B will be completed and forwarded to the SSO and PM where they will be kept on file.

13.0 TRAINING PROGRAM

13.1 Medical Surveillance Program

Medical monitoring is required by OSHA as a means of monitoring worker exposure to certain toxic substances under 29 CFR 1910.120(f), OSHA's Hazardous Waste Operations and Emergency Response Standard. All employees who may be exposed to hazardous substances or health hazards are included in a medical surveillance program. Medical monitoring programs are designed to track the physical condition of employees on a regular basis as well as survey pre-employment or baseline conditions prior to potential exposures. The medical surveillance program is a part of each employers Health and Safety program. A yearly examination is then conducted for each employee. If an employee develops symptoms of overexposure to hazardous substances, has been injured or has been exposed above permissible limits, an additional examination will be completed by a physician immediately.

13.1.1 Personnel Training and Respirator Protection

All personnel involved in the field work, including subcontractors conducting field activities, will be trained in accordance with OSHA’s Hazwoper requirements in 29 CFR 1910.120 unless otherwise designated as exempt personnel described in Section 11.2 below. Personnel required to meet the training requirements must present evidence of this training, when requested. The subcontractor is also solely responsible for complying with all applicable OSHA requirements and all other federal, state and local safety requirements.

All personnel must be certified as medically fit to use a respirator in accordance with 29 CFR 1910.134 (Respiratory Protection). Records including fit testing results and medical form stating that the person is fit to wear respirator must prevent evidence of these items, when requested.

13.1.2 Exempt Personnel

Those personnel working on the construction site in the support zone, but not entering the exclusion zone are exempt to these training requirements. Exempt personnel requesting access to the work areas could include, but not limited to, personnel making deliveries or performing repairs to utilities, public or government officials or untrained visitors. Individuals from these groups would not be required to comply with the OSHA training requirements.

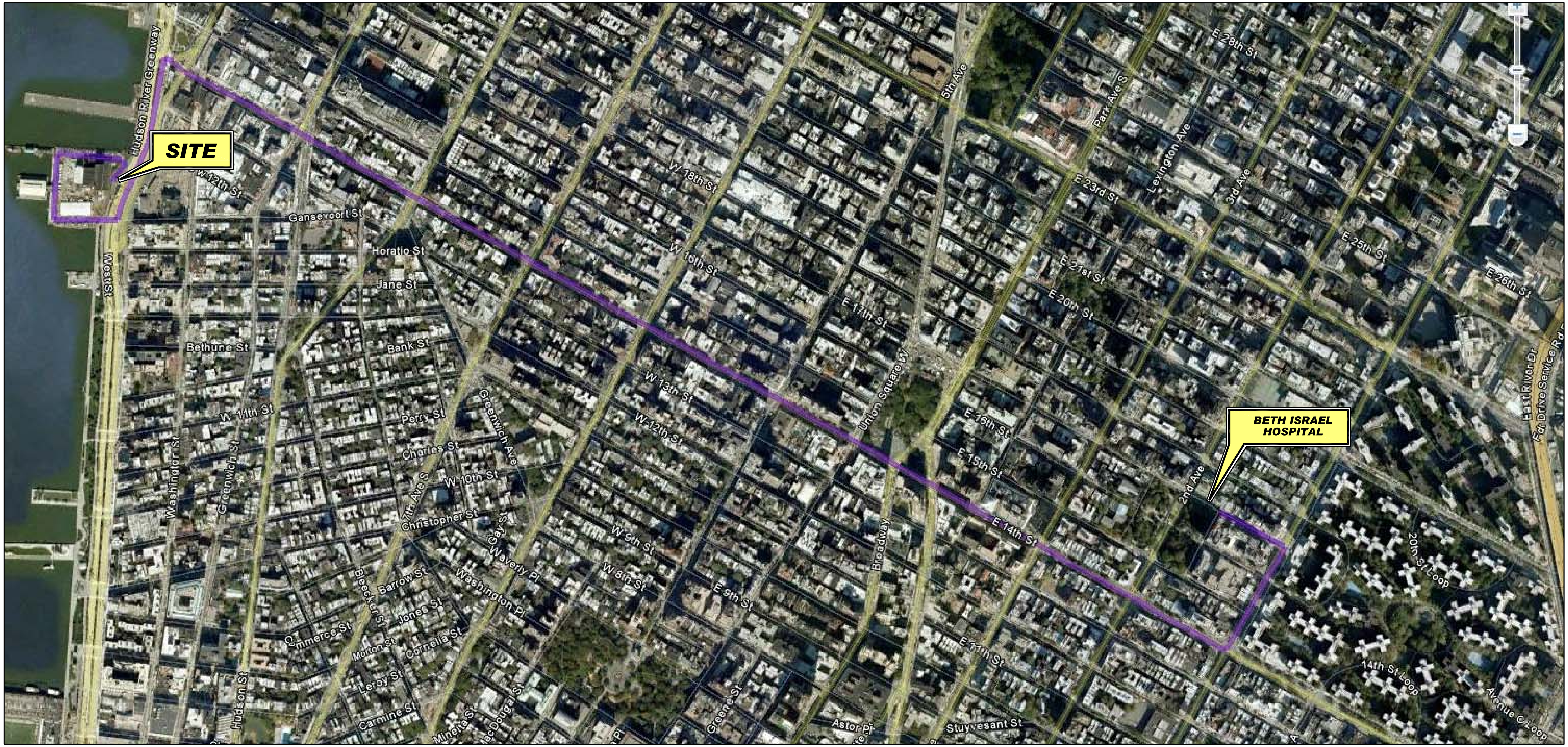
Observation areas will be upwind from site operations, as decided on the basis of predominant wind directions, so as not to receive dust or chemical contaminants. Weather conditions or site activities may restrict access to observation areas. Approvals for exempting personnel and decisions on access limitation for other personnel will be handled on a case-by-case basis by the SSO in consultation with the Field Supervisor and/or Project Manager.

TO BE PROVIDED UPON REQUEST

FIGURES

Name: Street Map
Date: 9/17/2009
Scale: 1 inch equals 5167 feet

TEXAS EASTERN TRANSMISSION LP
NJ/NY EXPANSION PROJECT
PROPOSED STUDY CORRIDOR 9-17-09 REV-0



SOURCE: GOOGLE EARTH

1. Head northeast on Bloomfield St./Gansevoort St. toward Hudson River Greenway (0.3 miles
2. Turn left at 11 Ave./New York 9A North (0.2 miles)
3. Take the 1st right onto West 14th St. (1.6 miles)
4. Turn left at 1st Ave.
5. Take the 3rd left onto East 17th St. and destination will be on the right

Beth Israel Hospital
317 East 17th Street
New York, NY 10011

Emergency No.
(212)420-2840

TRC ENVIRONMENTAL CORP.
57 East Willow Street
Millburn, New Jersey 07041

DIRECTIONS TO BETH ISREAL HOSPITAL
MANHATTAN, NEW YORK

SPECTRA ENERGY PIPELINE EXPANSION PROJECT
NEW YORK/NEW JERSEY

JOB NO. 168217

JN/ODL	DATE: OCTOBER 2010	FIGURE: 6

FILE: M:\CAD FILES\VISION PROJECTS\168217\DIRECTION TO BETH ISRAEL HOSPITAL MANHATTAN.DWG, DATE: 10/27/2010 11:37:13AM

SOURCE: GOOGLE MAP

Trinitas Regional Medical Center
225 Williamson St
Elizabeth, NJ

(908) 994-5000 (Emergency no.)

Directions to Trinitas Regional Medical Center

Proceed northwest on Park Avenue South
Turn right onto US-1 & 9 North
Turn left onto South Broad Street
Turn Right onto South Street
Turn Left into the hospital complex on Williamson Street

TRC ENVIRONMENTAL CORP.
57 East Willow Street
Millburn, New Jersey 07041

DIRECTIONS TO
TRINITAS REGIONAL MEDICAL CENTER

SPECTRA PIPELINE - LINDEN, NEW JERSEY

JOB NO. 168217

KR/ODL	DATE: DECEMBER 2009	FIGURE: 2

FILE: M:\CAD FILES\VISION PROJECTS\168217\TRINITAS REGIONAL MED CENTER.DWG, DATE: 01/04/2010 10:26:26AM

SOURCE: GOOGLE MAP

Staten Island:
Staten Island University Hospital
475 Seaview Avenue (718) 226-9000 (emergency no.)
Staten Island, NY 10305

Directions from Western Avenue to Staten Island University Hospital (9.9 miles, 15 minutes)
1. Head southwest on Western Ave toward Goethals Rd N (0.6 mi)
2. Merge onto I-278 E via the ramp on the left to Staten Is Expy/Verrazano Br. (6.6 mi)
3. Take exit 15 for Lily Pond Ave toward S Beach/Bay St. (0.3 mi)
4. Turn right at Lily Pond Ave (0.4 mi)
5. Lily Pond Ave turns slightly right and becomes Father Capodanno Blvd. (1.5 mi)
6. Turn right at Seaview Ave and destination will be on the right (0.6 mi)

TRC ENVIRONMENTAL CORP.
57 East Willow Street
Millburn, New Jersey 07041

DIRECTIONS TO HOSPITAL
STATEN ISLAND, NEW YORK

SPECTRA ENERGY PIPELINE EXPANSION PROJECT
NEW YORK/NEW JERSEY

JOB NO. 168217

KR/ODL | DATE: DECEMBER 2009 | FIGURE: 3

FILE: M:\CAD FILES\VISION PROJECTS\168217\DIRECTION TO HOSPITAL STATEN ISLAND.DWG, DATE: 12/17/2009 10:53:44AM

SOURCE: GOOGLE MAP

Bayonne Medical Center
29 East 29th Street (201) 858-5000 (emergency no.)
Bayonne, NJ 07002-4695 (201) 858-5257 (general emergency no.)

Directions from Port Terminal Blvd to Bayonne Medical Center (1.4 miles, 4 minutes)
1. Head west on Port Terminal Blvd toward Access Rd. (0.9 mi)
2. Turn left at NJ-440 S (0.1 mi)
3. Turn right at E 32nd St. (0.1 mi)
4. Take the 2nd left onto Avenue E (0.2 mi)
5. Turn right at E 29th St. and destination will be on the right (430 ft)

TRC ENVIRONMENTAL CORP.
57 East Willow Street
Millburn, New Jersey 07041

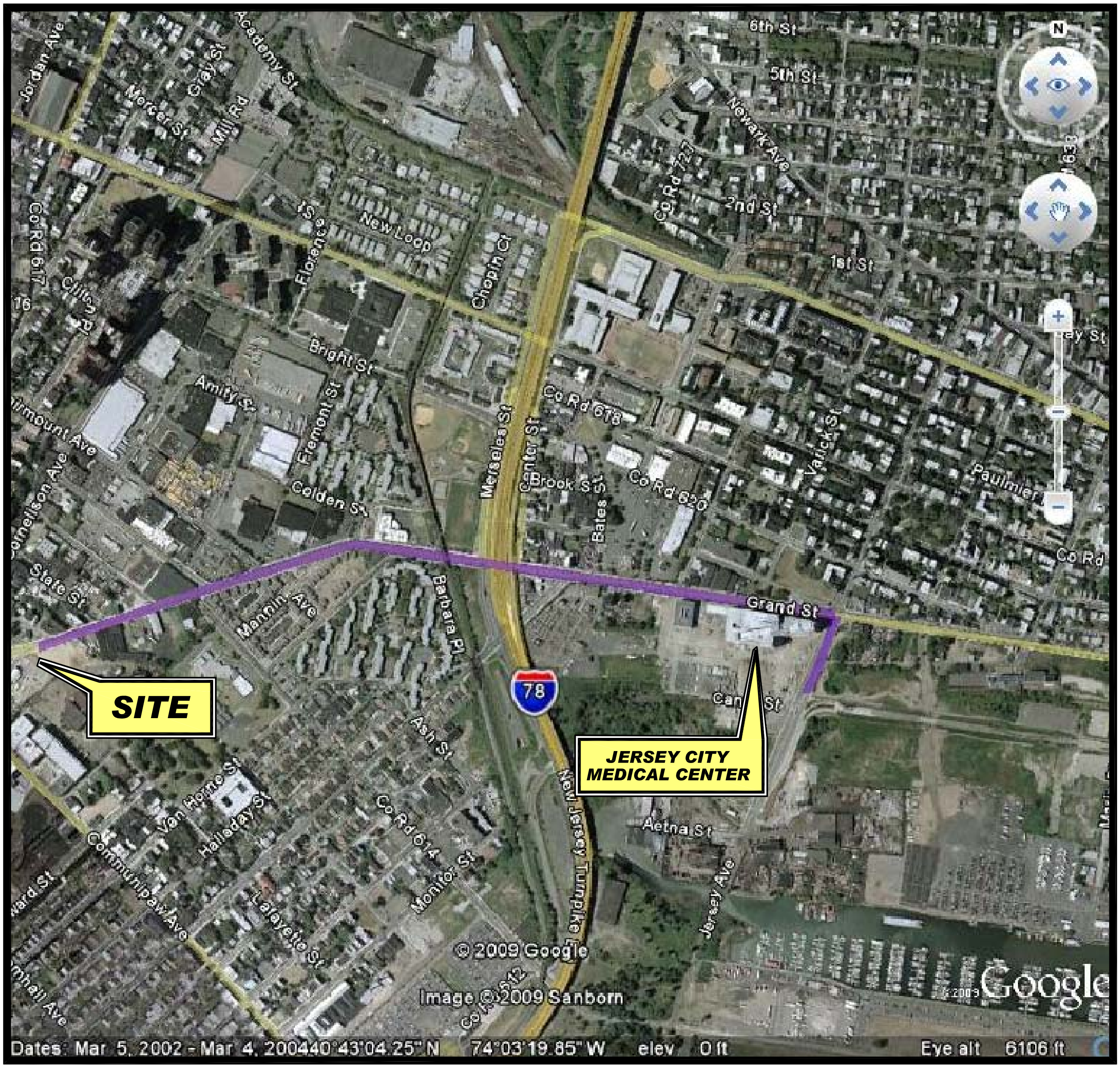
DIRECTIONS TO HOSPITAL
BAYONNE, NEW JERSEY

SPECTRA ENERGY PIPELINE EXPANSION PROJECT
NEW YORK/NEW JERSEY

JOB NO. 168217

KR/ODL	DATE: DECEMBER 2009	FIGURE: 4

FILE: M:\CAD FILES\VISION PROJECTS\168217\DIRECTION TO HOSPITAL BAYONNE.DWG, DATE: 01/04/2010 09:23:45AM



SOURCE: GOOGLE MAP

Jersey City Medical Center
355 Grand St (201) 915-2000 (emergency no.)
Jersey City, New Jersey 07302

Directions from Grand Street to Jersey City Medical Center

1. Head east on Grand St toward Jersey Ave. (0.9 mi, 2 mins)
2. 355 Grand St is on the right.

TRC ENVIRONMENTAL CORP.
57 East Willow Street
Millburn, New Jersey 07041

DIRECTIONS TO HOSPITAL
JERSEY CITY, NEW JERSEY

SPECTRA ENERGY PIPELINE EXPANSION PROJECT
NEW YORK/NEW JERSEY

JOB NO. 168217

KR/ODL	DATE: DECEMBER 2009	FIGURE: 5

FILE: M:\CAD FILES\VISION PROJECTS\168217\DIRECTION TO HOSPITAL JERSEY CITY.DWG, DATE: 01/04/2010 12:59:11PM

APPENDIX A

JOB SAFETY ANALYSIS (JSA) SHEET

APPENDIX B

NJ-NY EXPANSION PROJECT EMERGENCY INFORMATION

JOB SAFETY/ENVIRONMENTAL ANALYSIS (JSA)

JOB: Spectra Energy – NJ/NY Expansion Project SITE OR PROJECT SEGMENT:__________ DATE: __________

PROJECT COORDINATOR: Patricia Ward CONTRACTOR(S): TRC

SUBCONTRACTORS:__________

JSA TEAM:

Field Crew: __________ Phone:__________

EHS Field Safety Advisor:__________ Phone:__________

Site Safety Officer:__________ Phone:__________

PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIRED (circle):

Hard Hat | Steel-Toed Boots | Safety Glasses | Traffic Safety Vest | Gloves | Hearing Protection | Respiratory Protection (if required)

ADDITIONAL PPE:

Specific Work Location *(Provide details on work location):*

Work Activities	Hazards Involved	Recommendations for Safe Work
1)		
2)		
3)		
4)		

SPECIFIC COMMENTS:

APPROVALS:

Site Safety Officer:__________ Date:__________

NJ-NY EXPANSION PROJECT
EMERGENCY INFORMATION

LINDEN, NJ

Linden NJ Police Dept.
302 N. Wood Ave.
Linden, NJ 07036
(908) 474-8500

Linden NJ Fire Dept.
1205 E. Elizabeth Ave.
Linden, NJ 07036
(908) 298-3899
(908) 298-3827 fax

Robert Wood Johnson University Hospital
Union St./Middlesex St.
Linden, NJ 07036
(732) 499-7336

Trinitas Regional Hospital
225 Williamson St.
Elizabeth, NJ 07207
(908) 994-5000

Rahway Memorial Hospital
865 Stone St.
Rahway, NJ 07065
(732) 381-4200

JERSEY CITY, NJ

Jersey City NJ Police Dept.
8 Erie St.
Jersey City, NJ 07302
(201) 547-5300
(201) 547-5283 fax

Jersey City NJ Fire Dept.
465 Marin Blvd.
Jersey City NJ
(201) 547-4239
(201) 547-4398 fax

Jersey City Medical Center
355 Grand St.
Jersey City, NJ 07302
(201) 915-2000

STATEN ISLAND, NY

Staten Island NY Police Dept.
78 Richmond Terrace
Staten Island, NY 10301
(718) 876-8500

Staten Island Fire Dept.
1688 Victory Blvd., Suite 101
Staten Island, NY 10314
(718) 815-4111

Staten Island University Hospital
57 Bay St.
Staten Island, NY
(718) 876-9561

MANHATTAN, NY

New York Police Dept.
5th Precinct
19 Elizabeth St.
New York, NY 10013
(212) 334-0711

New York City Fire Dept.
1 Chase Manhattan Plaza
New York, NY 10005
(212) 809-4887

St. Vincent's Hospital
320 W. 13th St.
New York, NY
(212) 255-5014

Greater New York Hospital
75 9th Ave.
New York, NY
(646) 638-2641

BAYONNE, NJ

Bayonne Police Dept.
630 Avenue C
Bayonne, NJ 07002
(201) 858-6900
(201) 858-6949

Bayonne NJ Fire Dept.
630 Avenue C
Bayonne, NJ 07002
(201) 858-6008
(201) 858-6039 fax

Bayonne Medical Center
398 Avenue East
Bayonne, NJ
(201) 858-1827

Bayonne Hospital
29 East 29th St.
Bayonne, NJ
(201) 858-2819

12/11/09

APPENDIX C

ACCIDENT REPORTING FORM

ACCIDENT REPORTING FORM
(MUST BE GIVEN TO TRC'S HSO ASAP)

Basic Rules for Accident Investigation

- Find the cause to prevent future accidents - Use an unbiased approach during investigation
- Interview witnesses & injured employees at the scene - conduct a walkthrough of the accident
- Conduct interviews in private - interview one witness at a time.
- Get signed statements from all involved.
- Take photos or make a sketch of the accident scene.
- What hazards are present - what unsafe acts contributed to accident
- Ensure hazardous conditions are corrected immediately.

Field Personnel		**Job Name and No.**	
Date & Time		**Location**	
Tasks performed		**Witnesses**	
Resulted in	**__ Injury __ Fatality** **__Property Damage**	**Property Damage**	
Injured Person		**Weather Conditions**	
Describe Accident Facts & Events			

Supervisor's Root Cause Analysis	*Check ALL that apply to this accident*		
Unsafe Acts		**Unsafe Conditions**	
Improper work technique		Poor Workstation design	
Safety rule violation		Unsafe Operation Method	
Improper PPE or PPE not used		Improper Maintenance	
Operating without authority		Lack of direct supervision	
Failure to warn or secure		Insufficient Training	
Operating at improper speeds		Lack of experience	
By-passing safety devices		Insufficient knowledge of job	
Protective equipment not in use		Slippery conditions	
Improper loading or placement		Excessive noise	
Improper lifting		Inadequate guarding of hazards	
Servicing machinery in motion		Defective tools/equipment	

Horseplay		Poor housekeeping	
Drug or alcohol use		Insufficient lighting	
Unsafe Acts require a written warning and re-training <u>before</u> the Employee resumes work			
Date		**Date**	
Re-Training Assigned		Unsafe Condition Guarded	
Re-Training Completed		Unsafe Condition Corrected	
Supervisor Signature		**Supervisor Signature**	

Accident Report Review

Employee Signature_________________________________ Date ______________

Sr. Project Manager _________________________________ Date ______________

Safety Manager _________________________________ Date ______________

APPENDIX D

TRAINING FOR HEAT STRESS

HEAT STRESS CASUALTY PREVENTION PLAN

Due to the increase in ambient air temperatures and the effects of protective outer wear decreasing body ventilation, there exists an increase in the potential for injury, specifically, heat casualties. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties.

1. IDENTIFICATION AND TREATMENT

- **Heat Exhaustion**

Symptoms: Usually begins with muscular weakness, dizziness, nausea and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, skin is clammy, and may perspire profusely. The pulse is weak and fast, breathing is shallow. The victim may faint unless victim lies down. This may pass, but sometimes it remains and death could occur.

First Aid: Immediately remove the victim to the Contamination Reduction Zone in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock. Make victim lie down, raise feet 6 to 12 inches and keep victim warm but loosen all clothing. If the victim is conscious, it may be helpful to ingest sips of a salt water solution (1 teaspoon of salt to 1 glass of water). Transport victim to a medical facility as soon as possible.

- **Heat Stroke**

Symptoms: This is the most serious of heat casualties due to the fact that the body excessively overheats. Body temperatures often are between 107 degrees Fahrenheit to 110 degrees Fahrenheit. First there is often pain in the head, dizziness, nausea, oppression and the skin is dry, red and hot. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly.

First Aid: Immediately evacuate the victim to a cool and shady area in the Contamination Reduction Zone. Remove all protective outer wear and all personal clothing. Lay victim on back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels, ice bags, etc., to the head. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place victim in a tub of cool water. The main objective is to cool victim without chilling. Give no stimulants. Transport the victim to a medical facility as soon as possible.

2. PREVENTION OF HEAT STRESS

Proper training and preventive measures will help prevent serious illness and loss of productivity. To manage heat stress, the following measure will be implemented, as needed:

- ➢ Workers will be trained to recognize and deal with heat stress. The following signs and symptoms of heat stress will be communicated to all workers:
  - ◆ **Heat Rash** may result from continuous exposure to heat or humid air. This rash may spread. If heat rash occurs, refer the employee for medical follow-up;
  - ◆ **Heat Cramps** are caused by heavy sweating with inadequate electrolyte (salt) replacement. Heat cramps may be prevented by ensuring adequate electrolyte replace by drinking fluids such as Gatorade or other commercially available electrolyte fluids a Signs and symptoms include:
    - ✓ -muscle spasms
    - ✓ -pain in hands, feet and abdomen
  - ◆ **Heat exhaustion** occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
    - ✓ -pale, cool, moist skin
    - ✓ -heavy sweating
    - ✓ -dizziness
    - ✓ -nausea
    - ✓ -fainting

- **Heat Stroke** is the most serious form of heat stress. Temperature regulation of the body fails and the body temperature rises to critical levels *Immediate action must be taken to cool the body before serious injury and death occur.* **Cool the individual immediately by applying cool water on the person. No fluids are to be given by mouth unless individual is conscious and alert. Call 911 immediately.** Signs and symptoms include:

  - ✓ -red, hot, usually dry skin
  - ✓ -lack of or reduced perspiration
  - ✓ -nausea
  - ✓ -dizziness and confusion
  - ✓ -strong rapid pulse
  - ✓ -coma, with possible death

If heat stroke is suspected, do not hesitate. Time is of the essence. Call 911 for help. Fan and cool victim immediately with water and air movement. Check for vital signs. Assist EMTs in/by removing victim from exclusion zone, then decontaminate if needed. Use water to cool victim by applying to body, no fluids by mouth unless EMTs direct to do so. Advanced care will include fluid replenishment at the medical care facility

One of the major causes of heat casualties is the depletion of body fluids. Have plenty of fluids available at the Site. Personnel should replace water and salts loss from sweating. Salts can be replaced by eating more heavily salted foods, or commercial electrolyte mixes such as Gatorade. The commercial mixes are advised for personnel on low sodium diets.

A work schedule may be established so that the majority of the heavy work day will be during the morning hours before ambient air temperature levels reach their highs.

A work/rest regimine guideline will be implemented for personnel required to wear Modified Level D, Level C or Level B PPE protection. This guideline is as follows:

> **Screening Criteria For Heat Stress Exposure, WBGT Values In Degrees F NOTE: these criteria are guidelines. For workers wearing PPE on this project, monitoring**

of heat stain (physiological monitoring of pulse, temperature and body water loss) is a better indicator of worker heat stress. When the screening criteria given in the table below is reached, implementation of physiological monitoring will be implemented as determined by the SSHSO

Work/Rest Schedule per hour	LIGHT WORK	MODERATE WORK	HEAVY WORK
100% work	86	80	77
75% work, 25% rest	87	82	78
50% work, 50% rest	89	85	82
25% work, 75% rest	90	88	86

A sufficient period (15 minutes) will be allowed for personnel to "cool down" at scheduled breaks in an air conditioned trailer or other area that is cooler than the ambient work area. The trailer will be located in the Contamination Reduction Zone, so that workers may cool down without having to enter the Support Zone. In addition, the break trailer, located in the Support Zone will be air conditioned

A field cool down are will also be used so that workers may cool down as they feel the need. Since this area will be in the CRZ, full decontamination will not be required in the field cool down area. This will be a shaded area in the, CRZ, constructed of wood , using a white cloth painters type tarp, or equivalent are to provide shading. A large fan will be placed in this field cool down area to assist with evaporative cooling. Fluids will be available here for workers to drink after doffing gloves and washing hands.

3. HEAT STRESS/STRAIN PHYSIOLOGICAL MONITORING

For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism. Monitoring of personnel wearing protective clothing should commence according to the above table.

Frequency of monitoring should increase as the ambient temperature increases or if slow recovery rates are indicated.

Excessive heat strain may be marked by one or more of the following measures, and individual's exposure to heat stress should be discontinued, until the individual has been medically monitored, and approved for return to work.

- Heart rate (HR) should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats per minute, or if a sustained (several minutes) heart rate equal to or above the maximum age adjusted heart rate is observed, described as: 180 bpm minus the individuals age in years (180-age), for individuals with assessed normal cardiac performance. For example, if an individual is 44 years old, the maximum age adjusted heart rate is 180-44 = 136. (From ACGIH 2001 TLV booklet, page 173). If the HR is higher, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period stays the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle should be shortened by 33%.

- Body temperature should be measured orally with a clinical or ear type thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period, before drinking fluids, should not exceed 99.6 degrees Fahrenheit. If it does, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period stays the same. However, if the OT exceeds 99.6 degrees Fahrenheit at the beginning of the next period, the following work cycle should be further shortened by 33%. OT should be measured again at the end of the rest period to make sure that it has dropped below 99.6 degrees Fahrenheit.

  If body core temperature (oral or ear plus 1 degree F) 100.4 F, do *not* permit a worker to wear impermeable or semi-impermeable PPE.

- Body water loss (BWL) due to sweating may be measured, as determined by the SSHSO, by weighing the worker in the morning, at breaks and in the evening. The clothing worn should be similar at all weighings. The scale should be accurate to plus or minus 1/4 pound.

pound. BWL should not exceed 1.5% of the total body weight. If it does, workers should be instructed to increase their daily intake of fluids by the weight lost.

Ideally, body fluids should be maintained at a constant level during the work day. This requires replacement of salt lost in sweat as well, through normal food consumption DO NOT permit workers to take salt tablets. Using electrolyte fluids may be helpful.

Ten Suggestions to Employers for Helping Workers Stay Cool in Hot Workplaces:

- Encourage workers to drink plenty of water (without salt)--about one cup of cool water every 15-20 minutes, even if they are not thirsty. Avoid alcohol, coffee, tea, and caffeinated soft drinks that contribute to dehydration.
- Help workers adjust to the heat by assigning a lighter workload and longer rest periods for the first five to seven days of intense heat. And this process needs to start all over again when a worker returns from vacation or absence due to illness or injury.
- Encourage workers to wear lightweight, loose-fitting, light-colored clothing. Workers should change their clothing if it gets completely saturated.
- Use general ventilation and spot cooling at points of high heat production. Good air flow increases evaporation and cooling of the skin. Stagnant atmospheric conditions and poor air quality can induce heat-related illnesses.
- Learn to spot the signs of heat stroke, which can be fatal. The symptoms are severe headache, mental confusion/loss of consciousness, flushed face, and hot, dry skin. If someone has stopped sweating, seek medical attention immediately. Other heat-induced illnesses include heat exhaustion, heat cramps, skin rashes, swelling and loss of mental and physical work capacity.
- Train first-aid workers to recognize and treat the signs of heat stress. Be sure that all workers know who is trained to render first aid. Supervisors also should be able to detect early signs of heat-related illness and permit workers to interrupt their work if they become extremely uncomfortable.
- Consider a worker's physical condition when determining fitness to work in hot environments. Obesity, lack of conditioning, pregnancy and inadequate rest can increase susceptibility to heat stress.
- Alternate work and rest periods, with longer rest periods in a cooler area. Shorter, but frequent, work-rest cycles are best. Schedule heavy work for cooler parts of the day and use appropriate protective clothing.
- Certain medical conditions, such as heart conditions, or treatments like low-sodium diets and some medications, increase the risk from heat exposure. Seek medical advice in those cases.
- Monitor temperatures, humidity and workers' responses to heat at breaks.

APPENDIX E

TRAINING FOR COLD STRESS

COLD EXPOSURE CASUALTY PREVENTION PLAN

Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling, causing death. Areas of the body which have high surface area-to-volume ratio such as fingers, toes and ears are the most susceptible.

EFFECTS OF COLD EXPOSURE

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10 degrees Fahrenheit with a wind of 15 mile per hour (mph) is equivalent in chilling effect to still air at -18 degrees Fahrenheit.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration soaked.

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

- **Frost nip or incipient frostbite:** characterized by suddenly 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.

To administer first aid for frostbite, bring the victim indoors and rewarm the areas <u>quickly</u> in water between 102 degrees Fahrenheit and 105 degrees Fahrenheit. Give a warm drink not coffee, tea or alcohol. The victim should not smoke. Keep the frozen parts in warm water or covered with warm clothes for 30 minutes, even though the tissue will be very painful as it thaws. Then elevate the injured area and protect it from injury. Do not allow blisters to be broken. Use sterile, soft dry material to cover the injured areas. Keep victim warm and get immediate medical care.

After thawing, the victim should try to move the injured areas a little, but no more than can be done alone, without help.

- Do not rub the frostbitten part (this may cause gangrene).
- Do not use ice, snow, gasoline or anything cold on frostbite.
- Do not use heat lamps or hot water bottles to rewarm the part.
- Do not place the part near a hot stove.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature, it symptoms are usually exhibited in five stages: 1) shivering; 2) apathy, listlessness, sleepiness and (sometimes) rapid cooling of the body to less than 95 degrees Fahrenheit; 3) unconsciousness, glassy stare, slow pulse and slow respiratory-rate; 4) freezing of the extremities; and, finally, 5) death.

As a general rule, field activities should be curtailed if equivalent chill temperature (degrees Fahrenheit) is below zero unless the activity is of an emergency nature. The ultimate responsibility for proposing on delaying work at a site due to inclement weather rests with the SSO.

APPENDIX F

MATERIAL SAFETY DATA SHEETS (MSDS)

Issue Date: 2005-05

1,1,1-Trichloroethane
MET2840

Section 1 - Chemical Product and Company Identification 54/60

Material Name: 1,1,1-Trichloroethane **CAS Number:** 71-55-6
Chemical Formula: $C_2H_3Cl_3$
Structural Chemical Formula: CH_3CCl_3
EINECS Number: 200-756-3
ACX Number: X1000020-3
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.

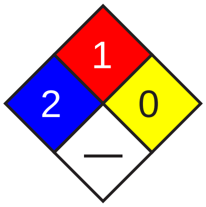
ACGIH TLV
TWA: 350 ppm; STEL: 450 ppm.

NIOSH REL
Ceiling: 350 ppm, 1900 mg/m^3; 15-minute.

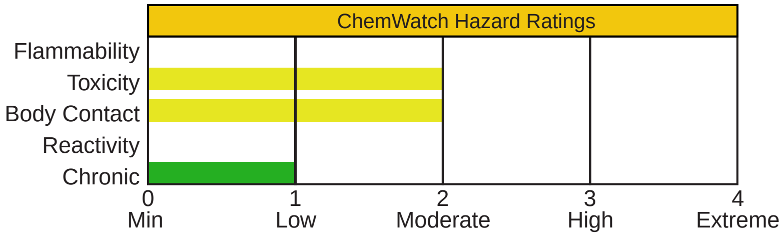
IDLH Level
700 ppm.

DFG (Germany) MAK
TWA: 200 ppm; PEAK: 200 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
1 Flammability
1 Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: headache, dizziness, incoordination; mild liver/kidney dysfunction. 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.

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: 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

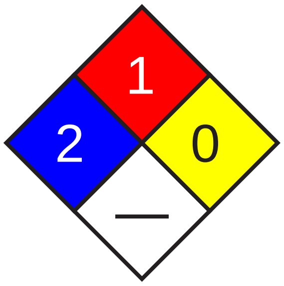
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

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

See DOT ERG



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

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: 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
Evaporation Rate: 12.8 (n-(BuAc=1)
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 74 °C (165 °F) at 760 mm Hg
Freezing/Melting Point: -30.4 °C (-22.72 °F)
Volatile Component (% Vol): 100
Decomposition Temperature (°C): 260
Water Solubility: 0.4% by weight

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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: 1,1,1-Trichloroethane
ID: UN2831
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, 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:** 40

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

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.

1,1,2,2-Tetrachloroethane
TET2610

Issue Date: 2004-12

Section 1 - Chemical Product and Company Identification

Material Name: 1,1,2,2-Tetrachloroethane **CAS Number:** 79-34-5
Chemical Formula: $C_2H_2Cl_4$
Structural Chemical Formula: $Cl_2CHCHCl_2$
EINECS Number: 201-197-8
ACX Number: X1002607-8
Synonyms: ACETOSAL; ACETOSOL; ACETYLENE TETRACHLORIDE; BONOFORM; BOROFORM; CELLON; 1,1,2,2-CZTEROCHLOROETAN; 1,1-DICHLORO-2,2-DICHLOROETHANE; DICHLORO-2,2-DICHLOROETHANE; EPA PESTICIDE CHEMICAL CODE 078601; ETHANE,1,1,2,2-TETRACHLORO-; SYMMETRICAL TETRACHLOROETHANE; TCE; 1,1,2,2-TETRACHLOORETHAAN; 1,1,2,2-TETRACHLORAETHAN; 1,1,2,2-TETRACHLORETHANE; TETRACHLORETHANE; 1,1,2,2-TETRACHLOROETHANE; S-TETRACHLOROETHANE; SYM-TETRACHLOROETHANE; TETRACHLOROETHANE; TETRACHLORURE D'ACETYLENE; 1,1,2,2-TETRACLOROETANO; WESTRON
General Use: Solvent, cleansing and degreasing of metals, paint removers, varnishes, lacquers, photographic film, resins and waxes. Used also to extract oils and fats, as an alcohol denaturant, in organic syntheses of insecticides, fumigants and weed killers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,1,2,2-tetrachloroethane	79-34-5	>98

OSHA PEL
TWA: 5 ppm; 35 mg/m^3; skin.

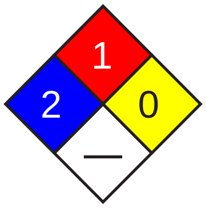
NIOSH REL
TWA: 1 ppm, 7 mg/m^3; skin.

DFG (Germany) MAK
TWA: 1 ppm; PEAK: 2 ppm; skin.

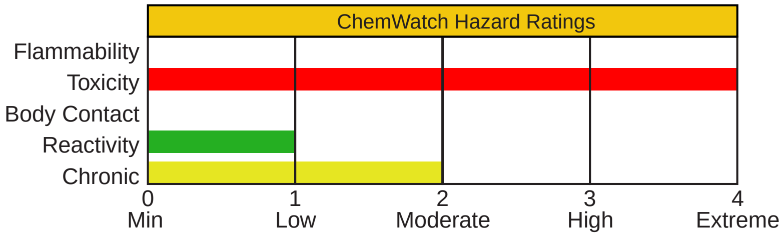
ACGIH TLV
TWA: 1 ppm; skin.

IDLH Level
100 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
0 Flammability
0 Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; chloroform odor. Irritating to eyes/respiratory tract. Other Acute Effects: narcosis, low BP, cardiac rhythm abnormalities, respiratory depression, transient liver/kidney changes. Chronic Effects: CNS effects, jaundice, numbness of hands/feet.

Potential Health Effects

Target Organs: skin, eyes, respiratory system, central nervous system (CNS), gastrointestinal (GI) tract, liver, kidneys
Primary Entry Routes: inhalation, skin contact/absorption
Acute Effects
Inhalation: 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.The vapor is highly discomforting to the upper respiratory tract and lungs harmful if inhaled.

Respiratory irritation and pulmonary edema may follow inhalation exposures.

Inhalation of vapor may aggravate a pre-existing respiratory condition.

Human volunteers retain about 97% of inspired tetrachloroethane.

Industrial experience with tetrachloroethane is unfavorable. A fatal case of exposure was described as cirrhosis of the liver with superimposed hepatitis. Other case reports describe vomiting (sometimes persistent), nausea, gastric pain, headache and dizziness. Acute poisoning results in central nervous system (CNS) depression which may be fatal within 12 hours.

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 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.

The calculated human skin permeability coefficient is 9 x 10-3 cm/hr.

Ingestion: The liquid is discomforting to the gastrointestinal tract and may be fatal if swallowed.

Eight humans, each of whom had ingested 3 mL by mistake, became comatose and arreflexic but recovered without any apparent ill-effects.

Probably the most toxic of the common chlorinated hydrocarbons.

The material is readily absorbed through the skin and lungs with excretion primarily occurring through the lungs.

Acute exposure may result in central nervous system depression with dizziness, nervousness, incoordination and death from respiratory failure.

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). 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.

Acute exposures to tetrachloroethane produce jaundice, liver enlargement, fatty degeneration, hepatic necrosis and cirrhosis.

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 - 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 exposures to tetrachloroethane produce jaundice, liver enlargement, fatty degeneration, hepatic necrosis and cirrhosis. Chronic poisoning in humans takes two forms. Hepatotoxicity is often accompanied by gastrointestinal disturbance. Symptoms involving the central nervous system may also occur and are characterized by tremors, vertigo and headache.

Fifty workers, exposed to tetrachloroethane over a period of 3-years, were observed in a penicillin plant. About half the workers developed hepatitis during the first year. Hepatic damage was diagnosed by palpation for enlarged livers and liver functions. No neurologic or hematologic alterations were reported although leukopenia was present in about 20% of the cases examined. Airborne concentrations over the 3-year period ranged from 1.5 to 247 ppm. Liver disease was apparent when concentrations were reduced to 15 ppm for most of the shift with peaks of up to 36.4 ppm.

Symptoms described in workers making bangles in India included a high incidence of nervous complaints with tremor being the dominant finding.

various gastric and general symptoms were also described although no cases of poisoning with jaundice were observed. Concentrations of tetrachloroethane vapor ranged from 9 to 98 ppm with most samples between 20 and 65 ppm.

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 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).

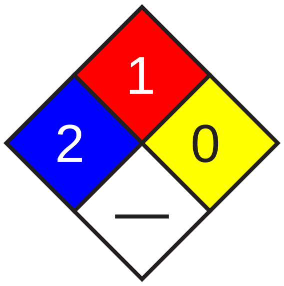
Seek medical attention in event of irritation.

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



Fire Diamond

Flash Point: None
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or 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

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 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, or 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.
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.

Respiratory Protection:
Exposure Range >5 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: 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:

PVA	Best selection
TEFLON	Best selection
VITON	Best selection
PE	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: 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): 1.62
Evaporation Rate: Fast
pH: Not applicable

pH (1% Solution): Not applicable
Boiling Point: 46.5 °C (116 °F)
Freezing/Melting Point: -43.8 °C (-46.84 °F)
Volatile Component (% Vol): 100
Water Solubility: 1 10 g/350 ml water at 25 °C

Section 10 - Stability and Reactivity

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

Storage Incompatibilities: Avoid strong bases. Reacts violently with sodium, potassium, nitrates and 2,4-dinitrophenyl disulfide.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 800 mg/kg
Inhalation (mouse) LC_{50}: 4500 mg/m^3/2h
Subcutaneous (mouse) LD_{50}: 1108 mg/kg

Irritation

Nil reported

See *RTECS* KI 8575000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most enters the atmosphere where it is extremely stable (half-life >2 years). Some of the chemical will eventually diffuse into the stratosphere where it will rapidly photodegrade. Released into water it will primarily be lost by volatilization in a matter of days to weeks. The volatilization half-lives from a model river and a model pond have been estimated to be 6.3 hr and 3.5 days, respectively. It is not expected to partition from the water column to organic matter contained in sediments and suspended solids. A measured K_{oc} of 79 in a silt loam indicates it will be highly mobile in soil. When disposed of on soil, part may leach into groundwater. There is evidence that it slowly biodegrades. A product of biodegradation under anaerobic conditions is 1,1,2-trichloroethane, a chemical which is resistant to further biodegradation. Under alkaline conditions, it may be expected to hydrolyze. A measured aqueous hydrolysis rate constant, KB of 2.3 x10^7 L/moles-year, corresponds to hydrolytic half-lives of 1.1,11.1, and 111 days at pH 9, 8, and 7, respectively. It will not be expected to bioconcentrate into the food chain.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) 12,300 ug/l/96 hr; in a static unmeasured bioassay; LC_{50} Selenastrum capricornutum 136,000-146,000 ug/l/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 37 ppm/7 day /Conditions of bioassay not specified; EC_{50} Skeletonema costatum (alga) 6,230 ug/l/96 hr; Toxic effect: Cell count. /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnow) 20.3 mg/l/96 hr (confidence limit 19.9 - 20.7 mg/l), flow-through bioassay with measured concentrations, 25.6 °C, dissolved oxygen 7.8 mg/l, hardness 45.2 mg/l; LC_{50} Daphnia magna 62 mg/l/48 hr /Conditions of bioassay not specified; EC_{50} Daphnia magna 14 mg/l/28 day; toxic effect: Reproductive impairment /Conditions of bioassay not specified

Henry's Law Constant: calculated at 4.55 x10^{-4}
BCF: fish 0.9 to 1
Octanol/Water Partition Coefficient: log K_{ow} = 2.39
Soil Sorption Partition Coefficient: K_{oc} = 79

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: 1,1,2,2-Tetrachloroethane
ID: UN1702
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: IB2, N36, T7, TP2
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U209 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.

Issue Date: 2004-12

1,1,2-Trichloroethane
TRI2650

Section 1 - Chemical Product and Company Identification 54/59

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.

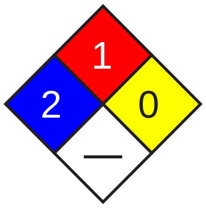
ACGIH TLV
TWA: 10 ppm; skin.

NIOSH REL
TWA: 10 ppm, 45 mg/m^3; skin.

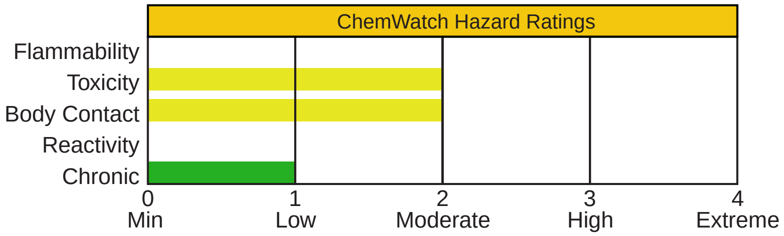
IDLH Level
100 ppm.

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

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.

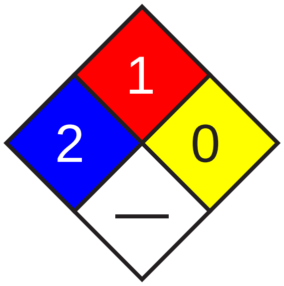
Avoid giving alcohol.

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

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 Diamond

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: 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
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:**

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: 2005-05

Vinylidene Chloride
DIC4450

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Vinylidene Chloride **CAS Number:** 75-35-4
Chemical Formula: $C_2H_2Cl_2$
Structural Chemical Formula: $H_2C=CCl_2$
EINECS Number: 200-864-0
ACX Number: X1003497-6
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

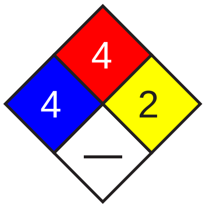
NIOSH REL

DFG (Germany) MAK
TWA: 2 ppm; PEAK: 4 ppm.

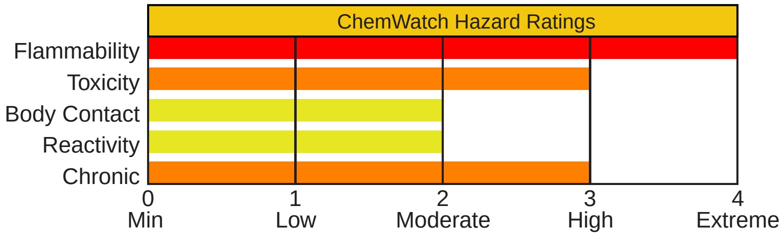
OSHA PEL Vacated 1989 Limits
TWA: 1 ppm; 4 mg/m^3.

ACGIH TLV
TWA: 5 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
4	Flammability
2	Reactivity

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating. Other Acute Effects: narcosis, drunkenness, unconsciousness, conjunctivitis, transient corneal injury, iritis. Chronic Effects: hepatic/renal dysfunction. Flammable.

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

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.

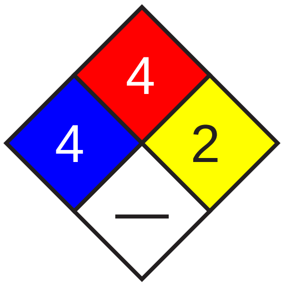
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: 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.

See DOT ERG



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 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

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.
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
Evaporation Rate: Fast
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 31.7 °C (89 °F) at 760 mm Hg
Freezing/Melting Point: -122.5 °C (-188.5 °F)
Water Solubility: 0.04% by weight

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
Oral (rat) LD_{50}: 200 mg/kg
Inhalation (human) TC_{Lo}: 25 ppm
Inhalation (rat) LC_{50}: 6350 ppm/4 hr

Irritation
Nil reported

See *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Vinylidene chloride, stabilized
ID: UN1303
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: I - Great Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: T12, TP2, TP7
Packaging: **Exceptions:** 150 **Non-bulk:** 201 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** E **Other:** 40

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

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Section 1 - Chemical Product and Company Identification 54/59

Material Name: 1,1-Dichloroethane **CAS Number:** 75-34-3
Chemical Formula: $C_2H_4Cl_2$
Structural Chemical Formula: Cl_2CHCH_3
EINECS Number: 200-863-5
ACX Number: X1002609-2
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.

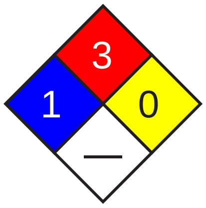
NIOSH REL
TWA: 100 ppm, 400 mg/m^3.

DFG (Germany) MAK
TWA: 100 ppm; PEAK: 200 ppm.

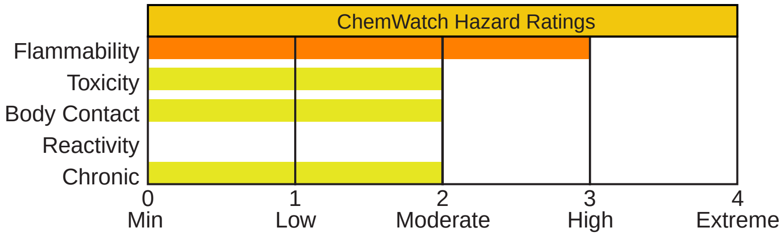
ACGIH TLV
TWA: 100 ppm.

IDLH Level
3000 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; chloroform odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, coughing, staggering, disturbed vision, irregular heartbeat, unconsciousness, coma, pulmonary edema. Chronic Effects: rash, neurological effects. Flammable.

Potential Health Effects

Target Organs: skin, central nervous system (CNS), liver, kidneys
Primary Entry Routes: inhalation, skin contact
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

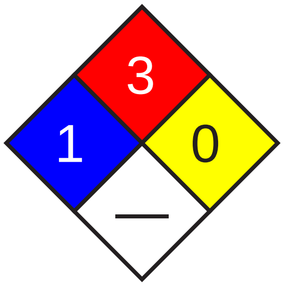
Autoignition Temperature: 458 °C

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 ....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
Evaporation Rate: 11.6 (BuAc=1)
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 57.3 °C (135 °F)
Freezing/Melting Point: -96.9 °C (-142.42 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.5 g/100 ml 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 oxidizing agents, alkalis, amines, aluminum and its alloys.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 725 mg/kg
Inhalation (rat) LC_{Lo}: 16000 ppm/4 hr
Equivocal tumorigenic agent by RTECS criteria.

Irritation
Nil reported

See *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; TL_m Lagodon rhomboides (pinperch) 160 mg/l/24 hr. /Conditions of bioassay not specified; TL_m 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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: 1,1-Dichloroethane
ID: UN2362
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 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

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.

Ethylene Dichloride
DIC4250

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

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
ACX Number: X1000031-6
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

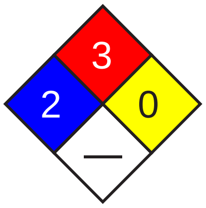
OSHA PEL
TWA: 50 ppm; Ceiling: 100 ppm; 200 ppm, 5-minute maximum peak in any 3 hours.

ACGIH TLV
TWA: 10 ppm.

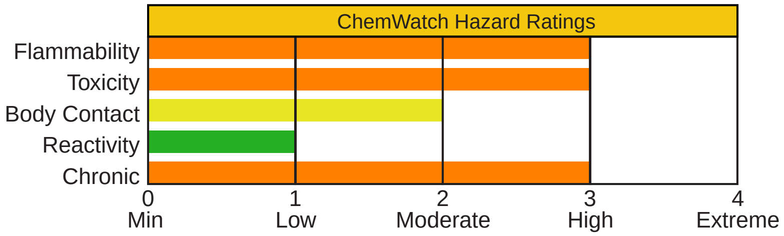
NIOSH REL
TWA: 1 ppm (4 mg/m^3); STEL: 2 ppm (8 mg/m^3) (Chloroethanes).

IDLH Level
50 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
3	Flammability
0	Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, colorless liquid; sweet chloroform-like odor. Irritating to respiratory tract. Other Acute Effects: intoxication, CNS depression, vomiting, dizziness, diarrhea, liver/kidney damage, cardiac arhythmia, coma. death. Possible human carcinogen. Highly flammable. Reacts violently with amines and finely divided alkali metals.

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

See DOT ERG

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.

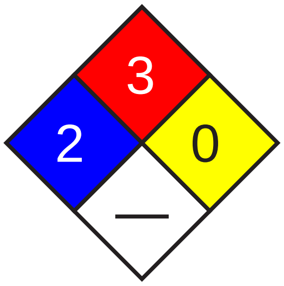
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless advised otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not* induce vomiting. Consult physician immediately.

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

See DOT ERG



Fire Diamond

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.

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

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. 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. Elec trically ground and bond all containers and equipment. Install Class I, Group D electrical equipment. Provide gen eral 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 sys tem, 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 cloth ing. 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 con tact 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 con tamination, 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 pres sure-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: 24 to 440 mg/m^3
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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Ethylene dichloride
ID: UN1184
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:

Label Codes: 3 - Flammable Liquid, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB2, T7, TP1
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:** 40

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 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: 2005-05

Methyl Ethyl Ketone
BUT2330

Section 1 - Chemical Product and Company Identification

Material Name: Methyl Ethyl Ketone **CAS Number:** 78-93-3
Chemical Formula: C_4H_8O
Structural Chemical Formula: $CH_3COCH_2CH_3$
EINECS Number: 201-159-0
ACX Number: X1001472-1
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.

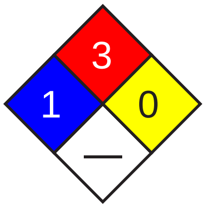
ACGIH TLV
TWA: 200 ppm; STEL: 300 ppm.

NIOSH REL
TWA: 200 ppm, 590 mg/m^3;
STEL: 300 ppm, 885 mg/m^3.

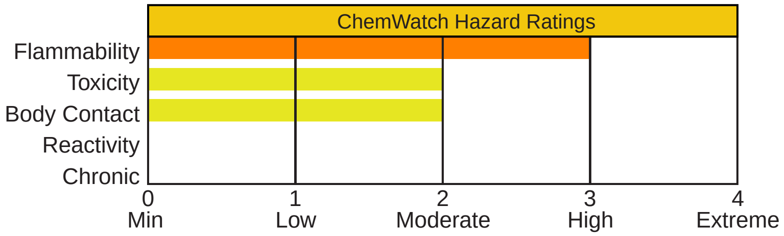
IDLH Level
3000 ppm.

DFG (Germany) MAK
TWA: 200 ppm; 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, volatile liquid; sweet mint odor. Irritating to eyes/respiratory tract. Other Acute Effects: corneal injury; inhalation may cause dizziness or vomiting. Chronic Effects: 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

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.

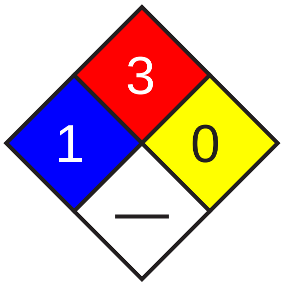
Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

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 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

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 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
Evaporation Rate: 5.7 Fast (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 79.6 °C (175 °F)
Freezing/Melting Point: -86.3 °C (-123.34 °F)
Volatile Component (% Vol): 100
Water Solubility: 353 g/L water at 10 °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 oxidizers hypochlorites, e.g. pool chlorine, bleaches and. strong bases and chloroform.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 2737 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm/5 m
Inhalation (rat) LD_{50}: 23500 mg/m^3/8 hr
Dermal (rabbit) LD_{50}: 6480 mg/kg

Irritation
Eye (human): 350 ppm -irritant
Eye (rabbit): 80 mg - irritant
Skin (rabbit): 402 mg/24 hr - mild
Skin (rabbit): 13.78mg/24 hr open - mild

See *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 x10^{-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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Ethyl methyl ketone *or* Methyl ethyl ketone
ID: UN1193
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 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

Section 1 - Chemical Product and Company Identification 54/59

Material Name: Acetone **CAS Number:** 67-64-1
Chemical Formula: C_3H_6O
Structural Chemical Formula: CH_3COCH_3
EINECS Number: 200-662-2
ACX Number: X1001253-6
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.

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

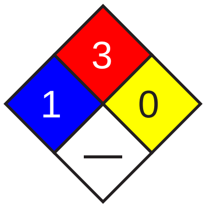
ACGIH TLV
TWA: 500 ppm; STEL: 750 ppm.

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

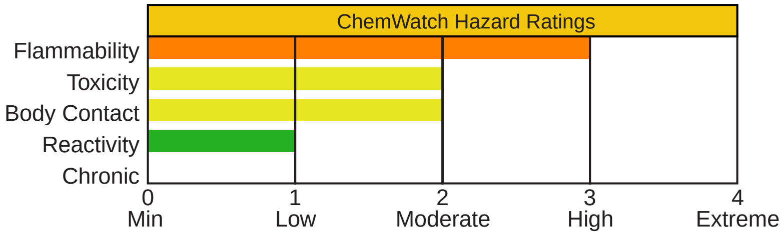
IDLH Level
2500 ppm (10% LEL).

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
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Target Organs: respiratory system, central nervous system (CNS), skin
Primary Entry Routes: inhalation, skin contact, eye 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.
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.

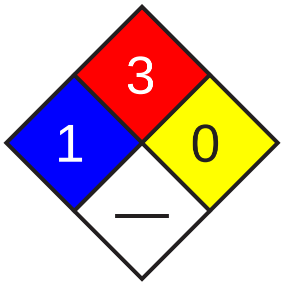
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

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	Best selection
PE/EVAL/PE	Best selection
PVDC/PE/PVDC	Best selection
BUTYL	Best selection
SARANEX-23 2-PLY	Satisfactory; may degrade after 4 hours continuous immersion
TEFLON	Satisfactory; may degrade after 4 hours continuous immersion
SARANEX-23	Poor to dangerous choice for other than short-term immersion
CPE	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
PVA	Poor to dangerous choice for other than short-term immersion
VITON/NEOPRENE	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+NEOPRENE	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	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, 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
Evaporation Rate: 11 (BuAc=1) VFast

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

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, 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

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 *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; TL_m 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; TL_m 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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Acetone
ID: UN1090
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 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

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: 2005-05

Benzene
BEN2200

Section 1 - Chemical Product and Company Identification 54/60

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.

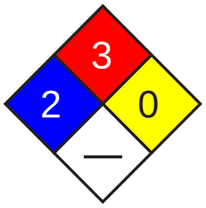
NIOSH REL
TWA: 0.1 ppm; STEL: 1 ppm.

DFG (Germany) MAK
Skin.

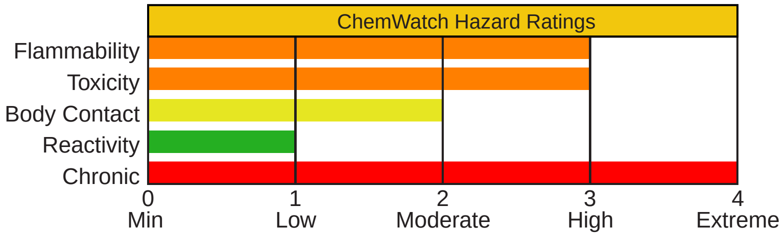
ACGIH TLV
TWA: 0.5 ppm; STEL: 2.5 ppm; skin.

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. Other Acute Effects: headache, dizziness, drowsiness. Absorbed through skin. Chronic Effects: 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

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.

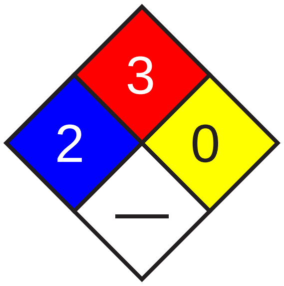
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: 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

See DOT ERG



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

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: 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 *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 x10^{-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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Benzene
ID: UN1114
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:** 40

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.

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Bromodichloromethane **CAS Number:** 75-27-4
Chemical Formula: $CHBrCl_2$
EINECS Number: 200-856-7
ACX Number: X1004020-9
Synonyms: BDCM; BROMODICHLOROMETHANE; DICHLOROBROMOMETHANE; DICHLOROMETHYLBROMIDE; DICHLOROMONOBROMOMETHANE; METHANE,BROMODICHLORO-; MONOBROMODICHLOROMETHANE
Derivation: Produced by treating the chlorine analog with hydrogen bromide in the presence of an aluminum halide catalyst. Bromodichloromethane is found in treated (chlorinated) water at levels significantly higher than untreated water. No longer produced or used commercially in the US.
General Use: Used in research as a laboratory reagent or for chemical synthesis. Formerly used as a flame retardant, in fire extinguishers, as a solvent for waxes, fats, and resins, and to separate minerals from salts.

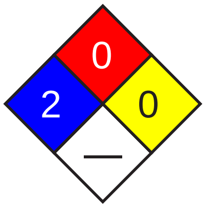
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Bromodichloromethane	75-27-4	ca 98+% vol

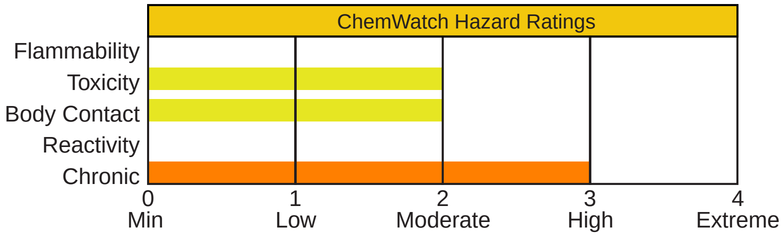
OSHA PEL **NIOSH REL**

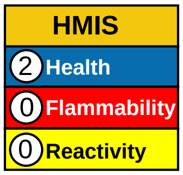
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid. Acute Effects: toxic to CNS resulting in sleep disturbances/fatigue, liver/kidney damage may occur. Potential human carcinogen based on animal studies.

Potential Health Effects

Target Organs: Central nervous system (CNS), blood, liver, kidneys.
Primary Entry Routes: Inhalation
Acute Effects Bromodichloromethane is metabolized to carbon monoxide in the liver. Therefore, toxic effects to the nervous system are due to carbon monoxide formation. This also explains why the liver can be adversely affected. Exposure to acetone and chlordecone potentiates liver toxicity.
Inhalation: CNS effects including fatigue, sleep disturbances, and incoordination. Methemoglobinemia (lack of oxygenated blood in body tissues), evident by a bluish tint to skin, lips, and fingernails, is also likely.
Eye: No effects reported.
Skin: No effects reported.
Ingestion: CNS effect may occur as via inhalation.
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.
Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Repeated exposure to bromodichloromethane has resulted in liver and kidney carcinogenicity in animals. It is not known whether or not chronic exposure will produce cancer in humans. Human 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.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with plenty of water followed by a thorough 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 to dilute. Inducement of vomiting should *not* be necessary except in cases of large ingestions.

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: Nonflammable

Autoignition Temperature: Nonflammable

LEL: Nonflammable

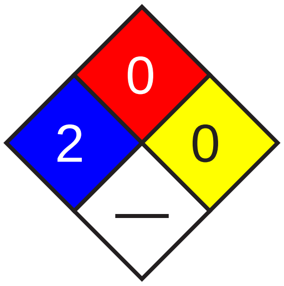
UEL: Nonflammable

Flammability Classification: Nonflammable

Extinguishing Media: Use agents suitable for surrounding fire.

General Fire Hazards/Hazardous Combustion Products: Thermal decomposition can result in chlorine, phosgene, bromine and carbon oxide(s) 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.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel and ventilate area. Cleanup personnel should protect against inhalation.

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 ventilation sufficient to maintain airborne concentrations at nonhazardous levels. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using bromodichloromethane, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from sources of elevated temperatures.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: No additional controls are necessary. 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: Employees should be informed of the potential carcinogenicity of bromodichloromethane and periodic medical exams should be used to detect any abnormal kidney or liver activity.

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 bromodichloromethane 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.
Physical State: Liquid
Odor Threshold: 1680 mg/m^3
Vapor Pressure (kPa): 50 mm Hg at 68 °F (20 °C)
Formula Weight: 163.83
Specific Gravity (H_2O=1, at 4 °C): 1.980 at 68 °F (20 °C)
Refractive Index: 1.4964 at 68 °F (20 °C)
Boiling Point: 195 °F (90.6 °C)
Freezing/Melting Point: -70.8 °F (-57.1 °C)
Water Solubility: 4,500 mg/L
Other Solubilities: Soluble in alcohol, acetone, benzene, chloroform, and ethyl ether.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Bromodichloromethane is stable at room temp. in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to elevated temperatures.
Storage Incompatibilities: None reported.
Hazardous Decomposition Products: Thermal oxidative decomposition of bromodichloromethane can produce chlorine, bromine, phosgene, and carbon oxide(s) gases.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 430 mg/kg caused somnolence, tremor, and liver changes.
Mouse, oral, LD_{50}: 450 mg/kg caused changes in circulation, fatty liver degeneration, and hemorrhage.
Other Effects:
Rat, oral: 25.5 g/kg administered continuously for 2 years produced gastrointestinal and kidney tumors.
Rat, oral: 5670 mg/kg administered continuously for 4 weeks resulted in changes in liver weight and serum composition, and weight loss or decreased weight gain.
Tumorgenicity, mouse, oral: 38.25 g/kg administered continuously for 2 years produced liver tumors.
Human, lymphocyte: 400 µmol/L caused sister chromatid exchange.
Mouse, lymphocyte: 180 mg/L (+S9) caused mutation.

See *RTECS* PA5310000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, bromodichloromethane is expected to volatilize due to its high vapor pressure. Because it is highly mobile in soil, leaching will occur and biodegradation will occur under anaerobic conditions. In water, volatilization is expected to be relatively rapid with a typical half-life from streams and rivers of 35 hr. Bioconcentration is not expected to be significant (BCF = 0.72 to 1.37). In air, bromodichloromethane is expected to exist almost entirely in the vapor phase and react with hydroxyl radicals in the troposphere (half-life = 6.65 months). This persistent half-life indicates that long-range global transport is possible. Any bromodichloromethane that does not undergo reaction with hydroxyl radicals can reach the stratosphere, where it will be destroyed via photolysis.
Ecotoxicity: Data not found.
Henry's Law Constant: 1.6×10^{-3} atm/m^3/mole at 68 °F (20 °C)
Octanol/Water Partition Coefficient: log K_{ow} = 1.88 (*calc*)

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, 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) 5000 lb (2268 kg)
  SARA 40 CFR 372.65: Listed
  SARA EHS 40 CFR 355: Not listed
  TSCA: Listed

Section 16 - Other Information

Issue Date: 2006-06

Carbon Tetrachloride
CAR5560

Section 1 - Chemical Product and Company Identification

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.

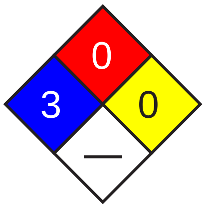
ACGIH TLV
TWA: 5 ppm; STEL: 10 ppm; skin.

NIOSH REL
STEL: 2 ppm (12.6 mg/m^3) (60-minute).

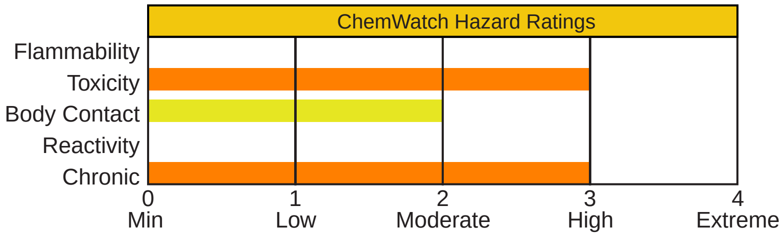
IDLH Level
200 ppm.

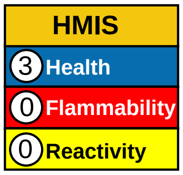
DFG (Germany) MAK
TWA: 0.5 ppm; PEAK: 1 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; ethereal odor. Irritating to eyes/skin/respiratory tract. Toxic. Other Acute Effects: incoordination, confusion, liver/kidney damage. Chronic Effects: 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

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: 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.

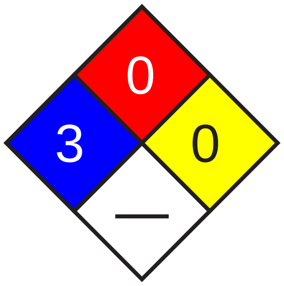
Preplacement and annual medical examinations are recommended for workers exposed to carbon tetrachloride. Preplacement examinations should include an evaluation of alcohol intake, a urinalysis that includes a microscopic examination, and kidney function tests. Special attention should be given to the 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

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.

See
DOT
ERG



Fire Diamond

Section 6 - Accidental Release Measures

See
DOT
ERG

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
Odor Threshold: 21.4 ppm
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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Carbon tetrachloride
ID: UN1846
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: IB2, N36, T7, TP2

Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** A **Other:** 40

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.

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

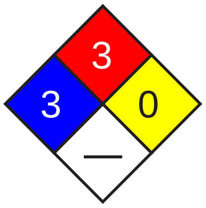
DFG (Germany) MAK
TWA: 10 ppm; PEAK: 20 ppm.

ACGIH TLV
TWA: 10 ppm.

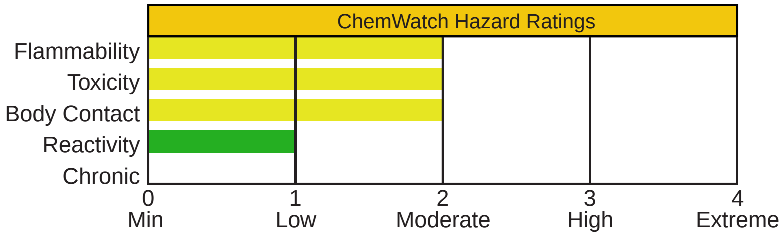
IDLH Level
1000 ppm.

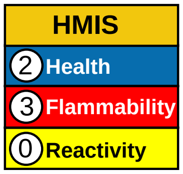
EU OEL
TWA: 23 mg/m^3 (5 ppm); STEL: 70 mg/m^3 (15 ppm).

Section 3 - Hazards Identification



Fire Diamond





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.

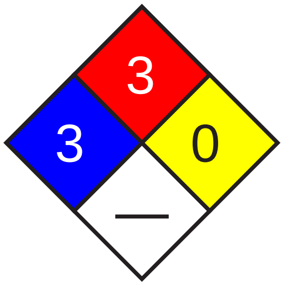
Note to Physicians: Treat symptomatically.

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

See DOT ERG



Fire Diamond

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.

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 x10^{-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

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

Issue Date: 2004-12

Chloroform
CHL4090

Section 1 - Chemical Product and Company Identification 54/59

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.

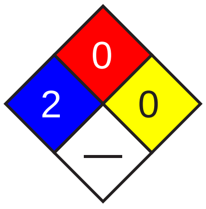
ACGIH TLV
TWA: 10 ppm.

NIOSH REL
STEL: 2 ppm, 9.78 mg/m^3; 60-minute.

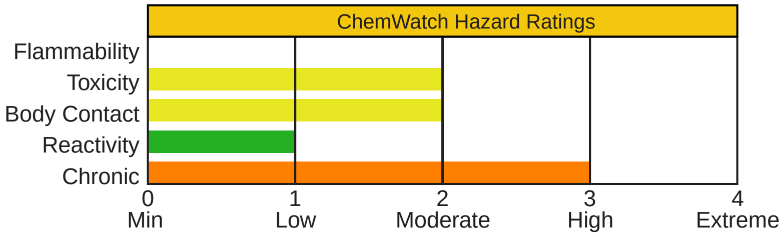
IDLH Level
500 ppm.

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

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.

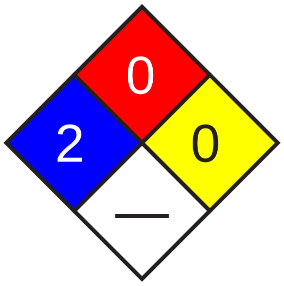
Avoid giving milk or oils.

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



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

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
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:**

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.

Section 1 - Chemical Product and Company Identification

Material Name: cis-Acetylene Dichloride **CAS Number:** 156-59-2
Chemical Formula: $C_2H_2Cl_2$
Structural Chemical Formula: CHCl=CHCl
EINECS Number: 205-859-7
ACX Number: X1007815-0
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

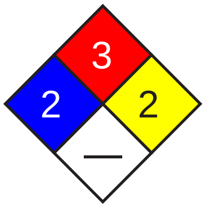
OSHA PEL
TWA: 200 ppm; 790 mg/m^3.

NIOSH REL

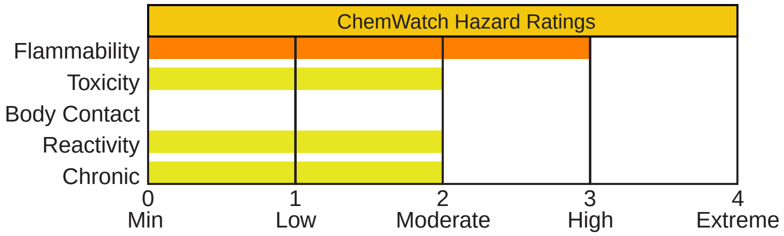
DFG (Germany) MAK
TWA: 200 ppm; PEAK: 400 ppm.

ACGIH TLV
TWA: 200 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
2 Reactivity

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

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: • 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.

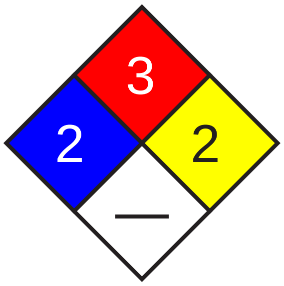
After first aid, get appropriate in-plant, paramedic, or community medical support.

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

See DOT ERG



Fire Diamond

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 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

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.
- 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

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

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

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

<u>**Toxicity**</u>

Inhalation (mouse) LC_{Lo}: 65000 mg/m^3/2 hr

Rat liver cell mutagen in vitro

<u>**Irritation**</u>

Nil reported

See *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: 1,2-Dichloroethylene
ID: UN1150
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T7, TP2
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: 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.

Issue Date: 2005-05

Acetylene Dichloride
DIC4500

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Acetylene Dichloride **CAS Number:** 540-59-0
Chemical Formula: $C_2H_2Cl_2$
Structural Chemical Formula: ClCH=CHCl
EINECS Number: 208-750-2
ACX Number: X1002625-6
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.

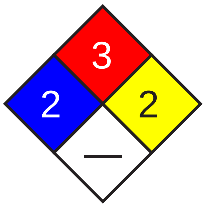
NIOSH REL
TWA: 200 ppm, 790 mg/m^3.

DFG (Germany) MAK
TWA: 200 ppm; PEAK: 400 ppm.

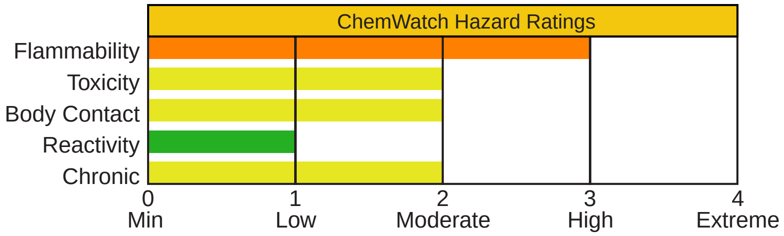
ACGIH TLV
TWA: 200 ppm.

IDLH Level
1000 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
1 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, respiratory system
Primary Entry Routes: inhalation, ingestion, skin contact, 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. 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

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: 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

See DOT ERG

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

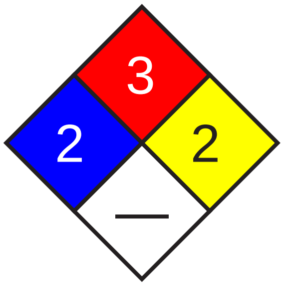
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: 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.



Fire Diamond

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

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.

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 .... 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
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 47.78 °C (118 °F)
Freezing/Melting Point: -50 °C (-58 °F)
Water Solubility: 0.4% 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.
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

Toxicity
Oral (rat) LD_{50}: 770 mg/kg
Intraperitoneal (mouse) LD_{50}: 2000 mg/kg

Irritation
Skin (rabbit): 100 mg/24h - mod.

See *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: 1,2-Dichloroethylene
ID: UN1150
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T7, TP2
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:** 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

Section 1 - Chemical Product and Company Identification

Material Name: Ethylbenzene **CAS Number:** 100-41-4
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_5{\bullet}C_2H_5$
EINECS Number: 202-849-4
ACX Number: X1003016-1
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.

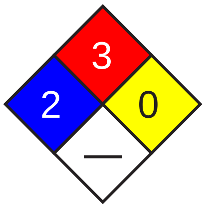
ACGIH TLV
TWA: 100 ppm; STEL: 125 ppm.

NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 125 ppm, 545 mg/m^3.

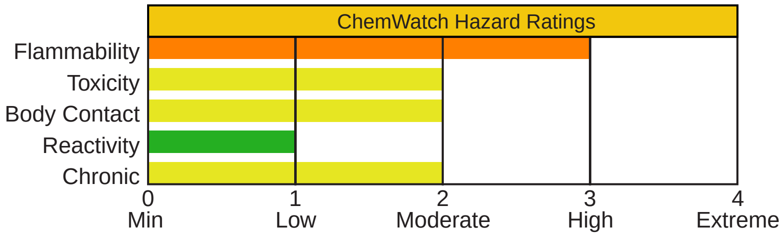
IDLH Level
800 ppm (10% LEL).

DFG (Germany) MAK
Skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; pungent odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: chest constriction, vertigo, narcosis, cramps, respiratory paralysis. Chronic Effects: fatigue, sleepiness, headache, blood disorders, lymphocytosis. Flammable.

Potential Health Effects

Target Organs: eyes, respiratory system, skin, central nervous system (CNS), blood
Primary Entry Routes: inhalation, skin contact, 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.

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

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: 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.

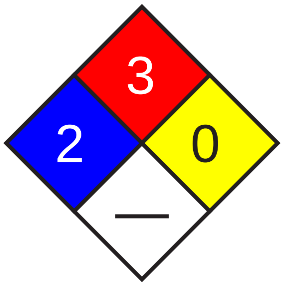
After first aid, get appropriate in-plant, paramedic, or community medical support.

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

See DOT ERG



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

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.
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	Best selection
TEFLON	Best selection

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
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 136.2 °C (277 °F) at 760 mm Hg
Freezing/Melting Point: -95 °C (-139 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.01% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 3500 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm/8h
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.

Irritation

Skin (rabbit): 15 mg/24h mild
Eye (rabbit): 500 mg - SEVERE

See *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Ethylbenzene
ID: UN1175
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: 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

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 44/59

Material Name: Methylene Chloride **CAS Number:** 75-09-2
Chemical Formula: CH_2Cl_2
EINECS Number: 200-838-9
ACX Number: X1000032-3
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.

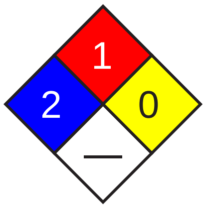
OSHA PEL
TWA: 25 ppm; STEL: 125 ppm.

NIOSH REL

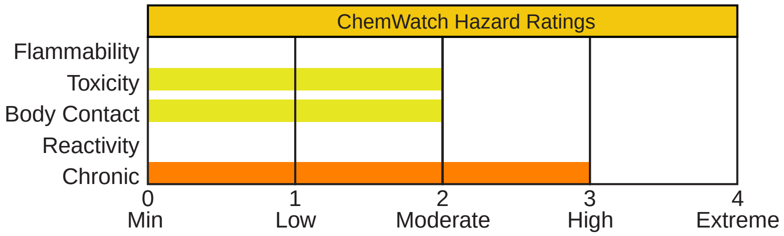
ACGIH TLV
TWA: 50 ppm.

IDLH Level
2300 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
1 Flammability
0 Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: narcosis at high concentrations. Can form flammable mixtures with air, 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.

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)

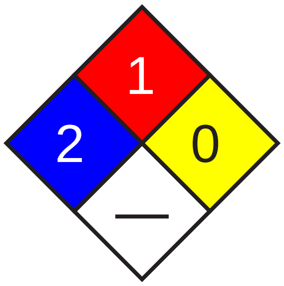
LEL: 15.5% (in oxygen); LFL: 12% v/v

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-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.



Fire Diamond

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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Dichloromethane
ID: UN1593
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:**

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 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.

Styrene
STY3000

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Styrene **CAS Number:** 100-42-5
Chemical Formula: C_8H_8
Structural Chemical Formula: $C_6H_5CH=CH_2$
EINECS Number: 202-851-5
ACX Number: X1001136-0
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.

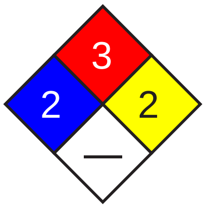
ACGIH TLV
TWA: 20 ppm; STEL: 40 ppm.

NIOSH REL
TWA: 50 ppm (215 mg/m^3); STEL: 100 ppm (425 mg/m^3).

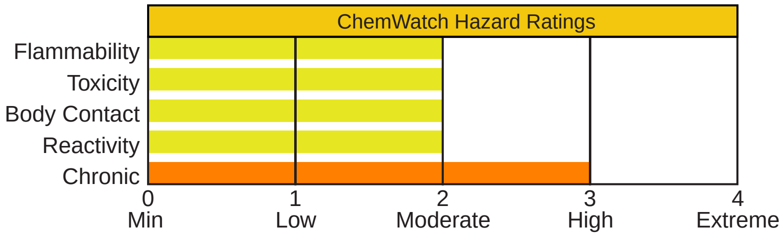
IDLH Level
700 ppm.

DFG (Germany) MAK
TWA: 20 ppm; PEAK: 40 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
2 Reactivity

ANSI Signal Word

Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless-yellow, oily liquid; sweet odor. Irritating. Other Acute Effects: difficulty breathing, dizziness. Chronic Effects: 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.

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: 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 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

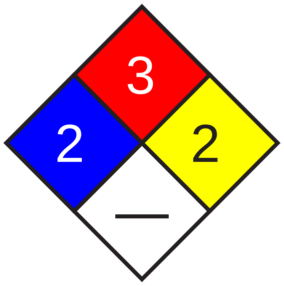
NS: Non-specific determinant; also seen after exposure to other materials.

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

See DOT ERG



Fire Diamond

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 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.

See DOT ERG

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
Odor Threshold: 0.15 to 25 ppm
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
Evaporation Rate: 0.49 (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 145 °C (293 °F)
Freezing/Melting Point: -31 °C (-23.8 °F)
Volatile Component (% Vol): 100
Water Solubility: Sparingly soluble in water

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
Oral (rat) LD_{50}: 5000 mg/kg
Inhalation (human)LC_{Lo}: 10000 ppm/30m.
Inhalation (human) TC_{Lo}: 0.02 mg/m^3
Inhalation (human) TC_{Lo}: 600 ppm
Inhalation (rat): 24000 $mg/m^3/4h$

Irritation
Skin (human): 500 mg - no skin effects.
Skin (rabbit): 500 mg - mild
Skin (rabbit): 100% - moderate
Eye (rabbit): 18 mg
Eye (rabbit): 100 mg/24h - moderate

See *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: TL_m 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; TL_m 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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Styrene monomer, stabilized
ID: UN2055
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: 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

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

Perchloroethylene
TET2750

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Perchloroethylene **CAS Number:** 127-18-4
Chemical Formula: C_2Cl_4
Structural Chemical Formula: $Cl_2C=CCl_2$
EINECS Number: 204-825-9
ACX Number: X1000034-7
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; Ceiling 200 ppm; 300 ppm, 5-minute maximum peak in any 3 hours.

OSHA PEL Vacated 1989 Limits
TWA: 25 ppm; 170 mg/m^3.

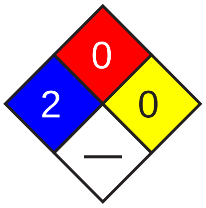
ACGIH TLV
TWA: 25 ppm; STEL: 100 ppm.

NIOSH REL
Minimize workplace exposure concentrations.

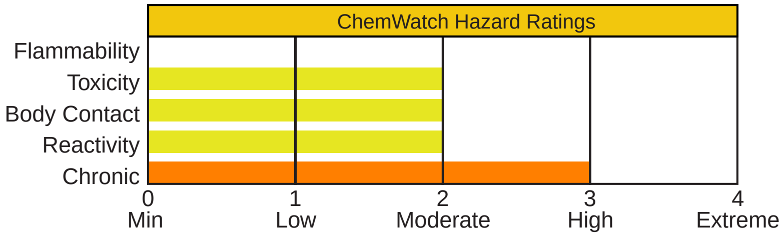
IDLH Level
150 ppm.

DFG (Germany) MAK
Skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
0 Flammability
0 Reactivity

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

Target Organs: liver, kidneys, eyes, upper respiratory system, skin, central nervous system (CNS)
Primary Entry Routes: inhalation, skin contact, eye contact

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 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

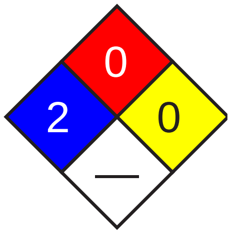
Flash Point: Nonflammable

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 .... Best selection

VITON/CHLOROBUTYL	Best selection
VITON/NITRILE	Best selection
VITON	Best selection
PVA	Best selection
CPE	Best selection
NITRILE	Satisfactory; may degrade after 4 hours continuous immersion
TEFLON	Satisfactory; may degrade after 4 hours continuous immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
SARANEX-23 2-PLY	Poor to dangerous choice for other than short-term immersion
SARANEX-23	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
BUTYL	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 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
Evaporation Rate: 0.09 Ether=1

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 121 °C (250 °F) at 760 mm Hg
Freezing/Melting Point: -19 °C (-2.2 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.02% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: 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

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

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: 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.

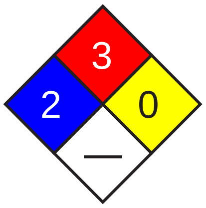
EU OEL
TWA: 192 mg/m^3 (50 ppm); STEL: 384 mg/m^3 (100 ppm).

NIOSH REL
TWA: 100 ppm (375 mg/m^3); STEL: 150 ppm (560 mg/m^3).

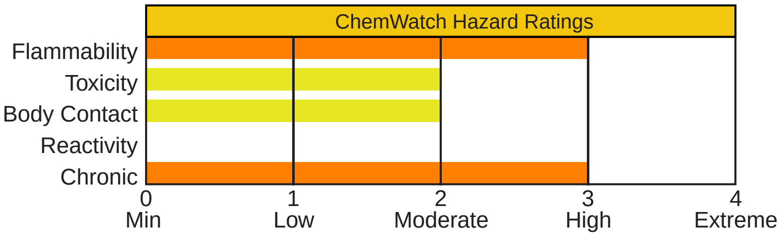
IDLH Level
500 ppm.

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):

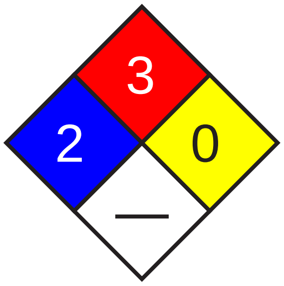
Determinant	Index	Sampling Time	Comments
Hippuric acid in urine	2.5 gm/gm creatinine	End of shift Last 4 hrs of shift	B,NS
Toluene in venous blood	1 mg/L	End of shift	SQ
Toluene in end-exhaled air		End of shift	SQ

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

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.

See DOT ERG

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: 2004-07

Trichloroethylene
TRI2710

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Trichloroethylene **CAS Number:** 79-01-6
Chemical Formula: C_2HCl_3
Structural Chemical Formula: $ClCH=CCl_2$
EINECS Number: 201-167-4
ACX Number: X1000039-2
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.

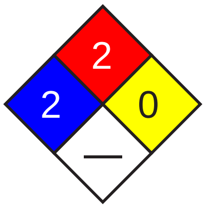
OSHA PEL Vacated 1989 Limits
TWA: 50 ppm; 270 mg/m^3; STEL: 200 ppm; 1080 mg/m^3.

ACGIH TLV
TWA: 50 ppm; STEL: 100 ppm.

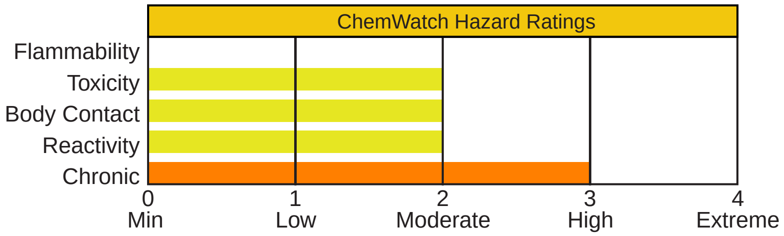
NIOSH REL

IDLH Level
1000 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
2 Flammability
0 Reactivity

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

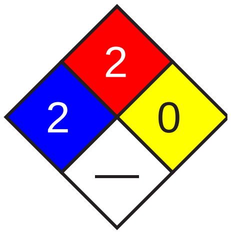
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

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
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 87 °C (189 °F)
Freezing/Melting Point: -73 °C (-99.4 °F)
Volatile Component (% Vol): 100
Water Solubility: < 1 mg/mL at 21 °C

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
Oral (human) LD_{Lo}: 7000 mg/kg
Oral (man) TD_{Lo}: 2143 mg/kg
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

Irritation
Skin (rabbit): 500 mg/24h - SEVERE
Eye (rabbit): 20 mg/24h - SEVERE

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

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Vinyl Chloride **CAS Number:** 75-01-4
Chemical Formula: C_2H_3Cl
Structural Chemical Formula: $CH_2{=}CHCl$
EINECS Number: 200-831-0
ACX Number: X1003494-5
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

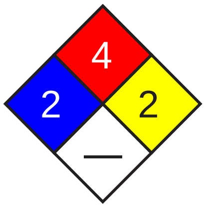
Name	CAS	%
vinyl chloride	75-01-4	>98

OSHA PEL
TWA: 1 ppm; Ceiling: 5 ppm, 15-minute; 1910.1017.

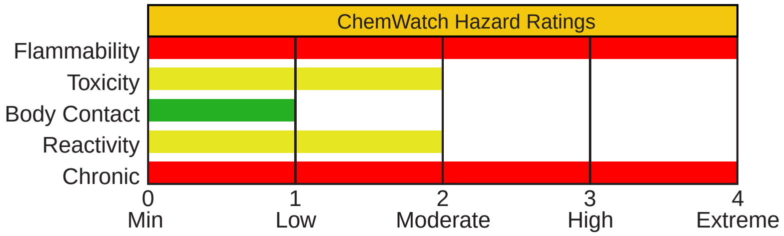
NIOSH REL

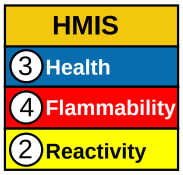
ACGIH TLV
TWA: 1 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Flammable


Compressed Gas

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas; pleasant ethereal odor. Compressed gas can cause frostbite. Toxic. Other Acute Effects: CNS depression. Chronic Effects: reproductive effects, skin/blood changes, arthralgias, bone effects (hand), vascular disorder (fingers/toes). Cancer hazard. Flammable

Potential Health Effects

Target Organs: liver, central nervous system (CNS), respiratory system, lymphatic system, bone, connective tissue of the skin
Primary Entry Routes: inhalation, skin contact, eye contact
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

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.

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.

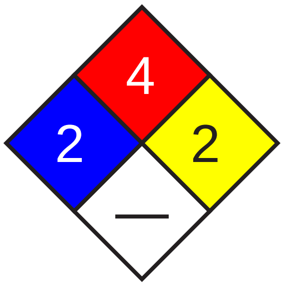
Ingestion: Not normally a hazard due to physical form of product. DO NOT delay. Immediately transport to hospital or doctor.

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

See DOT ERG



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

See DOT ERG

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	Best selection
NITRILE	Satisfactory; may degrade after 4 hours continuous 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
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: -13.37 °C (8 °F)
Freezing/Melting Point: -153.8 °C (-244.84 °F)
Volatile Component (% Vol): 100
Water Solubility: Slightly soluble

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: 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

<u>**Toxicity**</u>

Oral (rat) LD_{50}: 500mg/kg
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.

<u>**Irritation**</u>

Nil reported

See *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Vinyl chloride, stabilized
ID: UN1086
Hazard Class: 2.1 - Flammable gas
Packing Group:
Symbols:
Label Codes: 2.1 - Flammable Gas
Special Provisions: 21, B44, T50
Packaging: **Exceptions:** 306 **Non-bulk:** 304 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 150 kg
Vessel Stowage: **Location:** B **Other:** 40

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

Issue Date: 2004-12

Xylene
XYL2260

Section 1 - Chemical Product and Company Identification 54/59

Material Name: Xylene

CAS Number: 1330-20-7

Chemical Formula: C_8H_{10}

Structural Chemical Formula: $C_6H_4(CH_3)_2$

EINECS Number: 215-535-7

ACX Number: X1001166-8

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

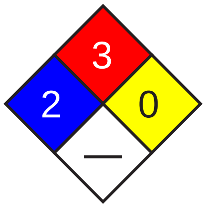
OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

ACGIH TLV
TWA: 100 ppm; STEL: 150 ppm.

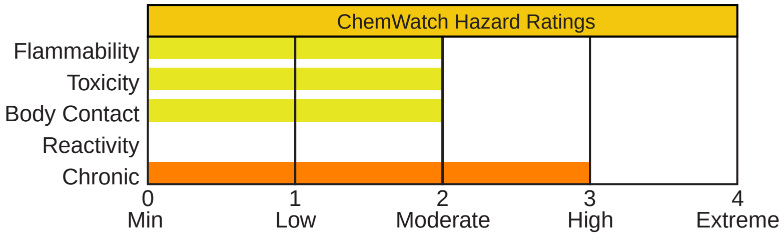
NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 150 ppm, 655 mg/m^3.

DFG (Germany) MAK
TWA: 100 ppm; PEAK: 200 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, nausea, drowsiness. Chronic Effects: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects (animal data). Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin

Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion

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.

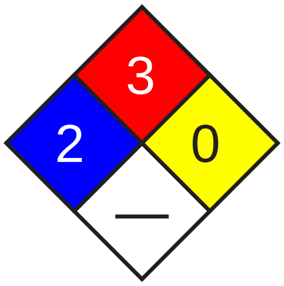
BIOLOGICAL EXPOSURE INDEX - BEI

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

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.



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 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	Best selection
PVA	Best selection
VITON	Best selection
TEFLON	Best selection
PVDC/PE/PVDC	Poor to dangerous choice for other than short-term immersion
NATURAL+NEOPRENE	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
HYPALON	Poor to dangerous choice for other than short-term immersion
NAT+NEOPR+NITRILE	Poor to dangerous choice for other than short-term immersion

BUTYL ....Poor to dangerous choice for other than short-term immersion
BUTYL/NEOPRENE ....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

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
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 137 °C (279 °F) to 140 °C (284 °F)
Freezing/Melting Point: -47 °C (-53 °F)
Volatile Component (% Vol): 100
Water Solubility: Practically 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

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 *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 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: Xylenes
ID: UN1307
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:**

Shipping Name and Description: Xylenes
ID: UN1307
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 U239 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

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

Acenaphthene
ACE1150

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification

Material Name: Acenaphthene **CAS Number:** 83-32-9
Chemical Formula: $C_{12}H_{10}$
Structural Chemical Formula: $C_{10}H_6(CH_2)_2$
EINECS Number: 201-469-6
ACX Number: X1001052-9
Synonyms: ACENAPHTHENE; ACENAPHTHYLENE,1,2-DIHYDRO-; 1,8-DIHYDROACENAPHTHALENE; 1,2-DIHYDROACENAPHTHYLENE; 1,8-DIHYDROACENAPHTHYLENE; 1,8-ETHYLENENAPHTHALENE; ETHYLENENAPHTHALENE; NAPHTHYLENEETHYLENE; PERI-ETHYLENE NAPHTHALENE; PERIETHYLENENAPHTHALENE
Derivation: By passing ethylene and benzene or naphthalene through a red hot tube; by heating tetrahydroacenaphthene with sulfur to 356 °F (180 °C); or by reacting acenaphthenone or acenaphthenequinone by high-pressure hydrogenation in decalin with nickel at 356 to 464 °F (180 to 240 °C). Occurs as a by-product in coal tar production during the high-temperature carbonization or coking of coal.
General Use: Used as an intermediate for dyes, pharmaceuticals, insecticides, fungicides, and plastics.

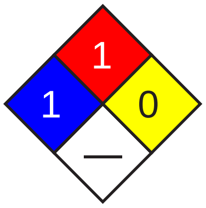
Section 2 - Composition / Information on Ingredients

Name	**CAS**	**%**
Acenaphthene	83-32-9	ca 98% wt

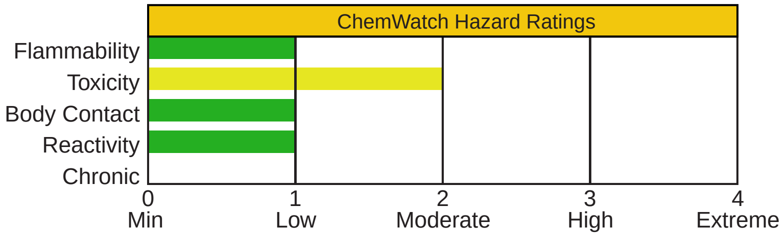
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
1	Flammability
0	Reactivity

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, needle-like crystals. Irritating to eyes/skin/respiratory tract. Also causes: vomiting if large amounts are ingested. Chronic: possible mutagenic activity (animal studies). Combustible.

Potential Health Effects

Target Organs: Eyes, skin, respiratory tract.
Primary Entry Routes: Inhalation, skin and eye contact.
Acute Effects
Inhalation: Irritation of the respiratory tract may occur.
Eye: Irritation may occur.
Skin: Irritation may occur.
Ingestion: Ingestion of large amounts may cause vomiting. Irritation of the gastrointestinal tract may occur.
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: Pre-existing 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. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water followed by a thorough 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 to dilute. Vomiting may be spontaneuos if large amounts are ingested.

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: Combustible

Autoignition Temperature: None reported.

LEL: None reported.

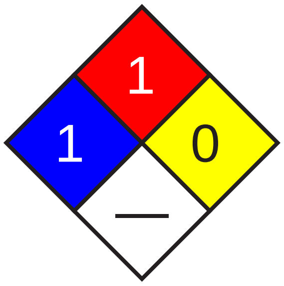
UEL: None reported.

Flammability Classification: Combustible Solid

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

General Fire Hazards/Hazardous Combustion Products: Carbon oxide(s).

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.

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with appropriate filter) and place in suitable containers.

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 ventilation adequate to prevent airborne hazards. *Do not* use near heat and ignition sources.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using acenaphthene, 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: Where possible, enclose all processes to prevent dust dispersion into work area. To prevent static sparks, electrically ground and bond all equipment used with and around acenaphthene. Provide general or local exhaust ventilation systems to maintain airborne concentrations at least as low as those given for *nuisance dusts*. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider periodic medical exams to determine if any irritation upon exposure to acenaphthene has occurred.

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 acenaphthene 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, needle-like crystals.
Physical State: Solid
Odor Threshold: 0.5048 mg/m^3
Vapor Pressure (kPa): < 0.02 mm Hg at 68 °F (20 °C); 10 mm Hg at 268 °F (131 °C)
Formula Weight: 154.21
Specific Gravity (H_2O=1, at 4 °C): 1.0242 at (194 °F) 90 °C
Refractive Index: 1.6048 at 212 °F (100 °C)
Boiling Point: 531.5 °F (277.5 °C)
Freezing/Melting Point: 200.5 °F (93.6 °C)
Water Solubility: 100 mg/L
Other Solubilities: Soluble as 1 g/ 31 mL (ethanol), 56 mL (methanol), 25 mL (propanol), 2.5 mL (chloroform), 5 mL (benzene & toluene); 3.2 g/100 mL glacial acetic acid.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Acenaphthene 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: Acenaphthene reacts with molecular oxygen in the presence of alkali-earth metal bromides to form acenaphthequinone; reacts with ozone in the presence of alkali-earth metal hydroxides to form 1,8-naphthaldehyde carboxylic acid; and is oxidized to aromatic alcohols and ketones by reaction with transition metal catalysts.

Hazardous Decomposition Products: Thermal oxidative decomposition of acenaphthene can produce carbon oxide(s) and thick, acrid smoke.

Section 11 - Toxicological Information

Other Effects:
Microorganisms (species unspecified): 3 mg (-S9) caused mutation.
Rat, intraperitoneal, LD_{50}: 600 mg/kg.

See *RTECS* AB1000000, for additional data.

Section 12 - Ecological Information

Environmental Fate: In soil, acenaphthene will biodegrade under aerobic conditions with a half-life of 10 to 60 days. A soil absorption coefficient of 2065 to 3230 indicates slight mobility. In water, biodegradation will occur under aerobic conditions with a half-life of 1 to 25 days, as well as photolysis in direct sunlight. Volatilization is another means of removal with half- lives of 11 hr from a model river and 39 days from a model pond which considers the effect of adsorption. In air, acenaphthene reacts with photochemically-produced hydroxyl radicals with a half-life of 7.2 hr.

Ecotoxicity: *Pimephales promelas* (fathead minnow), LC_{50} = 1700 µg/L/72 hr, 1600 µg/L/96 hr; *Salmo gairdneri* (rainbow trout), LC_{50} = 1570 µg/L/24 hr, 1130 µg/l/48 hr, 800 µg/L/72 hr, 670 µg/L/96 hr.

Henry's Law Constant: 1.55×10^{-4} atm/m^3/mole at 77 °F (25 °C)

Octanol/Water Partition Coefficient: log K_{ow} = 3.92

Section 13 - Disposal Considerations

Disposal: Acenaphthene 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:** 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

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

Anthracene
ANT2000

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 44/60

Material Name: Anthracene **CAS Number:** 120-12-7
Chemical Formula: $C_{14}H_{10}$
Structural Chemical Formula: $(C_6H_4CH)_2$
EINECS Number: 204-371-1
ACX Number: X1001589-1
Synonyms: ANTHRACEN; ANTHRACENE; ANTHRACENE OIL; ANTHRACIN; COAL TAR PITCH VOLATILES:ANTHRACENE; GREEN OIL; P-NAPHTHALENE; PARANAPHTHALENE; PARANAPTHALENE; TETRA OLIVE N2G
Derivation: Occurs naturally in smoke (gasoline, coal, cigarette, etc.), charbroiled foods, and coal tar pitch volatiles. Obtained by distilling crude anthracene oil with alkali carbonate in iron retorts (phenanthrene is removed via carbon disulfide) *or* by salting out from crude anthracene oil and draining; the crude salts are then purified by pressing and the use of various solvents (phen-anthrene and carbazole are removed).
General Use: Used in chemical manufacture (phenanthrene, carbazole, anthraquinone), in calico printing; as a component of dyes, scintillation fluid, smoke screens; and in organic semi-conductor research.

Section 2 - Composition / Information on Ingredients

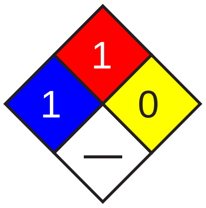
Name	CAS	%
Anthracene	120-12-7	ca 90 to 95% wt (commercial grade); 90 to 98% wt (technical grade)

Trace Impurities: phenanthrene, carbazole, chrysene, pyridine (0.2%), iron (0.03%)

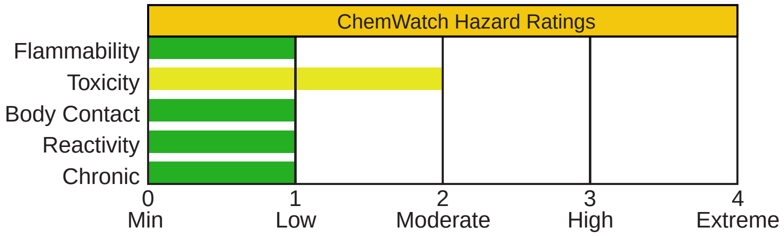
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
1	Flammability
0	Reactivity

ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless crystals with violet fluorescence (pure) or yellow crystals with green fluorescence. Irritating to eyes/skin/respiratory tract. Other Acute Effects: sun exposure can aggravate skin irritation and cause dermatitis. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, respiratory and digestive tracts.
Primary Entry Routes: Inhalation, skin/eye contact
Acute Effects
Inhalation: Symptoms include irritation of the respiratory tract, headache, nausea and vomiting, loss of appetite, slowed reactions, and adynamia (lack or loss of strength due to disease or other outside agent). Acute symptoms disappear within several days of last exposure.
Eye: Irritation of the conjunctiva with burning, itching and watering.
Skin: Irritation with burning, itching, and edema (fluid build-up). Volunteers with a 2% crude tar solution applied to the skin showed anthracene absorption via blood tests.

Ingestion: Gastrointestinal tract irritation.

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: Dermatitis.

Chronic Effects: Repeated skin contact can cause pigmentation of the skin with cornification of surface layers and telangioectasis (an abnormal dilatation of capillary vessels that often form small, raised, red, wart-like spots). Sensitization (including photo- sensitization) may also occur. Anthracene appears to concentrate in the fat and liver.

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 an ophthalmologist if pain and 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. Vomiting may be spontaneous.

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

Note to Physicians: Treatment is symptomatic and supportive.

See DOT ERG

Section 5 - Fire-Fighting Measures

Flash Point: 250 °F (121 °C), Closed Cup

Autoignition Temperature: 1004 °F (540 °C)

LEL: 0.6% v/v

UEL: Not reported.

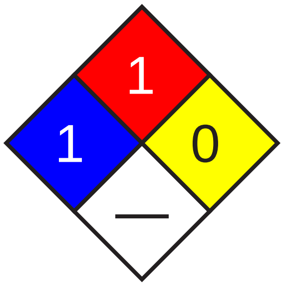
Flammability Classification: Combustible

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

General Fire Hazards/Hazardous Combustion Products: Include carbon oxide(s) and irritating, acrid smoke. May explode in 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: Carefully scoop up or vacuum (with appropriate filter) and place in suitable containers for disposal.

Large Spills: Use water to flush large spills 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).

See DOT ERG

Section 7 - Handling and Storage

Handling Precautions: *Do not* use near heat or flame. Wear appropriate PPE. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using anthracene, especially before eating, drinking, smoking, using the toilet, or applying cosmetics. Skin cleansers (ex. 55% kaolin, 25% neutral soap, 20% bran) are recommended.

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 equipment used with and around anthracene. Enclosure of equipment and mechanization of processes will aid in exposure control. 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 skin.

Personal Protective Clothing/Equipment: Limit work in sunlight as much as possible to prevent photosensitization. Photoprotective creams or pastes must be applied to bare skin regions. Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyvinyl chloride is a suitable material for PPE. 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 a SCBA or supplied-air respirator with a full facepiece and operated in pressure-demand or other 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 and place in closed containers until laundered. Remove anthracene 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 crystals with a violet fluorescence (pure), yellow crystals with a green fluorescence (due to tetracene and naphthacene).

Physical State: Solid
Vapor Pressure (kPa): 1mm Hg at 293 °F (145 °C)
Formula Weight: 178.22
Density: 1.25 g/cm^3 at 80.6 °F (27 °C)
Boiling Point: 644 °F (340 °C)
Freezing/Melting Point: 423 °F (217 °C)

Water Solubility: 1.29 mg/L at 77 °F/25 °C (*distilled water*), 0.6 mg/L at 77 °F/25 °C (*salt water*)

Other Solubilities: 1 g in 67 mL absolute alcohol, 70 mL methanol, 62 mL benzene, 85 mL chloroform, 200 mL ether, 31 mL carbon disulfide, 86 mL carbon tetrachloride, and 125 mL toluene. Also soluble in acetone.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Anthracene darkens upon exposure to sunlight (transformed to *para*-anthracene). Hazardous polymerization *does not* occur. Exposure to heat, ignition sources, sunlight, and incompatibles.

Storage Incompatibilities: Include calcium hypochlorite (exothermic), fluorine (explodes), chromic acid, and calcium oxychloride.

Hazardous Decomposition Products: Thermal oxidative decomposition of anthracene can produce carbon oxide(s) and acrid, irritating smoke.

Section 11 - Toxicological Information

Acute Oral Effects:
Mouse, oral, LD: > 17 g/kg caused fatty liver degeneration.

Irritation Effects:
Mouse, skin: 118 µg caused mild irritation.

Other Effects:
Rat, oral: 20 g/kg intermittently for 79 weeks caused liver tumors.
Genetic Effects - Rat, liver cell: 300 µmoL caused DNA damage.

See *RTECS* CA9350000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, anthracene is expected to absorb strongly and not leach to groundwater. It will not hydrolyze, but may be subject to biodegradation, the rate of which depends on soil type. In water, anthracene is subject to direct photolysis near the surface and undergoes significant biodegradation. Biodegradation in water is faster with increased temperature, increased oxygen, and acclimated microbes. Evaporation may also be significant with an estimated half-life range of 4.3 to 5.9 days from a river 1 m deep, flowing 1 m/sec, with a wind velocity of 3 m/sec. In the air, photolysis and reaction with photochemically-produced hydroxyl radicals (half-life: 1.67 days). Vapor phase anthracene is expected to degrade faster than particle-sorbed anthracene. A K_{oc} of 26,000 suggests anthracene is relatively immobile in soil and unlikely to leach to groundwater; it will absorb strongly to soil.

Ecotoxicity: *Leponis macrochirus* (bluegill sunfish), LC_{50} = 11.9 µg/L/96 hr; *Rana pipiens* (leopard frog), LC_{50} = 0.065 ppm/30 min & 0.025 ppm/5 hr. BCF (bioconcentration factor): goldfish (162), rainbow trout (4400-9200). Bioconcentration occurs most heavily in organisms which lack the enzyme microsomal oxidase. Anthracene can become concentrated on the waxy surface of some plant leaves and fruits.

Octanol/Water Partition Coefficient: log K_{ow} = 4.45 (calc.)

Section 13 - Disposal Considerations

Disposal: Anthracene is a waste chemical stream constituent which may be subjected to ultimate disposal by controlled 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: 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

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
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Issue Date: 2004-07

Benz[a]anthracene
BEN2040

Section 1 - Chemical Product and Company Identification 55/58

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

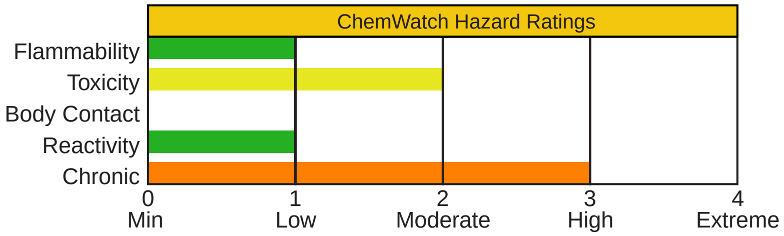
Name	CAS	%
benz[a]anthracene	56-55-3	>98

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

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

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

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	**Freezing/Melting Point:** 162 °C (323.6 °F)
Evaporation Rate: Half life 89 hours	**Volatile Component (% Vol):** Negligible
Boiling Point: Sublimes at 435 °C (815 °F)	**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 NIOSH, *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 Transportation Data (49 CFR 172.101):

Shipping Name: TOXIC SOLID, ORGANIC, N.O.S.
Hazard Class: 6.1
ID No.: 2811
Packing Group: III
Label: Harmful[6]

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.

Material Safety Data Sheet Collection
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Issue Date: 2004-07

Benzo(a)pyrene
BEN5560

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

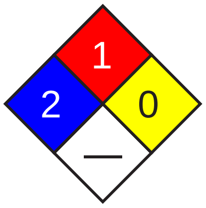
Except in laboratories, benzo(a)pyrene is usually mixed with other coal tar pitch chemicals. Consider exposure limits for coal tar pitch volatiles as a guideline. However, because benzo(a)pyrene is considered a probable carcinogen to humans, it is recommended that exposures to carcinogens be limited to the lowest feasible concentration.

OSHA PEL
TWA: 0.2 mg/m^3.

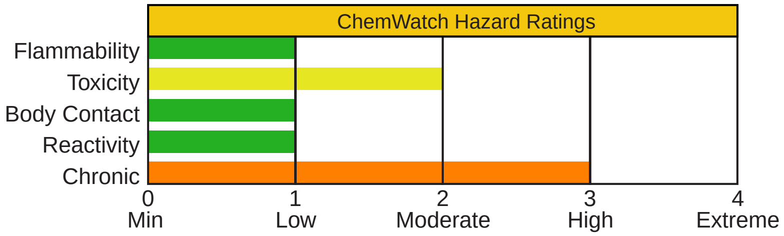
NIOSH REL

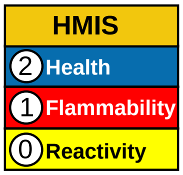
ACGIH TLV
Exposure by all routes should be carefully controlled to levels as low as possible.

Section 3 - Hazards Identification



Fire Diamond





HMIS
2 Health
1 Flammability
0 Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Benzo(a)pyrene is a pale yellow, crystalline solid or powder that is irritating to the skin, eyes, and respiratory tract. It is a carcinogen and 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

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

Flash Point: None reported. Benzo(a)pyrene may burn, but does *not* readily ignite.

Autoignition Temperature: None reported.

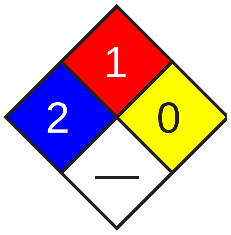
LEL: None reported.

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

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 NIOSH, *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 Transportation Data (49 CFR 172.101):

Shipping Name: Environmentally hazardous substances, solid, n.o.s.*
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9

Additional Shipping Information: * If it is in a quantity, in one package, which equals or exceeds the reportable quantity (RQ) of 1 lb (0.454 kg).

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.

Material Safety Data Sheet Collection

Genium Group, Inc.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Benzo[%i/i%]fluoranthene
BEN4520

Issue Date: 2004-07

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**

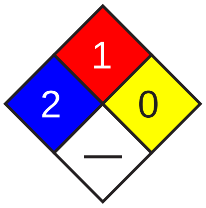
(Note that, except when in the form of a laboratory research chemical, benzo[%i/i%]fluoranthene is typically found in mixtures with other PAHs (polycyclic aromatic hydrocarbons), such as coal tar pitch).

OSHA PEL

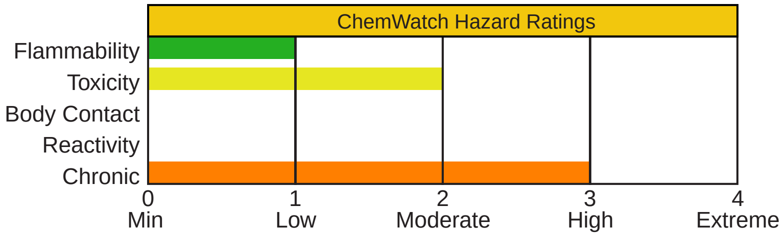
NIOSH REL

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 ☆☆☆☆☆

Benzo[%i/**i%]fluoranthene is a solid in the form of colorless needles. It can be irritating to the respiratory tract, skin and eyes. Like some other PAHs (polycyclic aromatic hydrocarbons), benzo[b]fluoranthene is a possible human carcinogen and mutagen. Handle with care! When heated to decomposition, benzo[%i/i%]fluoranthene will emit carbon monoxide (CO) and carbon dioxide (CO_2).**

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

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.

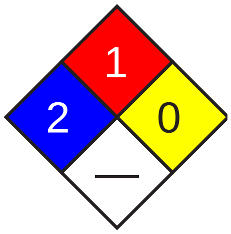
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

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



Fire Diamond

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.

Section 6 - Accidental Release Measures

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 NIOSH, *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 $\times 10^{-4}$ 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 Transportation Data (49 CFR 172.101):

Shipping Name: Environmentally hazardous substances, solid, n.o.s.*
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9

Additional Shipping Information: *If in a quantity in one package which equals or exceeds the final reportable quantity of 1 lb (0.454 kg).

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.

Benzo(g,h,i)perylene
BEN5400

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification

Material Name: Benzo(g,h,i)perylene **CAS Number:** 191-24-2
Chemical Formula: $C_{22}H_{12}$
EINECS Number: 205-883-8
ACX Number: X1007822-5
Synonyms: BENZO (G,H,I) PERYLENE; BENZO(GHI)PERYLENE; BENZO[GHI]PERYLENE; 1,12-BENZOPERYLENE; BENZO(G,H,I)PERYLENE; 1,12-BENZPERYLENE
Derivation: Combustion product of wood, coal, oil, propane, and diesel fuels.
General Use: Used for scientific research. There is no commercial production of this compound.

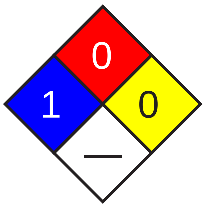
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Benzo(g,h,i)perylene	191-24-2	

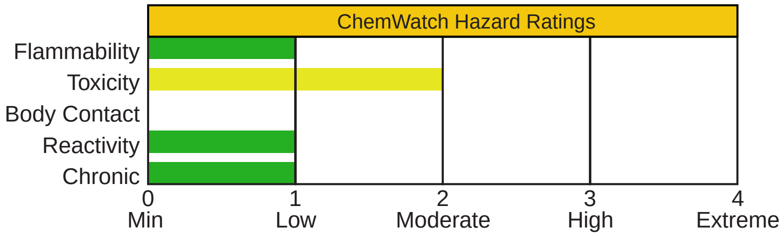
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
0	Flammability
0	Reactivity

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Yellowish-green leaflets or plates. Acute toxicity is probably low in humans but it may produce chronic effects. Questionable carcinogen. Mutation data reported.

Potential Health Effects

Target Organs: Skin, eyes
Primary Entry Routes: Inhalation, skin/eye contact, skin absorption, ingestion
Acute Effects
Inhalation: The toxicological properties of benzo(g,h,i)perylene have not been thoroughly investigated. In general, polynuclear aromatic hydrocarbons (PAHs) have a low order of acute toxicity in humans, but can produce a variety of non-cancer effects with chronic exposure.
Eye: Effects unknown.
Skin: May be absorbed through skin.
Ingestion: Effects unknown.
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: None reported.
Chronic Effects: Polynuclear aromatic hydrocarbons (PAH's) may produce chronic effects such as eye photosensitivity and irritation; respiratory irritation with cough and bronchitis; leukoplakia; skin irritation, "coal tar warts" (precancerous lesions enhanced by UV light exposure), redness, dermal burns, photosensitivity, and acneiform lesions; mild kidney and liver toxicity (animals). Some, but not all, PAHs are carcinogens.

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. *Do not* induce vomiting.

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

Section 5 - Fire-Fighting Measures

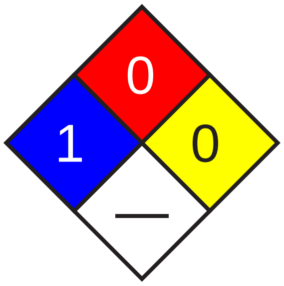
Flash Point: Data not found.

Autoignition Temperature: Data not found.

Extinguishing Media: Extinguish with water spray, carbon dioxide, dry chemical powder or appropriate foam.

General Fire Hazards/Hazardous Combustion Products: 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! Carefully scoop up or vacuum (with a HEPA filter). Avoid raising dust. 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: Wear personal protective clothing and equipment to prevent dust 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 operations to avoid dust 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. Consider preplacement and periodic medical exams with emphasis on liver and kidney functions, complete blood count, chest X-ray, pulmonary function tests, and skin and oral cavity examinations.

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 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, cartridge change schedules, 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: Yellowish-green; fluorescent
Physical State: Solid; leaflets or plates
Vapor Pressure (kPa): 1 x 10^{-10} mm Hg at 77 °F (25 °C)
Formula Weight: 276.34
Boiling Point: 1022 °F (550 °C)
Freezing/Melting Point: 530.6 °F (277 °C)
Ionization Potential (eV): 7.15 eV

Water Solubility: Insoluble; 2.5 - 2.7 x 10^{-4} mg/L at 77 °F (25 °C)
Other Solubilities: Soluble in 1,4-dioxane, dichloromethane, benzene, and acetone

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Benzo(g,h,i)perylene 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. Reacts with NO and NO_2 to form nitro derivatives.

Hazardous Decomposition Products: Thermal oxidative decomposition of benzo(g,h,i)perylene can produce toxic fumes of carbon dioxide and carbon monoxide.

Section 11 - Toxicological Information

Other Effects:
Genetic Effects: *S Typhimurium*, 2 µg/plate/48 hours (-S9) induced mutation.
Mouse, skin, 40 µmol/kg induced DNA damage.
Human, lymphocyte cell, 80 µg/L induced mutations in mammalian somatic cells.

See *RTECS* DI6200500, for additional data.

Section 12 - Ecological Information

Environmental Fate: Benzo(g,h,i)perylene biodegrades slowly in the environment, with a half-life range in aerobic soil from 600 to 650 days. It is not expected to hydrolyze. In aquatic systems it partitions from the water column to organic matter contained in sediments and suspended solids. It also has the potential to bioconcentrate in aquatic systems. Volatilization from shallow, fast-moving waters may be important. In the atmosphere, the vapor phase reaction with photochemically-produced hydroxyl radicals with a half-life of 2 hours may be an important fate process. However, benzo(g,h,i)perylene is expected to exist almost entirely in the particulate phase in ambient air, though it may undergo direct photolysis in the atmosphere. Benzo(g,h,i)perylene is expected to be highly immobile in soil. Log K_{ow}: 6.58 - 6.63

Ecotoxicity: Data not found.

Henry's Law Constant: 2.66 x 10^{-7} atm-m^3/mol

BCF: 64,000, estimated

Soil Sorption Partition Coefficient: K_{oc} = > 1 x 10^6

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 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: 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

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 55/60

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

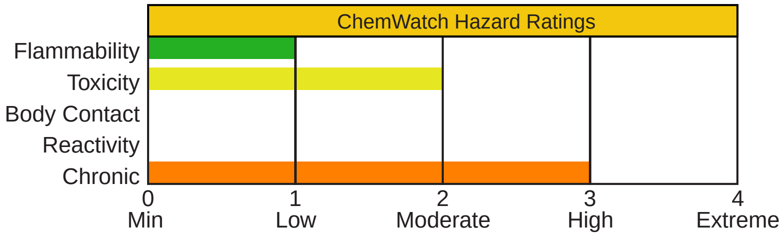
Section 2 - Composition / Information on Ingredients

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 4.2×10^{8}

BCF: fish 4.97

Octanol/Water Partition Coefficient: $\log K_{ow} = 6.84$

Soil Sorption Partition Coefficient: K_{oc} = nearly 1×10^{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

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

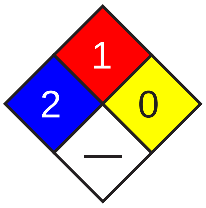
Name	CAS	%
No data found.		

OSHA PEL
TWA: 0.2 mg/m^3.

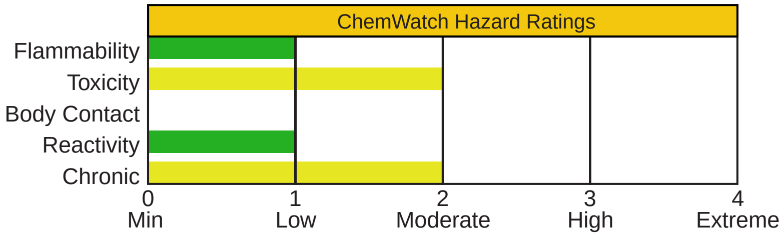
NIOSH REL

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.

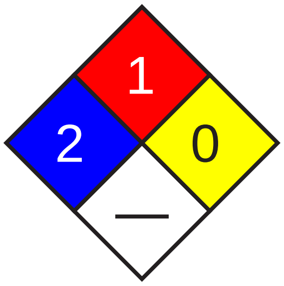
UEL: None reported.

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_2O=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

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

Issue Date: 2005-05

Dibenz[a,h]anthracene
DIB1550

Section 1 - Chemical Product and Company Identification 55/60

Material Name: Dibenz[a,h]anthracene **CAS Number:** 53-70-3
Chemical Formula: $C_{22}H_{14}$
EINECS Number: 200-181-8
ACX Number: X1002922-0
Synonyms: 1,2:5,6-BENZANTHRACENE; DB(A,H)A; 1,2,5,6-DBA; DBA; 1,2,5,6-DIBENZANTHRACEEN; 1,2,5,6-DIBENZANTHRACENE; 1,2:5,6-DIBENZ(A)ANTHRACENE; 1,2:5,6-DIBENZANTHRACENE; DIBENZ[A,H]ANTHRACENE; 1,2:5,6-DIBENZOANTHRACENE; DIBENZO(A,H)ANTHRACENE
General Use: research chemical

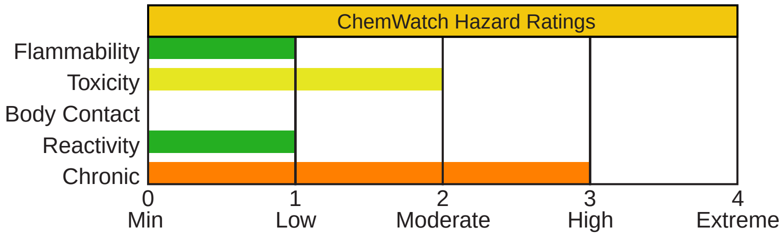
Section 2 - Composition / Information on Ingredients

Name	CAS	%
dibenz[a,h]anthracene	53-70-3	>98

OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless crystals, plates or leaflets. May cause irritation. Toxic. Chronic Effects: may cause heritable genetic damage; mutagen. Carcinogen. Will burn.

Potential Health Effects

Target Organs: respiratory system, liver
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 - Listed; 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: 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.

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 crystalline powder. Soluble in petroleum ether, benzene, toluene, xylene, oils and cyclohexanane.

Physical State: colorless crystals, plates or leaflets	**Boiling Point:** 524 °C (975 °F)
Vapor Pressure (kPa): 1 x10^{-10} mm Hg	**Freezing/Melting Point:** 266 °C (510.8 °F)
Formula Weight: 278.33	**Volatile Component (% Vol):** Negligible
Specific Gravity (H_2O=1, at 4 °C): 1.282	**Water Solubility:** 0.0005 mg/L in Water at 27 °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.
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* HN2625000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Release to the environment is quite general since it is a ubiquitous product of incomplete combustion. It is largely associated with particulate matter, soils, and sediments. Its presence in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long distance transport. If it is released to soils it will be expected to adsorb very strongly to the soils and will not be expected to leach to the groundwater, hydrolyze or evaporate from soils or surfaces. It will be subject to biodegradation in soils with reported half-lives of 18 and 21 days. If it is released to water it will be expected to adsorb very strongly to sediments and particulate matter and to bioconcentrate in aquatic organisms which lack microsomal oxidase (this enzyme enables the rapid metabolism of certain polycyclic aromatic hydrocarbons). Based on limited data from laboratory screening tests using settled domestic wastewater and activated sludge, it may be subject to biodegradation in natural waters. Since it absorbs solar radiation strongly, it may be subject to direct photolysis in natural waters. However, adsorption may significantly retard photolysis as the photosensitivity of polyaromatic hydrocarbons is strongly dependent upon the nature of the surface upon which the compound is adsorbed. It will not hydrolyze and should not evaporate from water. If released to the atmosphere it will likely be associated with particulate matter and may be subject to moderately long range transport, depending mainly on the particle size distribution and climatic conditions which will determine the rates of wet and dry deposition. Its presence in areas remote from primary sources demonstrates the potential for this long range transport as well as it's considerable stability in the air. It may be subject to direct photolysis in the atmosphere; however, adsorption may significantly retard photolysis as the photosensitivity of polyaromatic hydrocarbons is strongly dependent upon the nature of the surface upon which the compound is adsorbed. The estimated vapor phase half-life in the atmosphere is 1.00 day as a result of reaction with photochemically produced hydroxyl radicals.
Ecotoxicity: TL_m Neanthes arenaceodentata > 1 ppm/96 hr at 22 °C in a static bioassay
Henry's Law Constant: calculated at 7 x10^{-8}
BCF: daphnia manga 652
Octanol/Water Partition Coefficient: log K_{ow} = 6.50
Soil Sorption Partition Coefficient: K_{oc} = sediments 8.05392 x10^5 to 3.059425 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 U063 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.

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

Issue Date: 2005-05

Fluoranthene
BEN4760

Section 1 - Chemical Product and Company Identification

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.

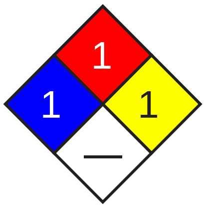
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Fluoranthene	206-44-0	ca 98% wt

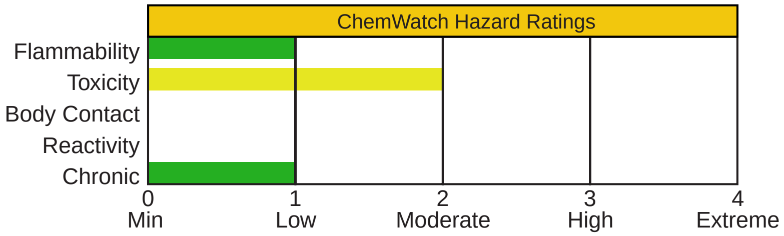
OSHA PEL **NIOSH REL**

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.

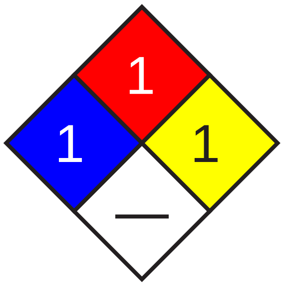
LEL: Data not found.

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

Fluorene
FLU3100

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 53/60

Material Name: Fluorene **CAS Number:** 86-73-7
Chemical Formula: $C_{13}H_{10}$
EINECS Number: 201-695-5
ACX Number: X1003048-3
Synonyms: 2,3-BENZINDENE; O-BIPHENYLENEMETHANE; O-BIPHENYLMETHANE; ALPHA-DIPHENYLENEMETHANE; DIPHENYLENEMETHANE; ALPHA-DIPHENYLENEMETHANE-9H-FLUORENE; 9H-FLUORENE; FLUORENE; METHANE,DIPHENYLENE-; 2,2'-METHYLENEBIPHENYL
Derivation: Fluorene is derived from coal tar; from acetylene and hydrogen in a red-hot tube; from charcoal by boiling and fuming with HNO_3; from 2,2'-dibromodiphenylmethane on boiling with hydrazine hydrate in the presence of palladium; or by reduction of diphenylene ketone with zinc.
General Use: Fluorene is used in the formation of polyradicals for resins, and in resinous products and dyestuffs. Derivatives of fluorene show activity as herbicides and growth regulators.

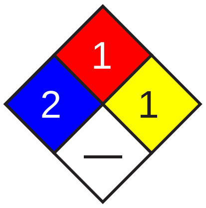
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Fluorene	86-73-7	ca 98% wt

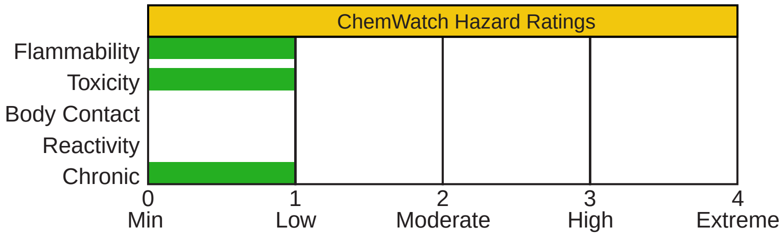
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
1 Flammability
1 Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆
Dazzling white leaflets or flakes, fluorescent when impure. Irritating to eyes/skin/respiratory tract. Chronic effects: mutation effects. Combustible.

Potential Health Effects

Target Organs: Skin, eyes, respiratory system
Primary Entry Routes: Inhalation and skin/eye contact
Acute Effects The toxicological properties of fluorene have not been thoroughly investigated. The following effects are for those of polycyclic aromatic hydrocarbons (PAHs) in general.
Inhalation: Causes irritation to the respiratory system.
Eye: Contact causes irritation.
Skin: Contact causes irritation.
Ingestion: Causes irritation.
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: None reported.
Chronic Effects: Include photosensitivity and irritation of the eyes; irritation of the respiratory system with cough, bronchitis, and chance of bronchogenic cancer; leukoplakia and cancers of the lip and oral cavity; dermal burns, "coal

tar warts" (precancerous lesions enhanced by UV light exposure), erythema, acneiform lesions, and irritation; mild hepatoxicity; hematuria; and an increased chance of cancer of the skin, kidney, bladder, lung and gastrointestinal tract. Fluorinated PAHs may cross the placenta.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100% humidified supplemental oxygen with assisted ventilation as required. If bronchospasm and wheezing occur, consider treatment with inhaled sympathomimetic agents.

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. Treat dermal irritation or burns with a standard topical therapy. Patients developing dermal hypersensitivity reactions may require treatment with systemic or topical corticosteroids or antihistamines. Avoid direct exposure of affected skin to sunlight and UV sources.

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. Gastric lavage and routine use of cathartics are not recommended.

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

Note to Physicians: Chronic effects, particularly cancer, are more common than acute toxicity. Acute respiratory effects in persons are typically due to other toxic agents at the worksite. Carefully observe patients with inhalation exposure for the development of any systemic signs or symptoms and administer symptomatic treatment as necessary. Monitor arterial blood gases, pulmonary function, and chest x-ray for patients with significant exposure.

Section 5 - Fire-Fighting Measures

Flash Point: Data not found; combustible

Autoignition Temperature: Data not found.

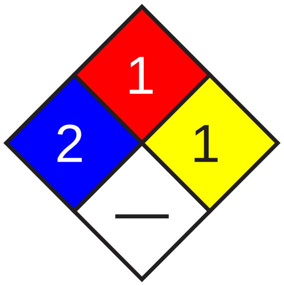
LEL: Data not found.

UEL: Data not found.

Extinguishing Media: Extinguish with water spray, carbon dioxide, dry chemical or appropriate foam.

General Fire Hazards/Hazardous Combustion Products: When heated to decomposition it emits acrid smoke and toxic fumes of carbon monoxide and carbon dioxide.

Fire-Fighting Instructions: *Do not* breathe the dust. *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 protective clothing including rubber boots and heavy rubber gloves to prevent contact with skin and eyes.



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! 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 dust inhalation and contact of solid or liquid 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 operations to avoid dust dispersion into the work area. Provide 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. Consider preplacement and periodic medical exams including a complete blood count, hepatic and renal function test, dermal assessments, chest x-ray and pulmonary function tests.

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 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. For 'normal' uses an air-purifying toxic dust* mask for particulates, and an organic vapor with toxic dust* pre-filters for vapors, dusts, and mists (* = purple or magenta color cartridge). 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. Fluorescent when impure.

Physical State: Solid; crystalline powder or small crystalline plates; leaflets or flakes from alcohol. Sublimes easily in high vacuum.

Vapor Pressure (kPa): 0.013 mm Hg at 68 °F (20 °C)

Formula Weight: 166.21

Density: 1.202 g/mL

Specific Gravity (H_2O=1, at 4 °C): 1.203 at 0 °C/4 °C

Boiling Point: 563 °F (295 °C) (decomposes)

Freezing/Melting Point: 237 to 241 °F (114 to 116 °C)

Ionization Potential (eV): 7.89 +/-0.2 eV

Water Solubility: Insoluble; 1.98 mg/kg

Other Solubilities: Freely soluble in glacial acetic acid; soluble in hot 95% ethanol, acetone, benzene, carbon disulfide, carbon tetrachloride, ether, pyridine, and toluene.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Fluorene 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. Avoid heating to decomposition.

Storage Incompatibilities: Include strong oxidizing agents.

Hazardous Decomposition Products: Thermal oxidative decomposition of fluorene can produce acrid smoke and toxic fumes of carbon monoxide and carbon dioxide.

Section 11 - Toxicological Information

Other Effects:

Genetic Effects: Mouse, lymphocyte, 150 µmol/L induced DNA damage.
Mouse, lymphocyte, 19500 nmol/L (+S9) induced mutations in microorganisms.
Mouse, lymphocyte, 584 µmol/L induced mutations in mammalian somatic cells.
Hamster, lung, 25 mg/L induced cytogenetic analysis.
Mouse, mammary gland, 1 µg/L induced morphological transformation.
Mouse, intraperitoneal, LD_{50}: >2 g/kg.

See *RTECS* LL5670000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, fluorene will exist primarily in the vapor phase where it will degrade readily by photochemically produced hydroxyl radicals (estimated half-life of 29 hr). If released to soil or water, fluorene will biodegrade readily (aerobically) in the presence of acclimated microbes; microbial adaptation is an important fate process. Biodegradation can be slow in pristine soils or waters (or under conditions of limited oxygen). Strong adsorption to soil and water sediment is an important transport process. Log K_{ow}: 4.18 to 4.38

Ecotoxicity: TL_m *Neanthes arenaceodentata* LC_{50}/1.0 ppm/96 hr at 72 °F (22 °C) in a static bioassay, seawater

Henry's Law Constant: 0.0001
BCF: 1288 (fathead minnow)
Soil Sorption Partition Coefficient: K_{oc} = log 3.70 to 4.21

Section 13 - Disposal Considerations

Disposal: Dissolve or mix fluorene with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. The particle-bound portion of polycyclic aromatic hydrocarbons (PAH) can be removed by sedimentation, flocculation, and filtration processes. The remaining dissolved polynuclear aromatic hydrocarbons usually require oxidation for partial removal/transformation. 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: 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

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: 2005-05

Indeno[1,2,3-cd]pyrene
IND3480

Section 1 - Chemical Product and Company Identification 56b/60

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.

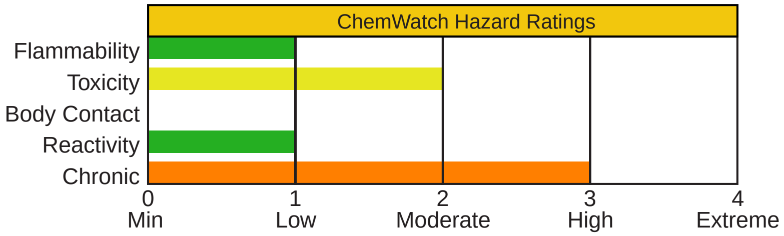
Section 2 - Composition / Information on Ingredients

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.

Phenanthrene
PHE1330

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 44/60

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.

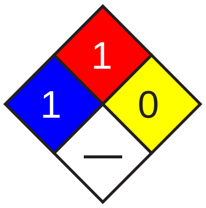
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Phenanthrene	85-01-8	ca 100 % wt

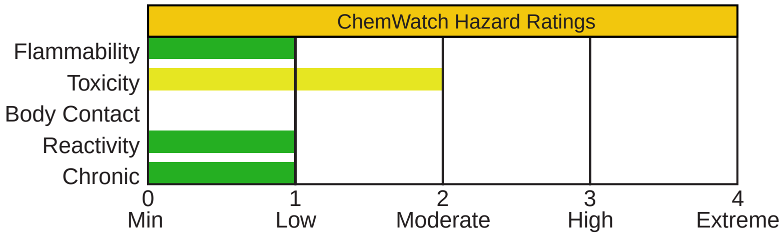
OSHA PEL **NIOSH REL**

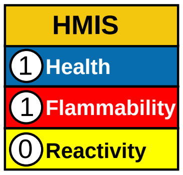
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





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.

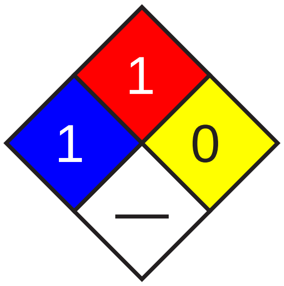
UEL: Not reported.

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

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

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 54/60

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

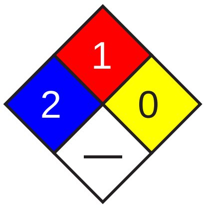
Name	CAS	%
pyrene	129-00-0	>98

OSHA PEL
TWA: 0.2 mg/m^3; as particulate polycyclical aromatic hydrocarbon.

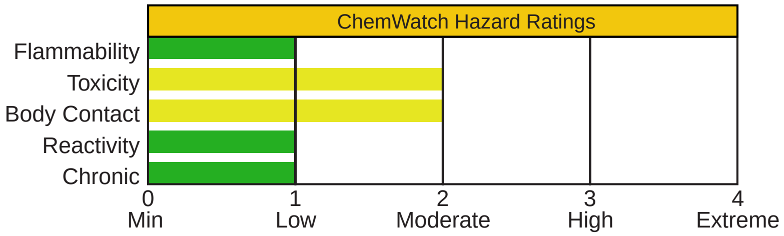
NIOSH REL
TWA: 0.1 mg/m^3, cyclohexane-extractable fraction; as particulate polycyclic aromatic hydrocarbon.

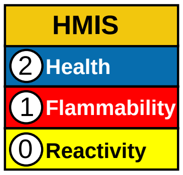
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Caution

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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.

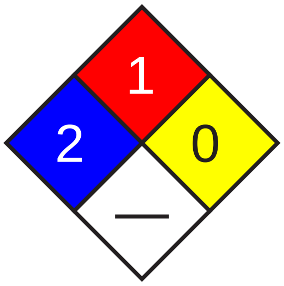
Water spray or fog - Large fires only.

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.

Material Safety Data Sheet Collection

Genium group inc.

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

Issue Date: 2005-05

Aluminum Powder Uncoated
ALU1560

Section 1 - Chemical Product and Company Identification

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).

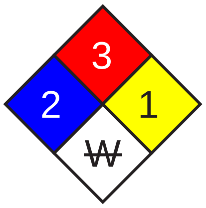
NIOSH REL
TWA: 10 mg/m^3; total; TWA: 5 mg/m^3; respirable.

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

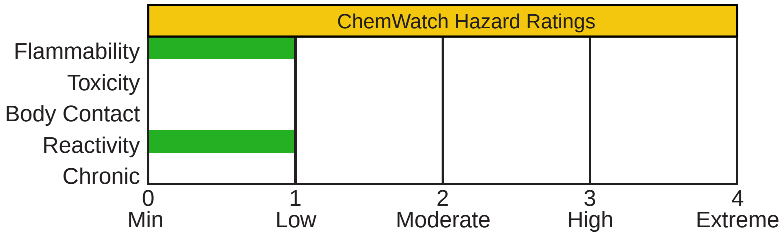
OSHA PEL Vacated 1989 Limits
TWA: 2 mg/m^3; as Al soluble.

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.

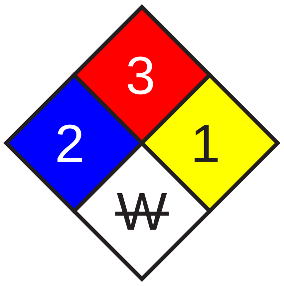
Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

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.

Material Safety Data Sheet Collection
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Issue Date: 2005-05

Antimony
ANT3500

Section 1 - Chemical Product and Company Identification 54/60

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.

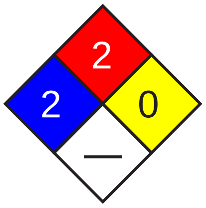
ACGIH TLV
TWA: 0.5 mg/m^3.

NIOSH REL
TWA: 0.5 mg/m^3.

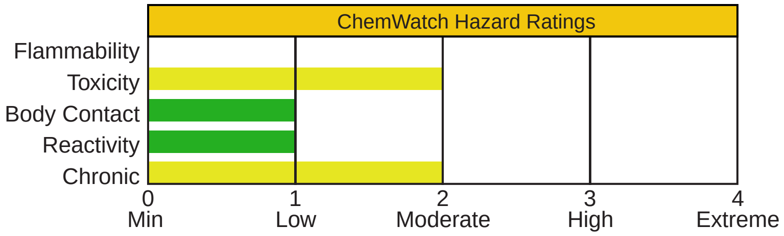
IDLH Level
50 mg/m^3 (as Sb).

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



HMIS	
3	Health
2	Flammability
1	Reactivity

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.

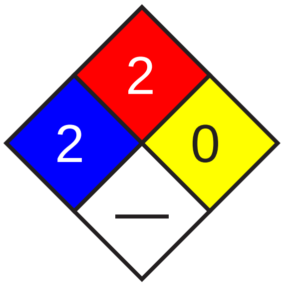
Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.

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.

Material Safety Data Sheet Collection

Genium group inc.

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Issue Date: 2005-05

Arsenic
ARS2340

Section 1 - Chemical Product and Company Identification 54/60

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

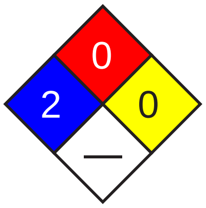
OSHA PEL
TWA: 0.01 mg/m^3.

NIOSH REL
Ceiling: 0.002 mg/m^3; 15-minute.

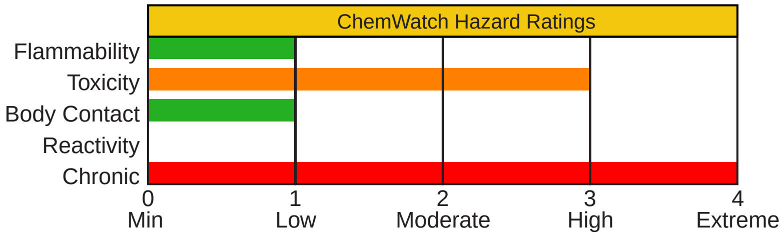
ACGIH TLV
TWA: 0.01 mg/m^3.

IDLH Level
5 mg/m^3 (as As).

Section 3 - Hazards Identification



Fire Diamond



HMIS	
3	Health
0	Flammability
1	Reactivity

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Brittle, crystalline, silvery-black metal. Irritating to eyes/skin/respiratory tract. Chronic Effects: damage to blood-forming organs, nervous/cardiovascular systems effects. Cancer hazard. Powder 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

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 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

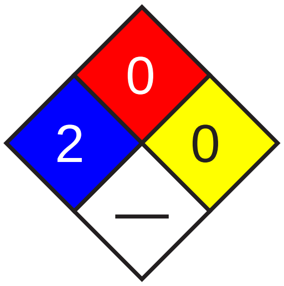
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

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

See DOT ERG



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

See DOT ERG

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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Arsenic
ID: UN1558
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:**

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
Genium Group, Inc.
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Issue Date: 2004-07

Barium
BAR1500

Section 1 - Chemical Product and Company Identification

Material Name: Barium

CAS Number: 7440-39-3

Chemical Formula: Ba
Structural Chemical Formula: Ba
EINECS Number: 231-149-1
ACX Number: X1002791-5
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

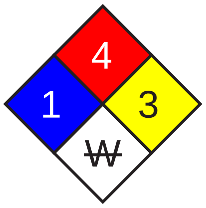
OSHA PEL
TWA: 0.5 mg/m^3.

ACGIH TLV
TWA: 0.5 mg/m^3.

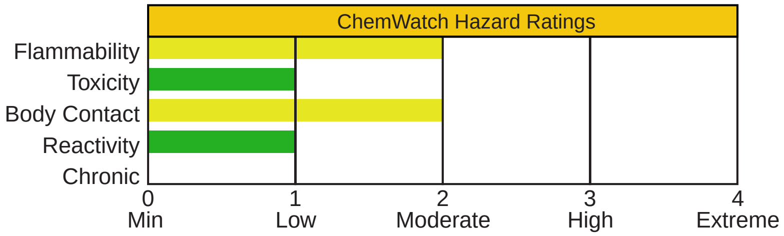
NIOSH REL
TWA: 0.5 mg/m^3.

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



HMIS	
2	Health
2	Flammability
4	Reactivity

ANSI Signal Word

Danger!

Explosive

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Silver/white powder. Chronic: benign pneumoconiosis (baritosis). Explosive! Pyrophoric! Reacts violently with water.

Potential Health Effects

Target Organs: skin, eyes, mucous membranes, lung, heart
Primary Entry Routes: inhalation of dust or fume, ingestion, skin contact, eye contact
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.

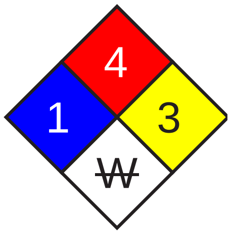
After first aid, get appropriate in-plant, paramedic, or community medical support.

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.

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 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.
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	**pH:** Not applicable
Vapor Density (Air=1): Not applicable	**Boiling Point:** 1640 °C (2984 °F)
Formula Weight: 137.34	**Freezing/Melting Point:** 725 °C (1337 °F)
Specific Gravity (H_2O=1, at 4 °C): 3.6	**Volatile Component (% Vol):** 0
Evaporation Rate: Not applicable	**Water Solubility:** Decomposes

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: 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]

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** 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.

Material Safety Data Sheet Collection

Genium group inc.

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(518) 842-4111

Issue Date: 2005-05

Beryllium
BER3010

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Beryllium **CAS Number:** 7440-41-7

Chemical Formula: Be

Structural Chemical Formula: Be

EINECS Number: 231-150-7

ACX Number: X1002803-0

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

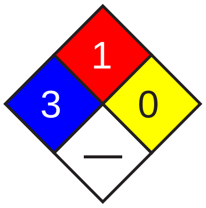
OSHA PEL
TWA: 0.002 mg/m^3; Ceiling: 0.005 mg/m^3; 30 min peak: 0.025 mg/m^3.

ACGIH TLV
TWA: 0.002 mg/m^3; STEL: 0.01 mg/m^3.

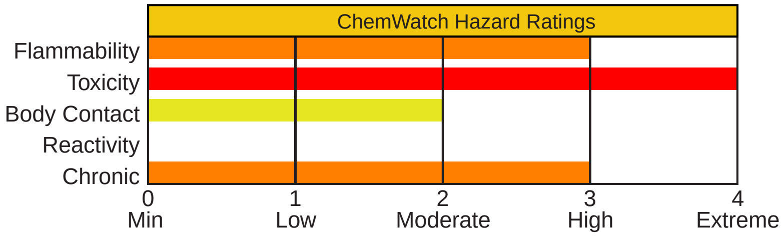
NIOSH REL
Not to exceed 0.0005 mg/m^3.

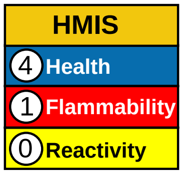
IDLH Level
4 mg/m^3 (as Be).

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!

Poison

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Gray-white powder; odorless. Poison. Other Acute Effects: respiratory inflammation, congestion, coughing, pulmonary edema, brain/spleen hemorrhaging, liver inflammation. Chronic Effects: 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

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

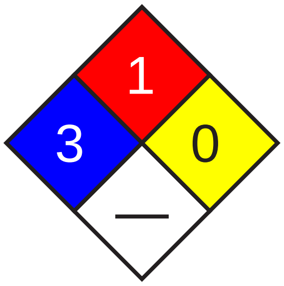
After first aid, get appropriate in-plant, paramedic, or community medical support.

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.
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.

See DOT ERG



Fire Diamond

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.

See DOT ERG

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	**pH:** Not applicable
Vapor Pressure (kPa): Not applicable	**pH (1% Solution):** Not applicable.
Vapor Density (Air=1): Not applicable	**Boiling Point:** 2970 °C (5378 °F)
Formula Weight: 9.01	**Freezing/Melting Point:** 1287 °C (2348.6 °F)
Specific Gravity (H_2O=1, at 4 °C): 1.848	**Volatile Component (% Vol):** Not applicable
Evaporation Rate: Not applicable	**Water Solubility:** Insoluble in cold 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, acids, alkalis, carbon tetrachloride, trichloroethylene, lithium and phosphorus.

Section 11 - Toxicological Information

Mutation DNA damage Human Tumorigenic - neoplastic by RTECS criteria.

See *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Beryllium, powder
ID: UN1567
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*, 4.1 - Flammable Solid
Special Provisions: IB8, IP2, IP4
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:**

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

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: 2005-05

Cadmium
CAD1500

Section 1 - Chemical Product and Company Identification 53/60

Material Name: Cadmium **CAS Number:** 7440-43-9

Chemical Formula: Cd

EINECS Number: 231-152-8

ACX Number: X1002486-9

Synonyms: C I 77180; C.I. 77180; CADMIUM; CADMIUM DUST FUME; CADMIUM POWDER; COLLOIDAL CADMIUM; KADMIUM

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.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Cadmium		ca 99.5+% wt

Trace Impurities: < 10 ppm

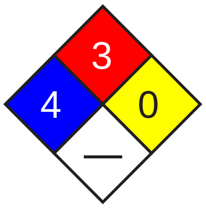
OSHA PEL
TWA: 0.005 mg/m^3.

NIOSH REL
Lowest Feasible Concentration.

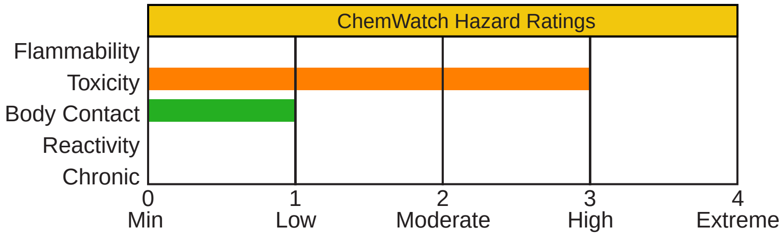
ACGIH TLV
TWA: 0.01 mg/m^3; measured as inhalable fraction of the aerosol; TWA: 0.002 mg/m^3; measured as respirable fraction of the aerosol.

IDLH Level
9 mg/m^3 (as Cd).

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
4 Flammability
0 Reactivity

ANSI Signal Word
Danger!

Explosive Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Lustrous metal solid, silver-white to bluish color; odorless. Irritating to skin/respiratory tract. Toxic by inhalation. Chronic Effects: kidney damage, obstructive lung disease, possible carcinogen/teratogen. Dust ignites spontaneously in air. Forms explosive dust-air mixtures.

Potential Health Effects

Target Organs: Respiratory system, kidneys

Primary Entry Routes: Inhalation and ingestion

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: NTP - Class 2A, Reasonably anticipated to be a carcinogen, limited evidence of carcinogenicity from studies in humans; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B1, Probable human carcinogen based on epidemiologic studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

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

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. 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

See DOT ERG

Flash Point: Data not found.

Autoignition Temperature: 482 °F (250 °C) (layer cadmium metal dust)

LEL: Data not found.

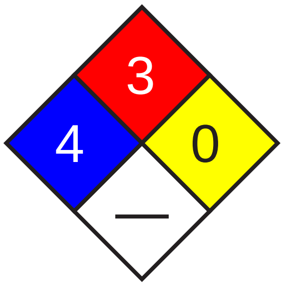
UEL: Data not found.

Flammability Classification: Flammable

Extinguishing Media: Extinguish with carbon dioxide, dolomite, dry powder, graphite, soda ash, sodium chloride, dry chemical, or sand.

General Fire Hazards/Hazardous Combustion Products: When heated to decomposition, toxic fumes of cadmium are emitted. The finely divided material is pyrophoric. The more finely divided the powder the greater the fire/explosion hazard.

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. Cleanup personnel should protect against exposure. 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). Also 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.

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, incompatibles, and air. Cadmium slowly oxidizes in air to form cadmium oxide.

Storage Requirements: Areas where cadmium is used or stored must be labeled according to 29 CFR 1910.1027.

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. 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.

Personal 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.

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.

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: Silver-white, blue-tinged. Odorless.

Physical State: Solid; lustrous metal or granular powder

Vapor Pressure (kPa): 1 mm Hg at 741 °F (394 °C)

Formula Weight: 112.41

Density: 8.642 at 77 °F (25 °C)

Refractive Index: 1.8 at 578 nm and 20 °C

Boiling Point: 1409 °F (765 °C)

Freezing/Melting Point: 609.8 °F (321 °C)

Ionization Potential (eV): 8.99367 eV

Water Solubility: Insoluble

Other Solubilities: Dissolved by acids; ammonium nitrate solution

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: 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. Hazardous polymerization cannot occur. Avoid creation of dust clouds, contact with chemical incompatibles, heat, and sources of ignition.

Storage 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.

Hazardous Decomposition Products: Thermal oxidative decomposition of cadmium can produce toxic fumes of cadmium and cadmium oxide.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD$_{50}$: 2330 mg/kg.
Mouse, oral, LD$_{50}$: 890 mg/kg.
Acute Inhalation Effects:
Rat, inhalation, LC$_{50}$: 25 mg/m^3/30 minutes produced dyspnea.
Human, inhalation, LC$_{Lo}$: 39 mg/m^3/20 minutes produced cardiac changes; respiratory depression.
Acute Skin Effects:
Rabbit, subcutaneous, LD$_{Lo}$: 6 mg/kg produced toxic effects: Effects on newborn - reduced weight gain and behavioral.
Other Effects:
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.
Mouse, micronucleus test, cell type - embryo: 6 µmol/L induced mutation.
Hamster, cytogenic analysis, cell type - ovary: 1 µmol/L induced mutation.
Tumorigenic Effects - Woman, inhalation, 129 µg/m^3/20 years, continuous produced toxic effects: carcinogenic by RTECS criteria; Lung, thorax or respiration - tumors.
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.
Rat, subcutaneous, 3372 µg/kg produced toxic effects: carcinogenic by RTECS criteria, tumors at site of application.

See *RTECS* EU9800000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
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.

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):

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: Cadmium compounds
ID: UN2570
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:**

Shipping Name and Description: Cadmium compounds
ID: UN2570
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: Cadmium compounds
ID: UN2570
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) 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.

Section 1 - Chemical Product and Company Identification

Material Name: Calcium **CAS Number:** 7440-70-2
Chemical Formula: Ca
EINECS Number: 231-179-5
ACX Number: X1000165-7
Synonyms: CALCICAT; CALCIUM
Derivation: Produced by thermal vacuum reduction of lime with aluminum, or by electrolysis of calcium chloride. Redistillation produces calcium with 99%+ purity.
General Use: Used as a deoxidizer for copper, beryllium and steel; also used in the decarburization and desulfurization of iron and its alloys; as a "getter" in the production of electronic vacuum tubes; and as a fertilizer ingredient.

Section 2 - Composition / Information on Ingredients

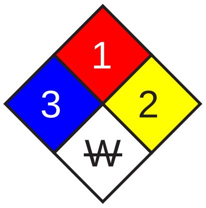
Name	**CAS**	**%**
Calcium	7440-70-2	99+% wt

Trace Impurities: Mg, N, Al, Fe, Co, Li, Be, Cr, Mn, and B

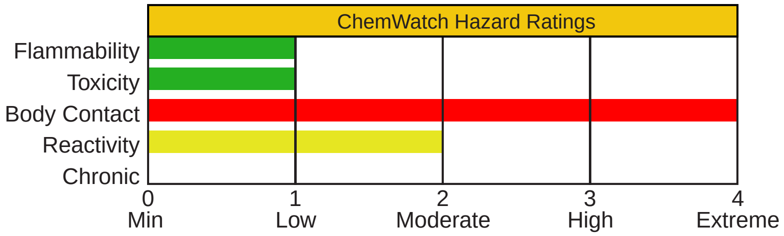
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
③ Health
① Flammability
② Reactivity

ANSI Signal Word

Danger!


Corrosive


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Lustrous silver-white metal. Corrosive. Harmful to respiratory tract. Dust is flammable.

Potential Health Effects

Target Organs: Eyes, skin and respiratory system
Primary Entry Routes: Inhalation, eye and skin contact
Acute Effects
Inhalation: Inhalation of calcium dust can cause respiratory tract irritation.
Eye: Contact can severely burn eyes.
Skin: Contact can severely burn skin.
Ingestion: Ingestion can severely burn mucous membranes.
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: Long-term exposure to calcium dust may affect the lungs, but is not known to cause lung damage.

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 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.

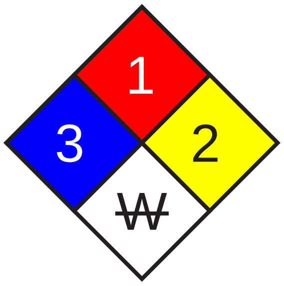
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water.

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

Note to Physicians: Treat symptomatically and supportively.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Calcium does not have a flash point by standard methods. Calcium dust does form flammable mixtures with air. When exposed to moist air, finely divided calcium may ignite spontaneously at room temperature.

Autoignition Temperature: None reported.

LEL: None reported

UEL: None reported.

Flammability Classification: Calcium is a flammable solid.

Extinguishing Media: Do not use water, halogenated hydrocarbons (CCl_4) or foam. For small fires, use dry chemical, soda ash, lime or sand. For large fires, withdraw from area and let fire burn.

General Fire Hazards/Hazardous Combustion Products: Calcium oxide (CaO_x) fumes which can react with water to produce heat, calcium hydroxide (CaOH) which is corrosive, and flammable hydrogen (H_2) gas. Flammable when finely divided; reacts with water to liberate hydrogen. *As finely divided calcium dust, Genium would rate flammability a 3 based on NFPA criteria.

Fire-Fighting Instructions: Move containers from fire area if it can be done without risk. Cool fire-exposed containers with water until well after fire is out. *Do not* get water inside containers. 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. SCBA and structural firefighter's protective clothing provide limited protection.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate, and deny entry. Shut off ignition sources. *Do not* touch spilled material. *Do not* put water on spilled material or get water inside container. Cleanup personnel should protect against dust inhalation and skin and eye contact.

Small Spills: Keep water away from spills. Carefully scoop up spilled calcium with a shovel and place in clean containers. Seal containers for future disposal or reclamation.

Large Spills: For large spills, dike far ahead of spill for later disposal. Cover with plastic sheet to avoid further dust dispersion. *Do not* release into sewers or waterways. Use nonsparking tools during clean-up. *Do not* dry sweep.

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. Wear protective clothing, gloves, goggles and full face shield. Keep calcium away from moisture and strong oxidizers.

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 moisture, oxidizers and acids. Store calcium in kerosene or other neutral oil. Protect containers against physical damage. Never store under halogenated hydrocarbons. Detached storage in fire-resistant building is recommended.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Keep calcium away from water and high temperatures. To prevent static sparks, electrically ground and bond all equipment used around calcium. Where feasible, enclose operations to prevent dust dispersion into the work area. Enclose operations using calcium and use local exhaust ventilation. 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. Perform lung function tests as necessary. Educate workers about the hazards associated with calcium. Train in work practices which minimize exposure.

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. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Use a full-face respirator to provide eye protection. 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: Lustrous, silver-white surface, face centered cubic structure below 572 °F (300 °C).

Physical State: Solid
Vapor Pressure (kPa): 10 mm Hg at 1801 °F (983 °C)
Formula Weight: 40.08
Density: 1.54 at 20 °C
Boiling Point: 2624 °F (1440 °C)
Freezing/Melting Point: 1562 °F (850 °C)

Water Solubility: Reacts exothermically with water; may evolve explosive hydrogen gas.
Other Solubilities: Soluble in acid, liquid ammonia; slightly soluble in alcohol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Calcium is stable at room temperature in closed containers under normal storage and handling conditions. It oxidizes in air to form an adherent, protective, oxide/nitride film (CaO/Ca_3N_2). Hazardous polymerization does not occur. Exposure to moisture, heat, ignition sources and incompatibles.

Storage Incompatibilities: Incompatible with air. Reacts violently with water to form hydroxide and explosive hydrogen. Violent reaction with mercury (at 734 °F/390 °C); silicon (above 1922 °F/1050 °C); sodium + mixed oxides + heat. Potentially explosive reaction with alkali metal hydroxides or carbonates; dinitrogen tetraoxide; lead chloride + heat; phosphorus (V) oxide + heat; sulfur + heat. Molten calcium reacts explosively with asbestos cement. Hypergolic reaction with chlorine fluorides (e.g., chlorine trifluoride; chlorine pentafluoride). Ignition on contact with halogens (e.g., fluorine, chlorine); sulfur + vanadium (V) oxide.

Hazardous Decomposition Products: Thermal oxidative decomposition of calcium can produce calcium oxides (CaOx), which can react with water to produce calcium hydroxide (CaOH) and hydrogen (H_2).

Section 11 - Toxicological Information

No data found.

See *RTECS* EV8040000, 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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Calcium
ID: UN1401
Hazard Class: 4.3 - Dangerous when wet material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 4.3 - Dangerous When Wet
Special Provisions: IB7, IP2
Packaging: **Exceptions:** 151 **Non-bulk:** 212 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 15 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** E **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

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 54/60

Material Name: Chromium **CAS Number:** 7440-47-3
Chemical Formula: Cr
Structural Chemical Formula: Cr
EINECS Number: 231-157-5
ACX Number: X1002501-1
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

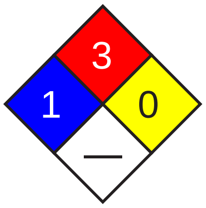
OSHA PEL
TWA: 1 mg/m^3.

NIOSH REL
TWA: 0.5 mg/m^3.

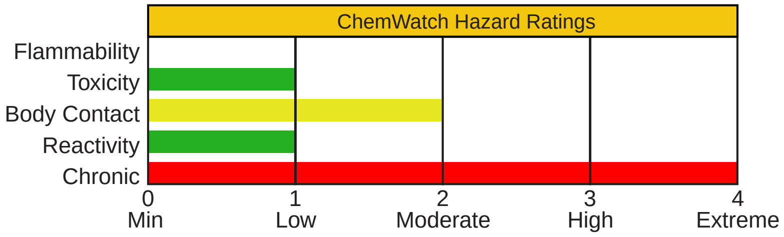
ACGIH TLV
TWA: 0.5 mg/m^3.

IDLH Level
250 mg/m^3 (as Cr).

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
3	Flammability
0	Reactivity

ANSI Signal Word

Warning!

Explosive Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Steel-gray, lustrous metal powder; odorless. Irritating to eyes/skin/respiratory tract. Chronic Effects: lung fibrosis. Flammable. Explosive in air.

Potential Health Effects

Target Organs: respiratory system
Primary Entry Routes: inhalation, skin absorption, ingestion
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.

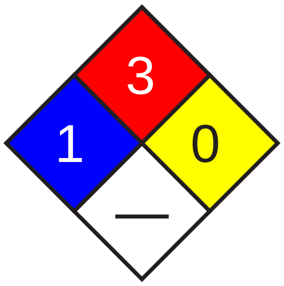
Ingestion: Contact a Poison Control Center.

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
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 2642 °C (4788 °F)
Freezing/Melting Point: 1900 °C (3452 °F)
Volatile Component (% Vol): Nil
Decomposition Temperature (°C): Not applicable
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: 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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: None

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

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

Cobalt
COB1000

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 51/60

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.

OSHA PEL Vacated 1989 Limits
TWA: 0.05 mg/m^3.

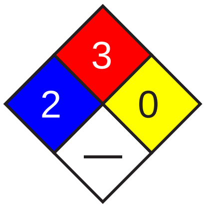
ACGIH TLV
TWA: 0.02 mg/m^3.

NIOSH REL
TWA: 0.05 mg/m^3.

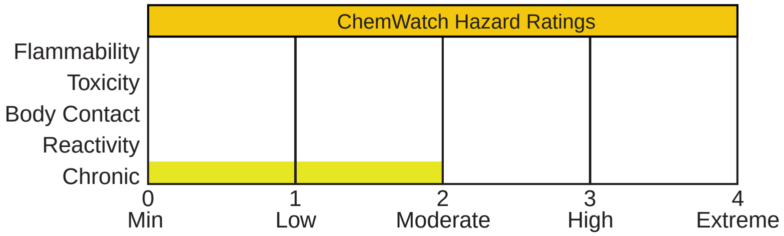
IDLH Level
20 mg/m^3 (as Co).

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

Flash Point: None reported; cobalt dust is flammable; bulk solid form is incombustible

Autoignition Temperature: None reported.

LEL: None reported.

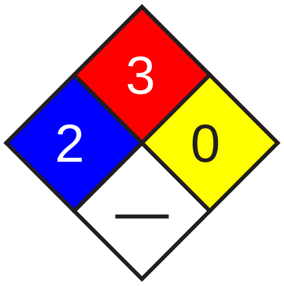
UEL: None reported.

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.



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. 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 concen trations 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 accumu lation 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 prac tices 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 respira tors (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 emer gency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respi rators 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

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

Copper
COP1000

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Copper **CAS Number:** 7440-50-8
Chemical Formula: Cu
Structural Chemical Formula: Cu
EINECS Number: 231-159-6
ACX Number: X1002511-7
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: 1 mg/m^3.

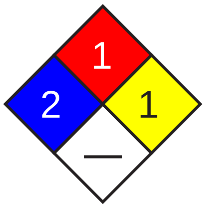
ACGIH TLV
TWA: 0.2 mg/m^3; fume, as Cu;
TWA: 1 mg/m^3; dusts and mists, as Cu.

NIOSH REL
TWA: 1 mg/m^3.

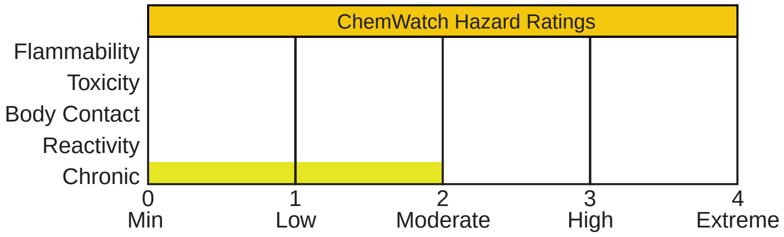
IDLH Level
100 mg/m^3 (as Cu).

DFG (Germany) MAK
TWA: 1 mg/m^3; PEAK: 2 mg/m^3; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
0	Flammability
0	Reactivity

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

Target Organs: respiratory system, skin, eyes, liver, kidneys
Primary Entry Routes: inhalation, ingestion
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).

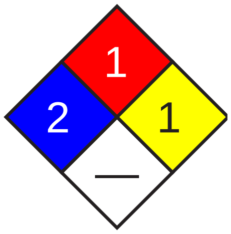
2.Pulmonary function tests may indicate reduced lung volumes, small airway obstruction and decreased carbon monoxide diffusing capacity but these abnormalities resolve after several months.

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
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 2595 °C (4703 °F)
Freezing/Melting Point: 1083 °C (1981.4 °F)
Volatile Component (% Vol): Not applicable
Decomposition Temperature (°C): Not applicable
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 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

Toxicity
Oral (human) TD_{Lo}: 0.12 mg/kg

Irritation
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
Packing Group: None
Label: No class label assigned

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

ANALYTICAL PRODUCTS GROUP INC -- HEXAVALENT CHROMIUM LEVEL 1 AND 2 -- 6640-00N043978

==================== Product Identification ====================

Product ID:HEXAVALENT CHROMIUM LEVEL 1 AND 2
MSDS Date:10/01/1991
FSC:6640
NIIN:00N043978
MSDS Number: BTLQP
=== Responsible Party ===
Company Name:ANALYTICAL PRODUCTS GROUP INC
Address:2730 WASHINGTON BLVD
City:BELPRE
State:OH
ZIP:45714
Country:US
Info Phone Num:614-423-4200
Emergency Phone Num:800-272-4442
Preparer's Name:R.A.T.
CAGE:0HWA6
=== Contractor Identification ===
Company Name:ANALYTICAL PRODUCTS GROUP INC
Address:2730 WASHINGTON BLVD
Box:City:BELPRE
State:OH
ZIP:45714
Country:US
Phone:740-423-4200/800-272-4442
CAGE:0HWA6

============= Composition/Information on Ingredients =============

Ingred Name:DICHROMIC ACID, DIPOTASSIUM SALT; (POTASSIUM DICHROMATE) (SARA III)
CAS:7778-50-9
RTECS #:HX7680000
Fraction by Wt: <0.02%
OSHA PEL:0.1 PPM (CRO*3), C
ACGIH TLV:0.5 MG/M3 (CR)
EPA Rpt Qty:10 LBS
DOT Rpt Qty:10 LBS

Ingred Name:WATER
CAS:7732-18-5
RTECS #:ZC0110000
Fraction by Wt: >99%
OSHA PEL:N/K
ACGIH TLV:N/K

==================== Hazards Identification ====================

LD50 LC50 Mixture:NONE SPECIFIED BY MANUFACTURER.
Routes of Entry: Inhalation:YES Skin:NO Ingestion:YES
Reports of Carcinogenicity:NTP:YES IARC:YES OSHA:NO
Health Hazards Acute and Chronic:ACUTE:NO. CHRONIC:CHROMIUM IS A HUMAN POISON BY INGESTION. LONG TERM EFFECTS ARE LOCALIZED ITCHING, BURNING & DERMATITIS. INDIVIDUALS W/BRONCHIAL ASTHMA CAN BE AFFECTED. THE METAL IS A SEVERE IRRITANT OF THE MUCOUS MEMBRANES.
Explanation of Carcinogenicity:POTASSIUM DICHROMATE:IARC MONOGRAPHS ON EVALUATION OF CARCINOGENIC RISK OF CHEMS TO MAN, VOL 49, PG 49, 1990: (SUPDAT)
Effects of Overexposure:SEE HEALTH HAZARDS.

Medical Cond Aggravated by Exposure:INDIVIDUALS W/DERMATITIS.

First Aid Measures

First Aid:SEEK MED ASSISTANCE FOR TREATMENT, OBSERVATION & SUPPORT IF NEC. INHAL:REMOVE TO FRESH AIR. SUPPORT BRTHG (GIVE O2/ARTF RESP) . EYE:WASH IMMED W/LG AMT OF WATER, OCCAS LIFTING UPPER & LOWER LIDS (FOR AT LST 15-20 MINS) . SKIN:WASH AFFECTED AREA W/SOAP & LG AMT OF WATER (15-20 MINS) . IN CASE OF CHEM BURNS, COVER AREA W/ STERILE, DRY PAD. INGEST:DRINK LG QTYS OF WATER/MILK. IF VOMIT (SUPDAT)

Fire Fighting Measures

Extinguishing Media:SAMPLE IS NON-FLAMMABLE, USE EXTINGUISHER MEDIA APPROPRIATE FOR SURROUNDING FIRE.
Fire Fighting Procedures:USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT .
Unusual Fire/Explosion Hazard:NONE SPECIFIED BY MANUFACTURER.

Accidental Release Measures

Spill Release Procedures:ADD NEUTRALIZING AGENT, FLUSH TO SEWER.
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

Handling and Storage

Handling and Storage Precautions:THESE ANALYTICAL STANDARDS MAY BE STORED IN NON-HAZARDOUS CHEMICAL STORAGE.
Other Precautions:NEVER HEAT OR EVAPORATE ANALYTICAL STANDARDS TO DRYNESS.

Exposure Controls/Personal Protection

Respiratory Protection:DEPENDS ON CONTAMINATION LEVELS IN THE WORKPLACE. NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN .
Ventilation:LOCAL EXHAUST.
Protective Gloves:VINYL OR LATEX GLOVES.
Eye Protection:ANSI APVD CHEMICAL SAFETY GOGGLES
Other Protective Equipment:EMPLYER SHLD PROVIDE ANSI APVD EYE-WASH FOUNTAIN & QUICK-DRENCH SHWR W/IN IMMED WORKPLACE. GOOD CHEM HYG PRACTICE(SUPDAT
Work Hygienic Practices:NONE SPECIFIED BY MANUFACTURER.
Supplemental Safety and Health
HMIS(LEVIEN) NOTES THAT THE ORAL LD50 (RAT) FOR POTASSIUM DICHROMATE IS 190MG/KG.EXPLAN OF CARCIN:GRP 1. NTP 6TH ANNUAL RPT ON CARCINS, 1991:KNOWN TO BE CARCINOGENIC. FIRST AID PROC:PERSISTS, ADMIN FLUIDS REPEATEDLY. OTHER PROT EQUIP:REQS LAB COAT/APRON.

Physical/Chemical Properties

HCC:T6
Boiling Pt:B.P. Text:>212F,>100C
Melt/Freeze Pt:M.P/F.P Text:32.0F,0.0C
Vapor Pres:760 @100C
Vapor Density:47.9
Appearance and Odor:COLORLESS TO PALE YELLOW LIQUID W/NO ODOR.

Stability and Reactivity Data

Stability Indicator/Materials to Avoid:YES
WATER REACTIVE MATERIALS.

Disposal Considerations

Waste Disposal Methods:OBSERVE ALL FEDERAL, STATE & LOCAL REGULATIONS. SAMPLES SHOULD BE DILUTED FOR DISPOSAL UNLESS LOCAL PRACTICE PROCEDURES SPECIFY OTHERWISE.

Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever, expressly or implied, warrants this information to be accurate and disclaims all liability for its use. Any person utilizing this document should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation.

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

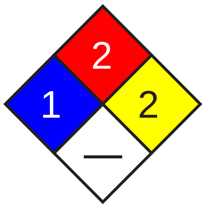
Name	CAS	%
iron, powder	7439-89-6	>99

OSHA PEL

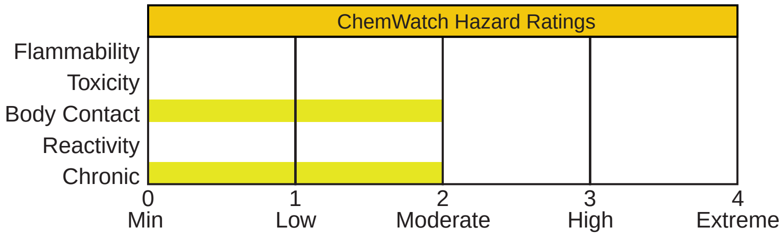
NIOSH REL
TWA: 5 mg/m^3; as Fe.

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!

☆☆☆☆☆ 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.

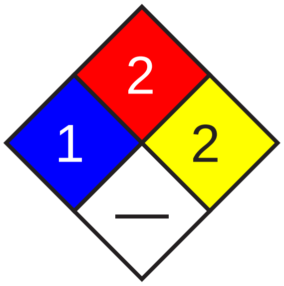
8.Catharsis (using sodium sulfate or magnesium sulfate) may only be used if the patient already has diarrhea.

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.



Fire Diamond

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 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.

Lead
LEA1000

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification

Material Name: Lead **CAS Number:** 7439-92-1
Chemical Formula: Pb
Structural Chemical Formula: Pb
EINECS Number: 231-100-4
ACX Number: X1000227-2
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
TWA: 0.05 mg/m^3; as Pb inorganic.

ACGIH TLV
TWA: 0.05 mg/m^3.

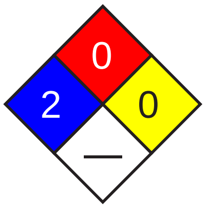
EU OEL
TWA: 0.1 mg/m^3.

NIOSH REL
TWA: 0.050 mg/m^3.

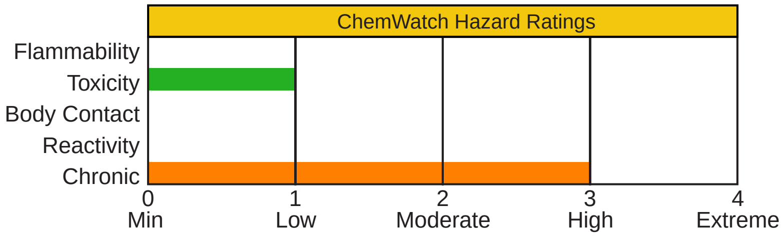
IDLH Level
100 mg/m^3 (as Pb).

DFG (Germany) MAK
TWA: 0.1 mg/m^3; PEAK: 8 mg/m^3; measured as inhalable fraction of the aerosol; Excluding lead arsenate and lead chromate.

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
1 Flammability
0 Reactivity

ANSI Signal Word
Danger!

Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Bluish-white, silvery, or gray metal. Cumulative poison. Chronic Effects: severe neurological effects, blood/kidney damage, sterility, decreased fertility, developmental damage to fetus. Possible cancer hazard.

Potential Health Effects

Target Organs: blood, central nervous system (CNS), peripheral nervous system, kidneys, gastrointestinal (GI) tract
Primary Entry Routes: inhalation, ingestion
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.

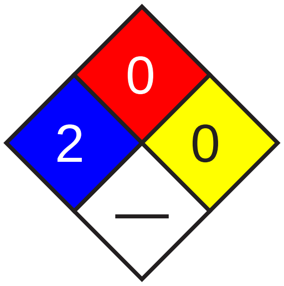
BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker 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



Fire Diamond

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 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

Evaporation Rate: Not applicable

pH: Not applicable

pH (1% Solution): Not applicable.

Boiling Point: 1740 °C (3164 °F)

Freezing/Melting Point: 327.4 °C (621.32 °F)

Volatile Component (% Vol): Not applicable

Water Solubility: Insoluble in water

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 strong acids, oxidants, ammonium nitrate, chlorine trifluoride and sodium azide.

Section 11 - Toxicological Information

Toxicity

Oral (woman) TD_{Lo}: 450 mg/kg/6 years

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.

Irritation

Nil Reported

See *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: None

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** 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

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: Magnesium **CAS Number:** 7439-95-4
Chemical Formula: Mg
EINECS Number: 231-104-6
ACX Number: X1000190-0
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

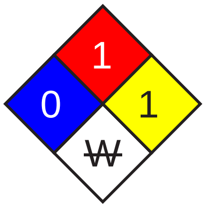
Trace Impurities: aluminum, copper, iron, manganese, nickel, and silicon

OSHA PEL

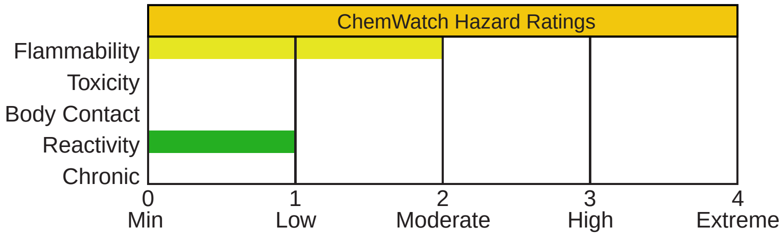
NIOSH REL

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
① Flammability
② Reactivity

ANSI Signal Word
Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Silvery white metal; odorless. Irritating to respiratory tract. Other Acute Effects: metal fume fever, molten metal causes thermal burns. Powder is dangerous fire hazard when wet. May ignite spontaneously. Powder forms explosive mixtures with air.

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

See DOT ERG

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.

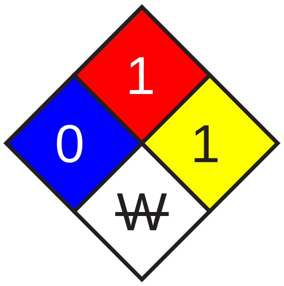
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center for significant ingestion. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

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

See DOT ERG



Fire Diamond

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-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

See DOT ERG

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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Magnesium *or* Magnesium alloys *with more than 50 percent magnesium in pellets, turnings or ribbons*
ID: UN1869
Hazard Class: 4.1 - Flammable solid
Packing Group: III - Minor Danger
Symbols:
Label Codes: 4.1 - Flammable Solid
Special Provisions: A1, IB8, IP3
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:** 39

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.

Section 1 - Chemical Product and Company Identification 51/60

Material Name: Manganese **CAS Number:** 7439-96-5
Chemical Formula: Mn
EINECS Number: 231-105-1
ACX Number: X1002539-5
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.

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.

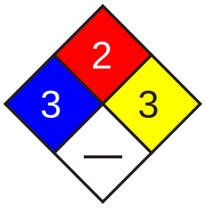
ACGIH TLV
TWA: 0.2 mg/m^3.

NIOSH REL
TWA: 1 mg/m^3; STEL: 3 mg/m^3.

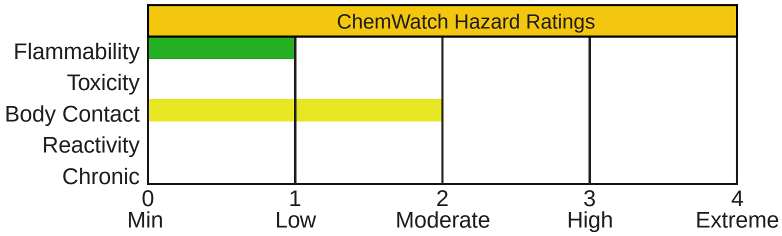
IDLH Level
500 mg/m^3 (as Mn).

DFG (Germany) MAK
TWA: 0.5 mg/m^3; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
② Flammability
③ Reactivity

ANSI Signal Word

Warning!

Explosive Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Lustrous, brittle, reddish-grey or silvery powder; odorless. Irritating to eyes/skin. Other Acute Effects: metal fume fever, managanese pneumonitis. Dust/powder 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

See DOT ERG

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

See DOT ERG

Flash Point: Not applicable, combustible solid

Autoignition Temperature: Manganese dust clouds: 842 °F (450 °C)

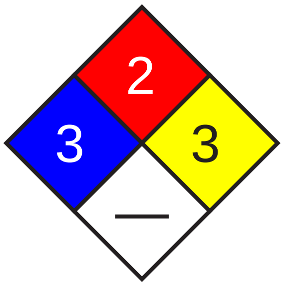
LEL: None reported.

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.



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. 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 nonhaz ardous 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$_2$O=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 *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 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 solid, inorganic, n.o.s.
ID: UN3288
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:** A **Other:**

Shipping Name and Description: Toxic solid, inorganic, n.o.s.
ID: UN3288
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:** A **Other:**

Shipping Name and Description: Toxic solid, inorganic, n.o.s.
ID: UN3288
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 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 group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Mercury
MER8040

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 44/60

Material Name: Mercury **CAS Number:** 7439-97-6
Chemical Formula: Hg
EINECS Number: 231-106-7
ACX Number: X1002555-9
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.

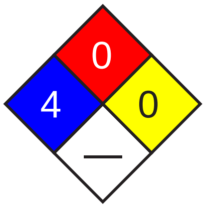
ACGIH TLV
TWA: 0.025 mg/m^3; skin.

NIOSH REL
Hg Vapor: TWA: 0.05 mg/m^3; skin. Other: Ceiling 0.1 mg/m^3; skin.

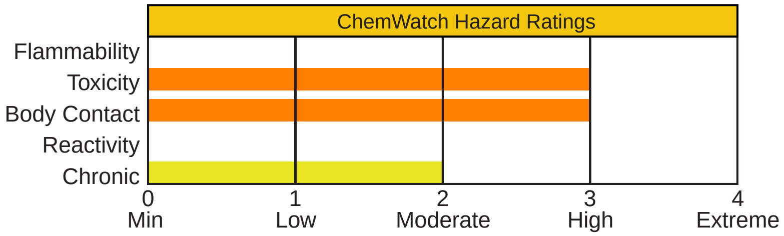
IDLH Level
10 mg/m^3 (as Hg).

DFG (Germany) MAK
TWA: 0.1 mg/m^3; PEAK: 0.8 mg/m^3; danger of sensitization of the skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
4	Health
0	Flammability
0	Reactivity

ANSI Signal Word

Danger!

Poison

Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Heavy silver-white liquid metal; odorless. Corrosive. Poison. Other Acute Effects: irreversible nervous system damage.

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), weakness, blurring or dimness of vision, miosis or mydiasis (dilatation of the pupils), tearing, bradycardia (slow heart beat), tachycardia (fast heart beat), cardiac irregularities (arrhythmias, complete 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

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 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.

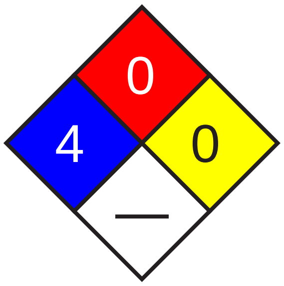
After first aid, get appropriate in-plant, paramedic, or community medical support.

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.

See DOT ERG



Fire Diamond

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).

See DOT ERG

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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Mercury
ID: UN2809
Hazard Class: 8 - Corrosive material
Packing Group: III - Minor Danger
Symbols: A W
Label Codes: 8 - Corrosive
Special Provisions:
Packaging: **Exceptions:** 164 **Non-bulk:** 164 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 35 kg **Cargo aircraft only:** 35 kg
Vessel Stowage: **Location:** B **Other:** 40, 97

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 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: 2004-07

Nickel
NIC1000

Section 1 - Chemical Product and Company Identification 54/58

Material Name: Nickel **CAS Number:** 7440-02-0
Chemical Formula: Ni
Structural Chemical Formula: Ni
EINECS Number: 231-111-4
ACX Number: X1002560-0
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.

OSHA PEL Vacated 1989 Limits
TWA: 1 mg/m^3; Insoluble as Ni. Other Values: soluble as Ni mg/m^3; 0.1.

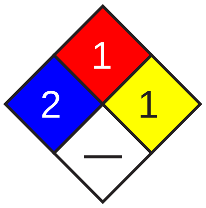
ACGIH TLV
TWA: 1.5 mg/m^3; measured as inhalable fraction of the aerosol.

NIOSH REL
TWA: 0.015 mg/m^3.

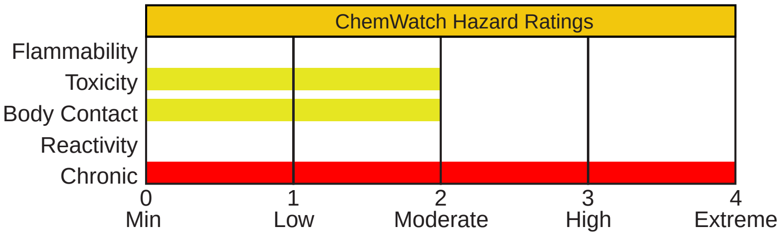
IDLH Level
10 mg/m^3 (as Ni).

DFG (Germany) MAK
Danger of sensitization of the airways and the skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
① Flammability
① Reactivity

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

Target Organs: nasal cavities, lungs, skin
Primary Entry Routes: inhalation, skin contact, 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.

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.

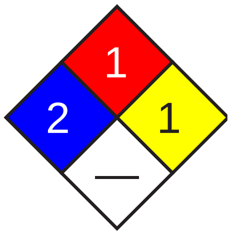
Ingestion: Rinse mouth out with plenty of water. Seek medical attention if irritation or discomfort persist.

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
Evaporation Rate: Non-volatile
pH: Not applicable

pH (1% Solution): Not applicable
Boiling Point: 2730 °C (4946 °F)
Freezing/Melting Point: 1455 °C (2651 °F)
Volatile Component (% Vol): Nil at 38 °C
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 reaction with oxidizing agents. Reacts with acids producing flammable/explosive hydrogen (H_2) gas.

Section 11 - Toxicological Information

Toxicity
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
Packing Group: None
Label: No class label assigned

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

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: Potassium **CAS Number:** 7440-09-7
Chemical Formula: K
EINECS Number: 231-119-8
ACX Number: X1000060-7
Synonyms: KALIUM; POTASSIUM; POTASSIUM,(LIQUID ALLOY); POTASSIUM,METAL
Derivation: By thermochemical distillation of potassium chloride with sodium or by electrolysis of molten salts. Potassium 40 is a naturally occurring radioactive isotope.
General Use: In the preparation of potassium peroxide, heat exchange alloys (see NaK); in the synthesis of inorganic potassium compounds; in organic syntheses involving condensation, dehalogenation, reduction and polymerization reactions; seeding of combustion gases in magnetohydrodynamic generators; as a compound of fertilizers; and the vaporized metal is used in turbines.

Section 2 - Composition / Information on Ingredients

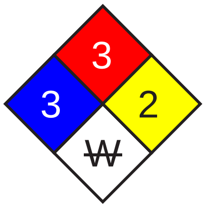
Name	CAS	%
Potassium	7440-09-7	99.9+ % wt

Trace Impurities: Oxygen, carbon, hydrogen, alkali metals, aluminum, calcium, copper, boron and silicon, along with iron, nickel and chromium which are leached from container metals. High purity potassium potentially has transition metals and other alkali metals.

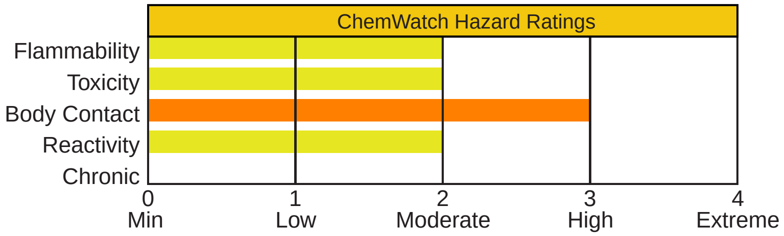
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
3 Flammability
3 Reactivity

ANSI Signal Word
Danger!


Corrosive


Flammable


Explosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Soft, silvery-white solid; odorless. Reacts violently with air and water to form corrosive materials. Harmful in excessive concentrations. Spontaneously combustible. Reacts violently with water. Violent explosion hazard.

Potential Health Effects

Target Organs: Eyes, skin, respiratory system
Primary Entry Routes: Inhalation, eye and skin contact
Acute Effects
Inhalation: Inhalation of dust or mist can irritate the eyes, nose, throat and lungs with sneezing, coughing and sore throat. Higher exposures may cause a potentially fatal buildup of fluid in the lungs (pulmonary edema).
Eye: Eye contact can cause severe burns leading to permanent damage.
Skin: Skin contact can cause severe burns leading to permanent damage. Prolonged exposure can lead to sores of the inner nose.
Ingestion: Significant esophageal or gastrointestinal tract irritation and/or burns could occur following ingestion.
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 disorders. Smoking may worsen respiratory conditions caused by potassium exposure.

Chronic Effects: Prolonged exposure may lead to sores of the inner nose and lung damage.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed. Medical observation is recommended for 24 to 72 hours after breathing overexposure, as pulmonary edema may be delayed.

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. Consult a physician immediately.

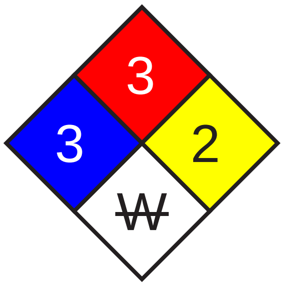
Ingestion: Never give anything by mouth to an unconscious or convulsing person. *Do not* induce vomiting. Consult a physician immediately.

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

Note to Physicians: Administer 100% humidified supplemental oxygen with assisted ventilation as required. If respiratory tract irritation or respiratory depression is evident, monitor arterial blood gases, chest x-ray and pulmonary function tests. Respiratory tract irritation, if severe, can progress to pulmonary edema which may be delayed in onset up to 24 to 72 hours after exposure. Treat dermal irritation or burns with standard topical therapy.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Flammable Solid

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use dry sand, dry chemical, soda ash or lime. *Do not* use water, foam, CO_2, or halogenated hydrocarbons.

General Fire Hazards/Hazardous Combustion Products: Potassium oxide. May ignite spontaneously if exposed to air or oxygen. May reignite after fire is extinguished. May ignite in presence of moisture. Violent reaction with water produces flammable hydrogen gas which can ignite from heat of reaction. Runoff to sewer may create fire or explosion hazard.

Fire-Fighting Instructions: If feasible and without undue risk, move containers from fire hazard area. *Do not* release runoff from fire control methods to sewers or waterways. If tank, rail car or tank truck is involved in a fire, *isolate* for 800 meters (1/2 mile) in all directions. Because fire will produce irritating, corrosive and/or toxic gases, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Wear chemically protective clothing.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area), evacuate all unnecessary personnel and isolate and ventilate area. *Do not* touch or walk through spilled material. Keep away from water.

Small Spills: Isolate area for at least 50 to 100 meters. Cover spill with dry earth, dry sand or other noncombustible material.

Large Spills: Cover with a plastic sheet to minimize spreading or contact with rain. *Do not* release into sewers or waterways. *Do not* clean up or dispose of, except under supervision of a specialist. Consider initial downwind evacuation for at least 250 meters (800 feet).

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

Section 7 - Handling and Storage

Handling Precautions: Avoid breathing vapors or contact with skin, eyes or clothing. Sources of ignition such as smoking, open flames and heat are prohibited. Use only nonsparking tools and equipment when opening and closing containers of potassium. Protect containers against physical damage.

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 inert atmospheres, such as argon or nitrogen or under liquids that are oxygen-free, such as toluene, kerosene, or petroleum, or in glass capsules that have been filled under vacuum. Store in airtight containers to prevent oxidation. The corrosive nature of potassium will cause perforation of commercially available aluminum containers. Keep away from water and/or high temperatures. A detached, fire-resistant building is recommended for quantity storage.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to prevent release into the work area. Use explosion-proof electrical equipment and filterings whenever potassium is used, handled, manufactured or stored. Provide general or local exhaust ventilation systems to maintain airborne concentrations. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement examinations to evaluate skin and respiratory conditions. Perform lung function tests. Communicate all information on the health and safety hazards of potassium to potentially exposed workers.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Wear protective eyeglasses or dust-proof 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. Check particulate filters every day before work for physical damage, such as rips or tears, and replace as needed. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA with a full facepiece operated in 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: Soft, silvery-white metal

Physical State: Solid

Vapor Pressure (kPa): 8 mm Hg at 810 °F (432 °C)

Formula Weight: 39.1

Specific Gravity (H_2O=1, at 4 °C): 0.86 at 68 °F (20 °C)

Boiling Point: 1410 °F (765.5 °C)

Freezing/Melting Point: 146 °F (63.2 °C)

Water Solubility: Negligible

Other Solubilities: liquid ammonia, ethylenediamine, aniline, several metals, acid and mercury

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Potassium is unstable. It may form reactive, explosive peroxides at room temperature even when stored under oil. Hazardous polymerization cannot occur. When potassium has prolonged exposure to air and it comes into contact with an organic contaminant, i.e. mineral oil, an explosion will result.

Storage Incompatibilities: Reacts vigorously/violently with oxygen, water, acids, carbon monoxide, carbon tetrachloride, halogens, hydrogen, sulfur, hydrogen sulfide, and hydrogen halides. Reduces silicates, sulfates, nitrates, carbonates, phosphates, oxides and hydroxides of the heavy metals. Mixtures of potassium with metal halides are sensitive to mechanical shock and ensuing explosions range from very violent to weak. Mixtures of potassium with non-metal halides and non-metal oxides usually explode violently on impact.

Hazardous Decomposition Products: Thermal oxidative decomposition of potassium can produce potassium oxide.

Section 11 - Toxicological Information

Other Effects:

Mouse, intraperitoneal, LD_{50}: 700 mg/kg.

See *RTECS* TS6460000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Naturally occurring in Earth's crust 2.59% by weight. Present in seawater at a concentration of 3.8×10^{-5} ug/L. Present in ferromanganese nodules in the Pacific Ocean at 0.753 wt % and in the Atlantic Ocean at 0.56 wt %.

Ecotoxicity: Aquatic Toxicity: 80 ppm/24 hr/mosquito fish/TL_m/ freshwater

Section 13 - Disposal Considerations

Disposal: Safe disposal of potassium covers the separation of metal from adhering oxide by melting under xylene containing 1% of isopropanol; disposal of small metal residues by treatment with 1:1 ethyl acetate-hydrocarbon diluent mixtures; and disposal of 30 g blocks by dropping into a 2 meter deep hole in the ground containing 0.5 m of water. 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: Potassium
ID: UN2257
Hazard Class: 4.3 - Dangerous when wet material
Packing Group: I - Great Danger
Symbols:
Label Codes: 4.3 - Dangerous When Wet
Special Provisions: A19, A20, B27, IB1, IP1, N6, N34, T9, TP3, TP7, TP31
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 244
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 15 kg
Vessel Stowage: **Location:** D **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

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

Section 1 - Chemical Product and Company Identification

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Material Name: Selenium **CAS Number:** 7782-49-2
Chemical Formula: Se
EINECS Number: 231-957-4
ACX Number: X1002211-2
Synonyms: C.I. 77805; COLLOIDAL SELENIUM; ELEMENTAL SELENIUM; EPA PESTICIDE CHEMICAL CODE 072001; GRAY SELENIUM; SELEN; SELENATE; SELENIUM; SELENIUM ALLOY; SELENIUM BASE; SELENIUM (COLLOIDAL); SELENIUM DUST; SELENIUM ELEMENTAL; SELENIUM HOMOPOLYMER; SELENIUM POWDER; VANDEX
Derivation: Recovered by roasting anode muds from electrolytic copper refineries with soda or sulfuric acid, or by smelting them with soda and niter.
General Use: Used as a pigment and decolorizing agent in the glass industry; in toning baths in photography; in making electrodes for arc lights, electrical instruments and apparatus; rectifier in radio and television sets; in semiconductor fusion mixtures, selenium cells, telephotographic apparatus; rubber vulcanizing agent; catalyst in determination of Kjeldahl nitrogen; for dehydrogenation of organic compounds; in steel and copper (degasifier and machineability improver); as a dietary supplement; in the manufacture of pigments, textiles, petroleum, and medical therapeutic agents.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Selenium	7782-49-2	> 99% wt (commercial grade)

Trace Impurities: (commercial grade): > 0.2% tellurium, 0.1% iron, 0.005% lead and 0.005% copper

OSHA PEL
TWA: 0.2 mg/m^3.

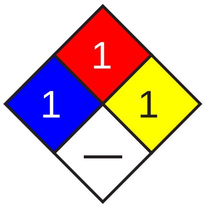
ACGIH TLV
TWA: 0.2 mg/m^3.

NIOSH REL
TWA: 0.2 mg/m^3.

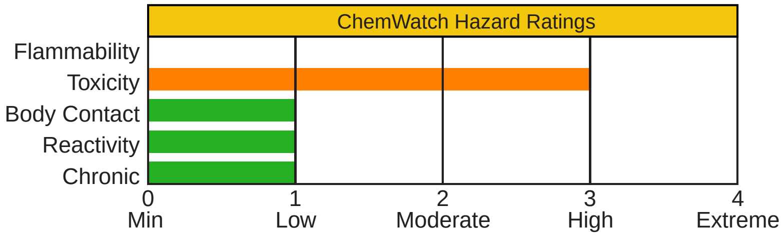
IDLH Level
1 mg/m^3 (as Se).

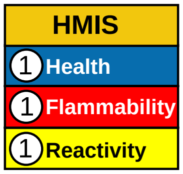
DFG (Germany) MAK
TWA: 0.05 mg/m^3; PEAK: 0.2 mg/m^3; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Amorphous red or black solid, or red, gray or black crystals; garlic or rotten horseradish odor when heated. Fumes/dust irritating to eyes/skin/respiratory tract. Other Acute Effects: respiratory system impairment, CNS/psychological effects. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, CNS, cardiovascular system (CVS), respiratory system, blood, liver, kidneys, spleen
Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption

Acute Effects

Inhalation: Inhalation of selenium dust or fumes (fumes contain selenium dioxide) may cause mucous membrane irritation, coughing, sneezing, breathing difficulty, shortness of breath, "metal fume fever" (chills, fever, headaches), hypotension (low blood pressure), psychological effects (depression, irritability, etc.), liver and kidney damage, and in extreme cases, pulmonary edema (accumulation of fluid in the lungs), CNS depression, and coma. Note that toxicity of selenium (elemental) is considerably less than that of selenium compounds. Toxic effects of selenium fume inhalation may largely be due to selenium dioxide content of fumes.

Eye: Exposure to dust or fumes may result in irritation, swelling and redness of the eyelids.

Skin: Exposure to selenium fumes causes irritation, contact dermatitis and burns (fumes contain selenium dioxide which forms selenious acid (irritant) upon contact with moist skin or mucous membranes. Both selenium dioxide and selenious acid can also be absorbed through the skin, and produce systemic toxicity).

Ingestion: Acute systemic effects may result, although intestinal absorption of elemental selenium is minimal. Toxic effects ahve been reported following excessive consumption of dietary supplements.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; 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: Asthma, allergies, known sensitization to selenium, chronic respiratory disease, gastrointestinal disturbances, liver or kidney disorders, dermatitis.

Chronic Effects: Bronchial irritation (through inhalation), inflammation of eye lining and lids, gastrointestinal distress, persistent garlic odor on breath, increased dental carries, mottled teeth, metallic taste, pallor, skin lesions, lowered blood clotting efficiency and hemoglobin levels, irritability, excessive fatigue, anorexia, pain or anesthesia in extremities, and, in extreme cases of "selenosis," skin discoloration (reddish), fingernail and hair discoloration or loss can result. Some individuals may be more sensitive than others to selenium toxicity. Reported daily ingestion of 27 to 2310 mg resulted in nausea, vomiting, nail changes, fatigue, and irritability. Lower selenium intake (700-800 µg/day) has not been found to produce toxic effects. Animal testing suggests spleen, liver and kidney damage, and reproductive effects.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

See DOT ERG

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. Consider also administration of charcoal slurry cathartic.

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

Note to Physicians: Treat overexposure symptomatically and supportively. Monitor whole blood selenium levels.

Section 5 - Fire-Fighting Measures

Flash Point: Not applicable; combustible solid.

See DOT ERG

Autoignition Temperature: None reported.

LEL: None reported.

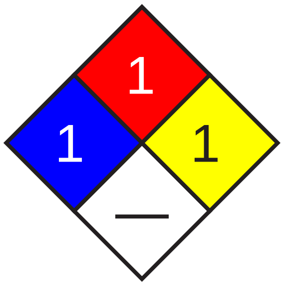
UEL: None reported.

Flammability Classification: Combustible solid

Extinguishing Media: Use extinguishing agents suitable for surrounding fire.

General Fire Hazards/Hazardous Combustion Products: Heating selenium can produce toxic selenium oxides (*e.g.*, selenium dioxide (SeO_2)). Containers 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

Spill/Leak Procedures: Isolate spill area for at least 80-160 feet (25-50 m). *Do not* touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. *Do not* get water inside containers.

See DOT ERG

Small Spills: Vacuum or carefully scoop up material and deposit in sealed containers.

Large Spills: Dike far ahead of spill for later disposal. *Do not* release into sewers or waterways. Spills of selenium in waterways may be remediated by dredging.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid dust or fume 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 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: Enclose operations and/or provide local exhaust ventilation at the site of chemical release. 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: Where possible, use a contained transfer method for transferring selenium from drums or other storage containers to process containers. Arrange pre-employment and annual medical examinations emphasizing urinary selenium (should be < 0.1 mg/L), eyes, skin (chronic disorders), respiratory system, liver, kidneys, blood, and medical conditions aggravated by long-term exposure to selenium (see Sec. 3). Give special consideration to women of childbearing age, because of possible reproductive effects. Remove workers from selenium exposure if exposure-related garlic odor of breath is detected.

Personal Protective Clothing/Equipment: Wear impervious, chemically protective neoprene or rubber gloves, boots, aprons, gauntlets and body-covering clothing to prevent skin contact. Wear protective eyeglasses, 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 <= 1 mg/m^3, use a dust and mist, or dust, mist and fume respirator, or air-purifying full face-piece respirator with high efficiency particulate (HEP) filter, or powered air-purifying respirator with dust and mist filter, or powered air-purifying respirator with dust, mist and fume filter, supplied air respirator, or SCBA with full facepiece; > IDLH/unknown/emergency, 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 SCBA. For escape, use an air-purifying, full facepiece respirator with HEP filter. *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: Red to bluish black, dark red, gray, or black, crystals odorless.

Physical State: Amorphous or crystalline solid

Vapor Pressure (kPa): > 0.001 mm Hg at 68 °F (20 °C)

Formula Weight: 78.96 +/- 3

Specific Gravity (H_2O=1, at 4 °C): 4.26 to 4.81

Boiling Point: 1274 °F (690 °C)

Freezing/Melting Point: 338 °F (170 °C) to 422.6 °F (217 °C) (crystals)

Surface Tension: 92.5 dynes/cm at 423 °F (217 °C)

Ionization Potential (eV): 9.75238 eV

Water Solubility: Insoluble

Other Solubilities: Soluble in sulfuric acid, carbon disulfide, ether, methylene iodide, benzene, quinoline, chloroform, aqueous potassium cyanide solution, potassium sulfite solution, caustic alkali solution. Insoluble in alcohol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Selenium is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Unintended contact in storage areas or reactor vessels.

Storage Incompatibilities: Include acids, fluorine, oxygen, cadmium, potassium, sodium, chlorine trifluoride, chromium trioxide, chromic oxide, lithium silicon, nitric acid, nitrogen trichloride, potassium bromate (explosive), silver bromate, bromine pentafluoride, and more materials. Contact with metal amides can be explosive. Metal carbides and chlorates incandesce in selenium vapor upon heating. Freshly precipitated amorphous selenium can react with water, producing selenous acid and hydrogen.

Hazardous Decomposition Products: Thermal oxidative decomposition of selenium can produce selenium dioxide.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 6700 mg/kg resulted in somnolence (general depressed activity), dyspnea, other changes in nutrition and gross metabolism.

Mouse, oral, LD_{Lo}: 134 mg/kg.

Acute Inhalation Effects:

Rat, inhalation, LC_{Lo}: 33 mg/kg/8 hr resulted in hemorrhage, emphysema, and acute pulmonary edema.

Other Effects:

Tumorgenicity, mouse, oral: 480 mg/kg/60 days continuous, resulted in tumors of the skin and appendages (equivocal tumorigenic agent by RTECS criteria).

Human, blood cultures: selenium (more than any tested selenium compounds) induced sister chromatid exchange.

Mouse, oral: 134 mg/kg, over multigenerations resulted in fetotoxicity, and fetal death.

See *RTECS* VS7700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Selenium undergoes complex chemical and biological cycling through surface water and bottom sediments. It has been found to concentrate in some plants and fish. Elemental selenium is insoluble in water and will have low mobility in the soil column.

Ecotoxicity: *Scenedesmus*, TL_m96=2.5 ppm; *E. Coli*, TL_m96=90 ppm. Selenium toxicity occurs frequently among livestock ("alkali disease") of the Great Plains of the US, Canada and Mexico.

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) 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 44/60

Material Name: Silver **CAS Number:** 7440-22-4

Chemical Formula: Ag

EINECS Number: 231-131-3

ACX Number: X1003391-9

Synonyms: ALGAEDYN; AMALGUM; ARGENTUM; C I 77820; C.I. 77820; C.I. 77870; EPA PESTICIDE CHEMICAL CODE 072501; L 3; L-3; C-PIGMENT 2; SHELL SILVER; SILBER; SILFLAKE 135; SILPOWDER 130; SILVER; SILVER ATOM; SILVER METAL; SILVER METAL: ARGENTUM SYNONYMS OF SOLUBLE SILVER COMPOUNDS SUCH AS SILVER NITRATE ($AGNO_3$) VARY DEPENDING UPON THE SPECI; SILVER METAL: ARGENTUM SYNONYMS OF SOLUBLE SILVER COMPOUNDS SUCH AS SILVER NITRATE (AGNO3) VARY DEPENDING UPON THE SPECI; SILVER,COLLOIDAL; SR 999; TCG 7R; V 9

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).

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Silver	7440-22-4	ca 100 % wt.

97.5 % silver + 2.5 % copper = *sterling* silver.

OSHA PEL
TWA: 0.01 mg/m^3.

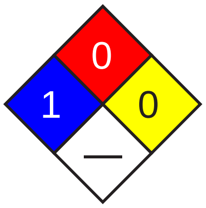
ACGIH TLV
TWA: 0.1 mg/m^3.

NIOSH REL
TWA: 0.01 mg/m^3.

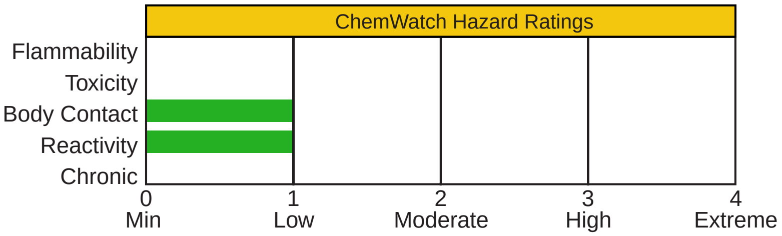
IDLH Level
10 mg/m^3 (as Ag).

DFG (Germany) MAK
TWA: 0.1 mg/m^3; PEAK: 0.8 mg/m^3; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
0	Flammability
0	Reactivity

ANSI Signal Word
Warning!


Explosive


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Hard, brilliant white, malleable metal. Acute Effects: argyria. Powder is flammable and explosive.

Potential Health Effects

Target Organs: Skin, eyes (especially the conjunctiva), and mucous membranes.

Primary Entry Routes: Inhalation, skin and eye contact.

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: No data found.

Skin: Effects are generally chronic.

Ingestion: None reported.

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: 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.

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 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-beta-D glucosaminidase was significantly elevated and correlated with blood silver concentrations and age. It may be an indicator of exposure. 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 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Noncombustible as the solid.

Autoignition Temperature: None reported.

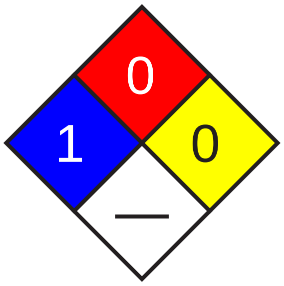
LEL: None reported.

UEL: None reported.

Extinguishing Media: Use agents suitable for surrounding fire.

General Fire Hazards/Hazardous Combustion Products: Silver fumes.

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. * Flammable when in highly divided powder form.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area. Cleanup personnel should protect against inhalation and skin/eye contact with dusts.

Small Spills: Carefully scoop up spill and place in sealed containers for reclamation.

Large Spills: No data found.

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. 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.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from incompatibles (Sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: No special controls needed. 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 skin, eyes, and mucous membranes (for presence of argyria).

Personal 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.

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.

Other: 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. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Hard, brilliant white, lustrous, ductile, malleable metal; odorless.

Physical State: Solid

Vapor Pressure (kPa): 0 mm Hg at 77 °F (25 °C), 100 mm Hg at 3389 °F (1865 °C)

Formula Weight: 107.868

Density: 10.5 g/mL

Boiling Point: 4013 °F (2212 °C)

Freezing/Melting Point: 1763 °F (961 °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.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Silver is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Contact with incompatibles.

Storage 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.

Hazardous Decomposition Products: Silver fumes will be given off when heated.

Section 11 - Toxicological Information

No data found.

See *RTECS* VW3500000, for additional data.

Section 12 - Ecological Information

Environmental Fate: In water, silver will undergo absorption by manganese dioxide and precipitation with halides.

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).

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 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) 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
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2005-05

Sodium, Metal
SOD1000

Section 1 - Chemical Product and Company Identification 49/60

Material Name: Sodium, Metal **CAS Number:** 7440-23-5
Chemical Formula: Na
EINECS Number: 231-132-9
ACX Number: X1000092-9
Synonyms: DUPONT SODIUM METAL DISPERSION; NATRIUM; SODIO; SODIUM; SODIUM-23; SODIUM (LIQUID ALLOY); SODIUM METAL; SODIUM, METAL
Derivation: By electrolyzing a fused mixture of sodium chloride and calcium chloride.
General Use: In the manufacture of tetraethyl and tetramethyl lead, in titanium reduction, sodium peroxide, sodium hydride, as a polymerization catalyst for synthetic rubber, as a lab reagent, as a coolant in nuclear reactors, in electric power cable, in nonglare lighting for highways, as radioactive forms in tracer studies and medicine, as a heat transfer agent in solar-powered electric generators.

Section 2 - Composition / Information on Ingredients

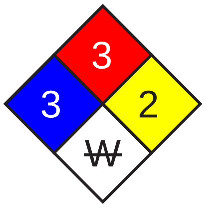
Name	CAS	%
Sodium, metal	7440-23-5	99.9% wt

Trace Impurities: Calcium and chlorides

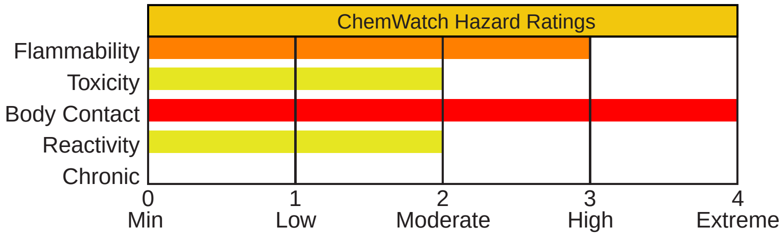
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
③ Health
③ Flammability
③ Reactivity

ANSI Signal Word
Danger!

Corrosive

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆
Solid lustrous metal. Corrosive. Violently decomposes on contact with water and may ignite spontaneously.

Potential Health Effects

Target Organs: Eyes, skin, digestive and respiratory tract
Primary Entry Routes: Ingestion, respiration.
Acute Effects
Inhalation: Causes irritation and severe burning of the respiratory tract with severe coughing and pain. After 72 hours may cause pulmonary edema (fluid in lungs), resulting in stridor (sounds of respiratory obstruction).
Eye: Causes severe burning and irritation of the cornea (surface tissue layer of the eye) and conjunctiva leading to irreversible damage and even permanent blindness.
Skin: Causes severe burning and irritation, with pain, redness, irritation or full thickness burns.
Ingestion: Causes severe burning and irritation, with associated drooling and vomiting. Ingestion may result in burns to the lips, tongue, oral mucous membrane, and upper airway.
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 tract disorders.

Chronic Effects: Chronic exposures can cause ulcers to form in the mouth and complications with respiratory and digestive tracts.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air, monitor for respiratory tract 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 tepid water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.

Skin Contact: *Quickly* remove contaminated clothing. Wash exposed area extremely thoroughlywith 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 rinse residual sodium around the mouth with flooding amounts of water. *Do not* induce vomiting. Contact physician immediately.

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

Note to Physicians: For oral exposure, the use of diluents is controversial, neutralization is contraindicated, and activated charcoal is not indicated. Perform esophagoscopy 12 to 24 hours after ingestion to determine severity where history indicates a definite ingestion of a caustic substance or where stridor, dysphagia or drooling are present. During esophagoscopy take care to avoid perforation of severely burned esophageal tissue. Treat dermal contamination with standard topical therapy, or if indicated for cases of hypersensitivity, treat with corticosteroids or antihistamines.

Special Precautions/Procedures: Use caution in the administration of steroids for burns and antibiotic for infection.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Flammable solid

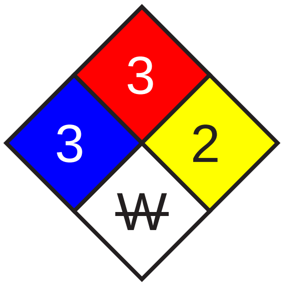
Autoignition Temperature: 239°F (115°C)

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use dry graphite, soda ash, powdered sodium chloride or appropriate dry powder. *Do not* use water, carbon dioxide, or halogenated extinguishing agents.

General Fire Hazards/Hazardous Combustion Products: Including sodium oxides (Na_2O, Na_2O_2) which can react with moisture or steam to produce heat, sodium hydroxide, and flammable hydrogen gas. Heated sodium is spontaneously flammable in air. Dangerous explosion hazard when exposed to moisture in any form.



Fire Diamond

Fire-Fighting Instructions: If feasible and without undue risk, move containers from fire hazard area. Otherwise, cool fire- exposed containers until well after fire is extinguished. Do not release runoff from fire control methods to sewers or waterways. *Do not* get water inside containers, cool containers with flooding quantities of water until well after fire is out, and withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. 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. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Structural firefighters' protective clothing will only provide limited protection.

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. Shut off ignition source. *Do not* use flares in the area. *Do not* touch or walk through spilled material; stop leak if you can do it without risk. *Do not* put water on spilled materials or inside container.

Small Spills: For dry spills, place into clean dry container with clean dry shovel, cover, and move from spill area. For wet spills, take up with sand or other noncombustible absorbent and material and place into container for later disposal.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Cover spill with plastic sheet or tarp to minimize spreading. Avoid dust generation. *Do not* dry sweep. Absorb spilled sodium dry, cover remainder with kerosene, paraffin oil or dry sand, eliminate last traces with methylated spirit.

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

Section 7 - Handling and Storage

Handling Precautions: Label as a flammable solid.

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: Place in hermetically-sealed steel drums, tin cans, and tank cars. *Do not* stack in tiers. Keep away from water, especially sprinkler systems. Keep submerged in oxygen free liquids, eg., kerosene or naphtha. Store large quantities in a separate fire-resistive building. Avoid mechanical injury of containers, exposure to heat, and wet conditions. Automatically transfer sodium from drums or other storage containers to process containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose operations and /or provide local exhaust ventilation at the site of chemical release. Isolate operation to reduce exposure. 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 respiratory and digestive tracts. Perform lung function tests. Stress good work practices to reduce hazardous exposures, removing and exchanging contaminated clothing promptly, monitor for exposure to sodium and sodium particulate levels, and provide worker training the use and handling of sodium.

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 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. 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: Light, silvery-white metal, wax-like at room temperature, lustrous when freshly cut; odorless.

Physical State: Solid

Vapor Pressure (kPa): 1.2 mm Hg at 752 °F (400 °C)

Formula Weight: 22.98977 g/mol

Density: 0.968 g/cm^3

Refractive Index: 4.22

Boiling Point: 1618.5 °F (881.4 °C)

Freezing/Melting Point: 208.1 °F (97.82 °C)

Water Solubility: Violently decomposes.

Other Solubilities: Insoluble in ether or benzene, dissolves in liquid ammonia and mercury

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Sodium is unstable at room temperature in closed containers under normal storage and handling conditions. It oxidizes readily with air. Hazardous polymerization can not occur with sodium. Avoid wet conditions, heat, air, and exposure to oxide and halide compounds, eg., aluminum bromide, antimony triiodide, etc.

Storage Incompatibilities: Sodium metal reacts vigorously or explosively with oxidizing agents. The following materials may cause an explosive reaction: water; acids (hydrochloric acid, hydrogen fluoride, nitric acid [fuming], and sulfuric acid); air; halides such as aluminum bromide, magnesium chloride, aluminum fluoride, and mercuric iodide; carbon dioxide; ammonia; chlorinated hydrocarbons; hydrogen peroxide; lead oxide; phosphorus; potassium oxides; sulfur; and sulfur dioxide.

Hazardous Decomposition Products: Thermal oxidative decomposition of sodium can produce sodium oxides [including sodium monoxide (Na_2O), sodium dioxide (NaO_2), and sodium peroxide (Na_2O_2)].

Section 11 - Toxicological Information

Other Effects:

Mouse, intraperitoneal, LD_{50}: 4 g/kg.

See *RTECS* VY0686000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: Sodium is dangerous to aquatic life in high concentrations and may be dangerous if it enters intakes.

Section 13 - Disposal Considerations

Disposal: Destroy scraps by reaction with *n*-butyl alcohol. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Container - Store empty sodium drums in storage area until disposed.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Sodium
ID: UN1428
Hazard Class: 4.3 - Dangerous when wet material
Packing Group: I - Great Danger
Symbols:
Label Codes: 4.3 - Dangerous When Wet
Special Provisions: A7, A8, A19, A20, B9, B48, B68, IB4, IP1, N34, T9, TP3, TP7, TP31 TP46
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 244
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 15 kg
Vessel Stowage: **Location:** D **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 10 lb (4.535 kg)
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 group inc.

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

Issue Date: 2005-05

Thallium
THA1730

Section 1 - Chemical Product and Company Identification 51/60

Material Name: Thallium **CAS Number:** 7440-28-0
Chemical Formula: Tl
EINECS Number: 231-138-1
ACX Number: X1003447-6
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%

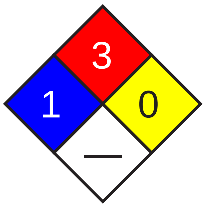
Trace Impurities: (technical grade): lead, zinc, nickel, cadmium, indium, germanium, selenium, tellurium, arsenic

OSHA PEL
TWA: 0.1 mg/m^3; skin.

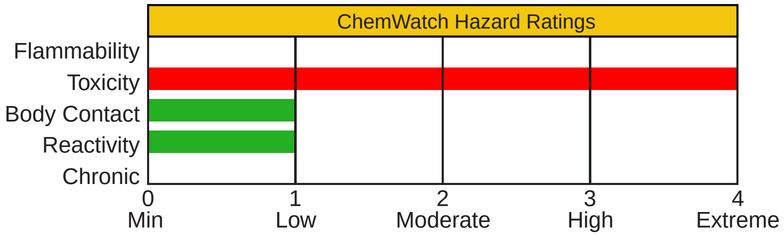
NIOSH REL
TWA: 0.1 mg/m^3.

ACGIH TLV
TWA: 0.1 mg/m^3; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
2 Flammability
1 Reactivity

ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Bluish-white, odorless soft metal or powder. Toxic. Other Acute Effects: skin sensitization, CNS/GI tract effects, kidney damage, death. Exposure is cumulative. 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.

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

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. 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

See DOT ERG

Flash Point: Not applicable, probable noncombustible solid

Autoignition Temperature: None reported.

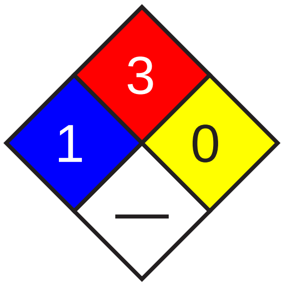
LEL: None reported.

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 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 Diamond

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

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. 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 *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 Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Thallium compounds, n.o.s.
ID: UN1707
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:**

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

Vanadium
VAN2140

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Vanadium **CAS Number:** 7440-62-2
Chemical Formula: V
Structural Chemical Formula: V
EINECS Number: 231-171-1
ACX Number: X1002586-4
Synonyms: VANADIUM
General Use: Target material for x-rays, manufacture of alloy steels, vanadium compounds, especially catalyst for sulfuric acid and synthetic rubber. Found in many minerals including patronite (polysulfide), vanadinite, roscoelite and carnotite.

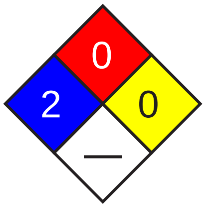
Section 2 - Composition / Information on Ingredients

Name	CAS	%
vanadium	7440-62-2	> 99

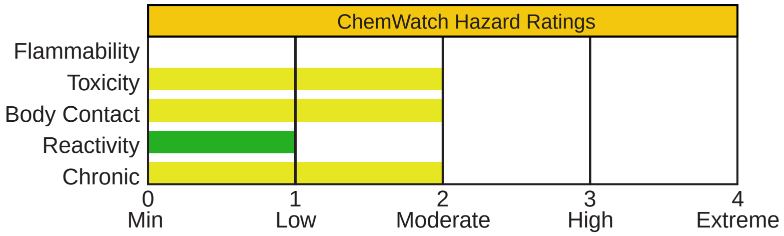
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
0 Flammability
0 Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, lustrous solid, light gray powder; odorless. Irritating to eyes/skin/respiratory tract. Other Acute Effects: pulmonary edema, blood vessel constriction, CNS effects, headache, tremors. Powder is explosive.

Potential Health Effects

Target Organs: respiratory system, skin, eyes
Primary Entry Routes: inhalation, ingestion
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.
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 produce eye discomfort and abrasive eye inflammation.
Skin: The material may be slightly discomforting to the skin from repeated exposures over long periods.
Ingestion: The material may be mildly discomforting to the gastrointestinal tract.

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 - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: 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: 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.

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

Autoignition Temperature: Not applicable

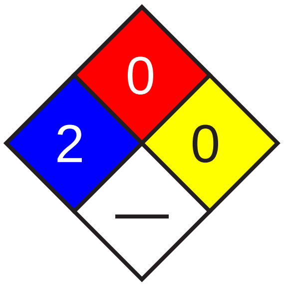
LEL: Not applicable

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.



Fire Diamond

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.

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 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. 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.
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.
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; plastic container.
Multi-ply woven plastic or paper bag with sealed plastic liner.
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: 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 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.

Other: Overalls. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Bright white soft ductile metal. Not tarnished in air and not appreciably affected by moisture at ordinary temperature. Soluble in nitric, hydrofluoric and concentrated sulfuric acids.

Physical State: Divided solid	**Evaporation Rate:** Not applicable
Vapor Pressure (kPa): Not applicable	**pH:** Not applicable
Vapor Density (Air=1): Not applicable	**pH (1% Solution):** Not applicable.
Formula Weight: 50.94	**Boiling Point:** 3380 °C (6116 °F)
Specific Gravity (H_2O=1, at 4 °C): 6.11	**Freezing/Melting Point:** 1917 °C (3482.6 °F)

Volatile Component (% Vol): Not applicable **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 strong oxidizing agents, strong acids, lithium and bromine trifluoride.

Section 11 - Toxicological Information

Toxicity
Subcutaneous (rabbit) LD_{50}: 59 mg/kg

Irritation
Nil reported

See *RTECS* YW 1355000, 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 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: 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: 2005-05

Zinc
ZIN1000

Section 1 - Chemical Product and Company Identification 51/60

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%).

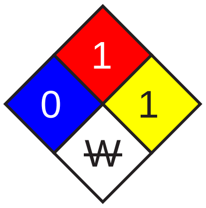
Trace Impurities: Tin, lead, iron, cadmium, arsenic, cesium, antimony, and zinc chloride (increases corrosion resistance).

OSHA PEL

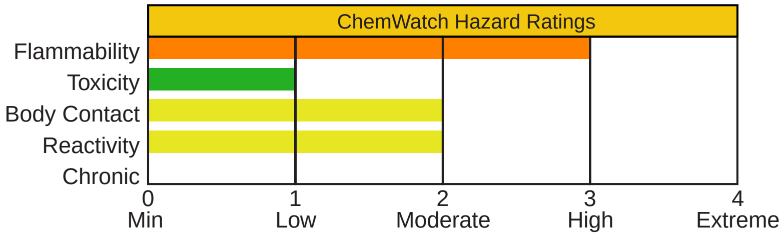
NIOSH REL

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
1	Flammability
1	Reactivity

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

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.

See DOT ERG

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

Flash Point: Not applicable, combustible solid

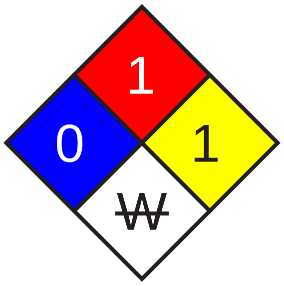
Autoignition Temperature: Cloud, 1256 °F (680 °C); dust layer, 860 °F (460 °C); powder 650 mJ spark.

LEL: Dust cloud explosion, 0.5 oz/ft^3

UEL: None reported.

Flammability Classification: Combustible solid

See DOT ERG



Fire Diamond

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

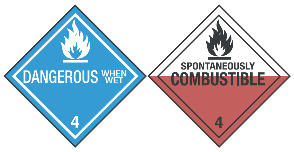
Disposal: Reclaim for salvage or reuse. Unsalvageable waste may be buried in an approved landfill. Maximum concentration in effluent to sewer or stream is 1 ppm. Criteria for land treatment or burial disposal practices are under significant review. Contact your supplier or a licensed contractor for detailed 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.

APPENDIX G

HAZARDS OF TRENCHES, TEST PITS AND EXCAVATIONS

Cave-in means the separation of a mass of soil or rack material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that is could entrap, bury or otherwise injure and immobilize a person.

Competent Persons means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them

Excavation means any man-made cut, cavity, trench, or depression in an earth surface, form by earth removal.

Sheeting means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure.

Shoring means a structure such as a metal hydraulic mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sloping means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Trench means a narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater the 15ft.

Protective Systems

Two general methods are commonly used to prevent cave-ins within an excavation. The first includes the use of a structure to support the soil such as shoring, sheeting and trench boxes. The second method incorporates benching or slopes in the excavation process. Sloping is less expensive than structural supports, but requires more area around the excavation.

When utilizing the slope or bench methods, the allowable angle of the walls is dependent on the type of soil being excavated. The attached figures provide the maximum allowable slopes for each type of soil. The soil types are classified, by a competent person, as A,B AND C as followed:

Type A means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot or greater. Examples of cohesive soils are: clay, silty clay sandy clay, clay loam and in some cases silty clay loam and sandy clay loam. No soil is is Type A if it is fissured, subject to vibration, previously disturbed, or unstable.

Type B means;

a. Cohesive soil with a unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf. or

b. Granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and in some cases silty clay loam and sandy clay loam.

c. Previously disturbed soils except those which would otherwise be classed as Type C soil.

d. Soil that meets the unconfined compressive strength or cementation requirements for Type A , but is fissured or subject to vibration

e. Dry rock that is not stable

Type C means;

a. Cohesive soil with an unconfined compressive strength of 0.5 tsf or less

b. Granular soils including gravel, sand and loamy sand.

c. Submerged soil or soil form which water is freely seeping

d. Submerged rock that is not stable.

Hazardous Atmospheres

Whenever an employee is required to enter an excavation of greater that four (4) feet the atmosphere must be tested for oxygen deficiency and if warranted, combustible atmosphere and toxic gas.

TABLE B-1

MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V)[1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [3]
STABLE ROCK	VERTICAL (90°)
TYPE A [2]	3/4 : 1 (53°)
TYPE B	1:1 (45°)
TYPE C	1½: 1 (34)

NOTES:

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

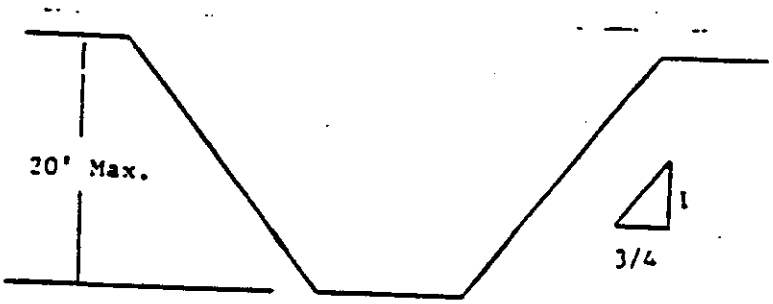
Figure B-.

Slope Configurations

(All slopes stated below are in the horizontal to vertical ratio)

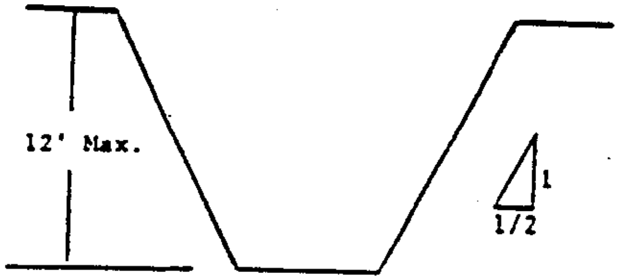
B-1.1 Excavations made in Type A soil.

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of ¾:1.



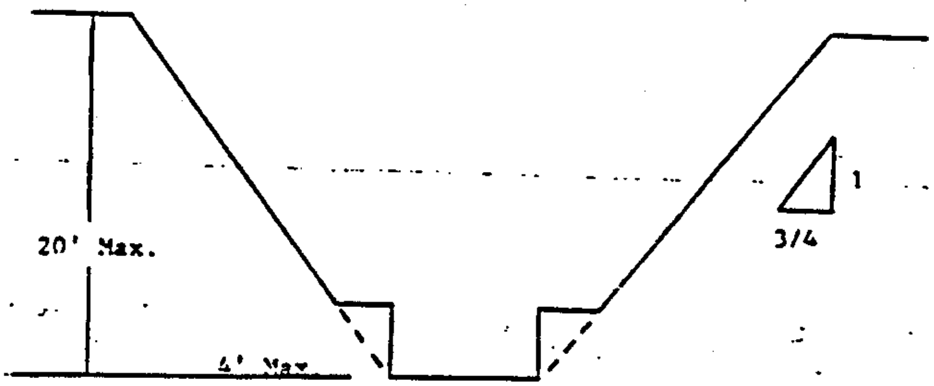
Simple Slope—General

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a aximum allowable slope of ½:1.

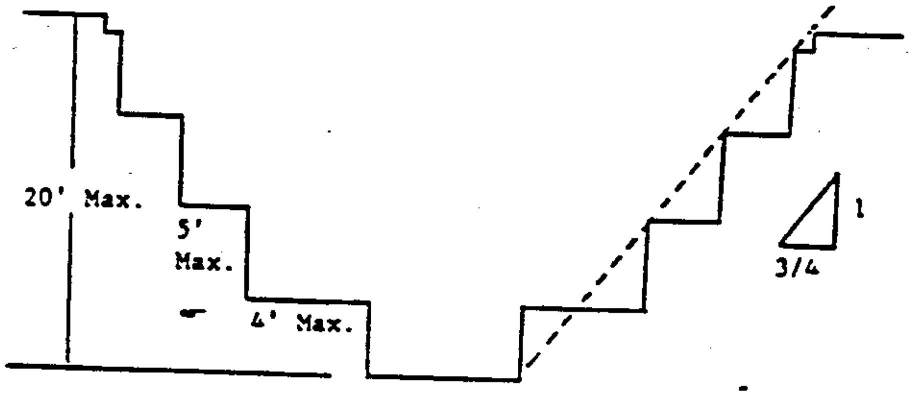


Simple Slope—Short Term

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of ¾ to 1 and maximum bench dimensions as follows:

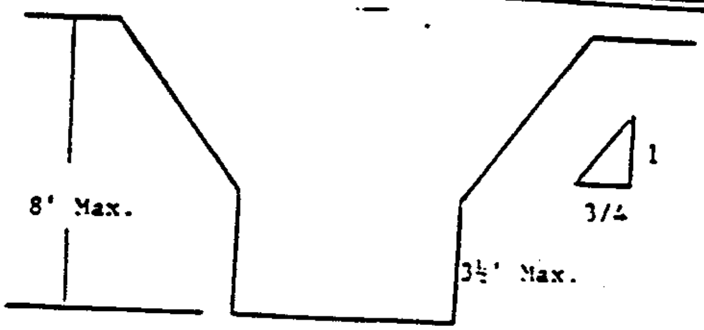


Simple Bench



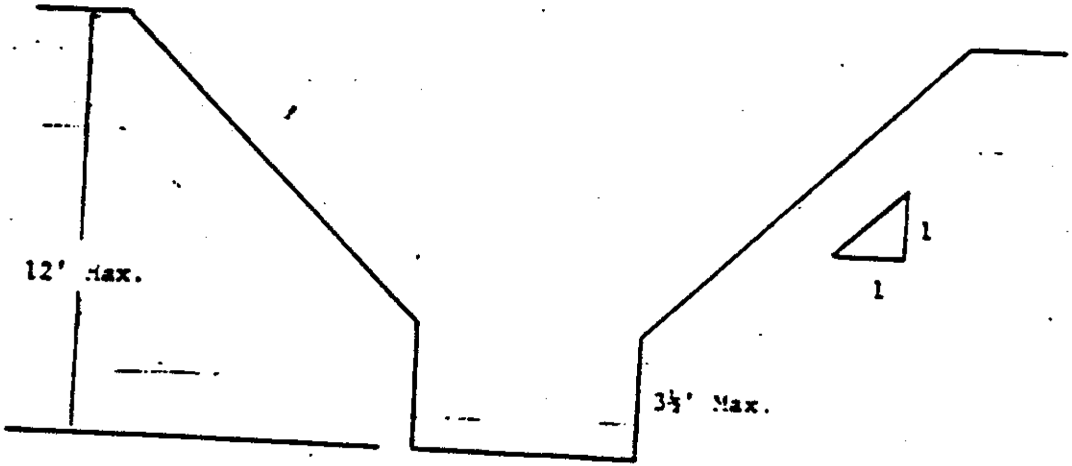
Multiple Bench

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3½ feet.



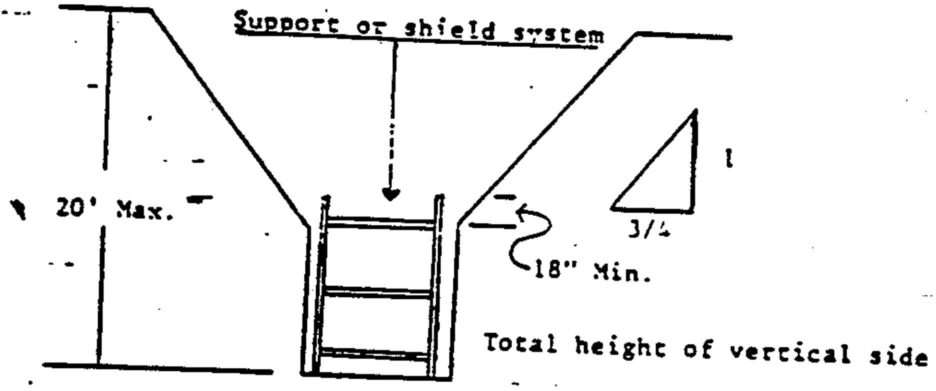
Unsupported Vertically Sided Lower Portion—Maximum 8 Feet in Depth

All excavations more than 8 feet but not more than 12 feet in depth which unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3½ feet.



Unsupported Vertically Sided Lower Portion—Maximum 12 Feet in Depth

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of ¾:1. The support or shield system must extend at least 18 inches above the top of the vertical side.

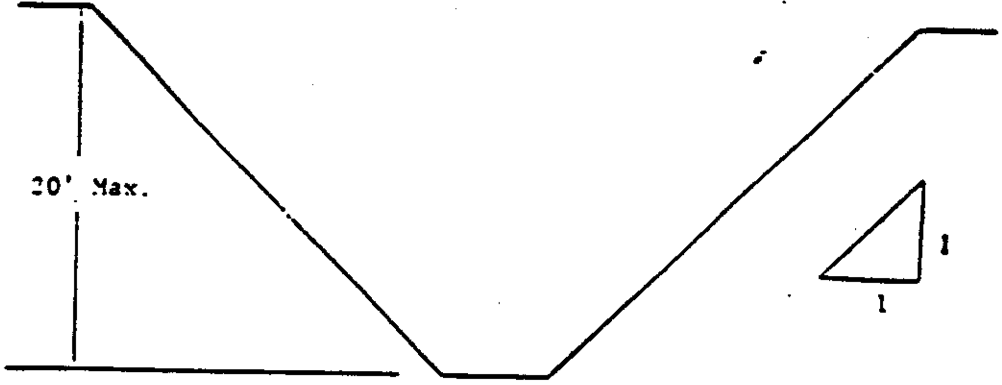


Suported or Shielded Vertically Sided Lower Portion

4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under § 1926.652(b).

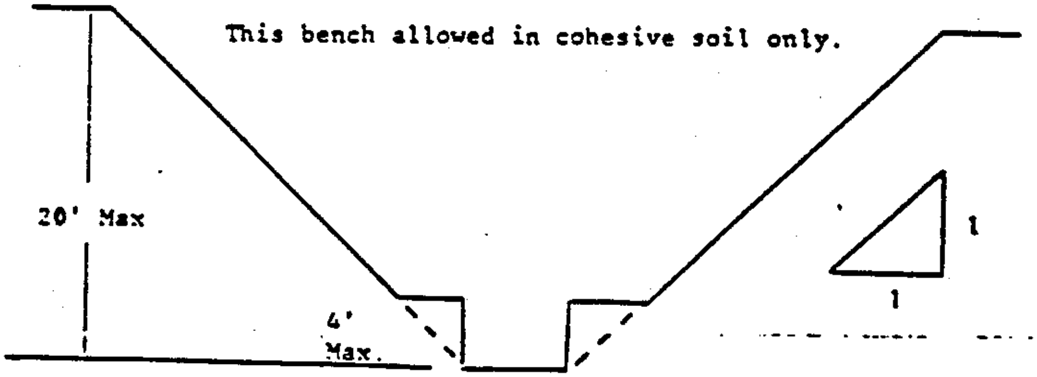
B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.

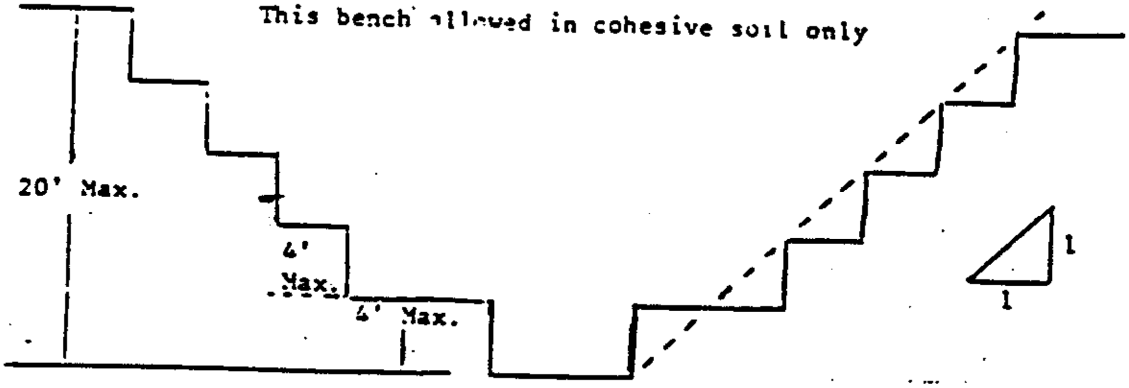


Simple Slope

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

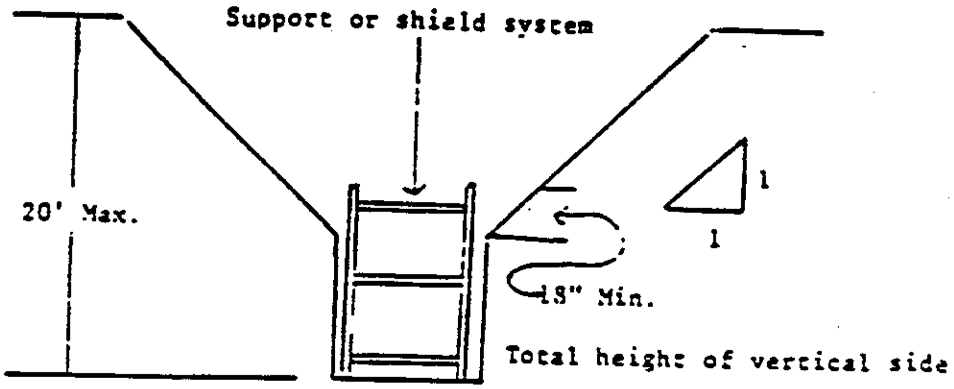


Single Bench



Multiple Bench

3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.

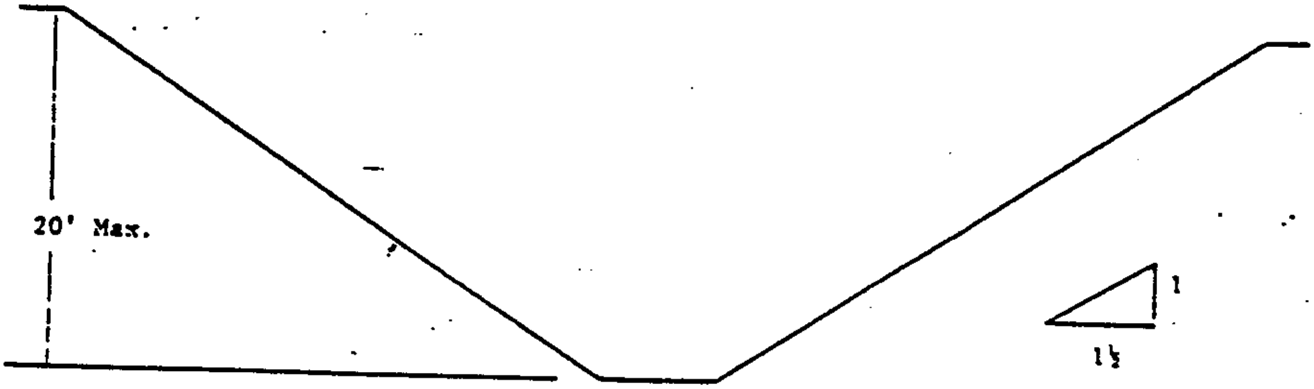


Vertically Sided Lower Portion

4. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

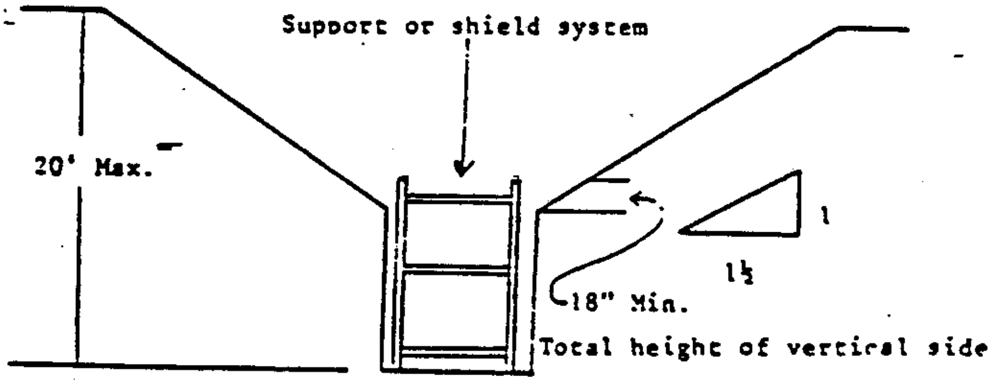
B-1.3 Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1½:1.



Simple Slope

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1½:1.

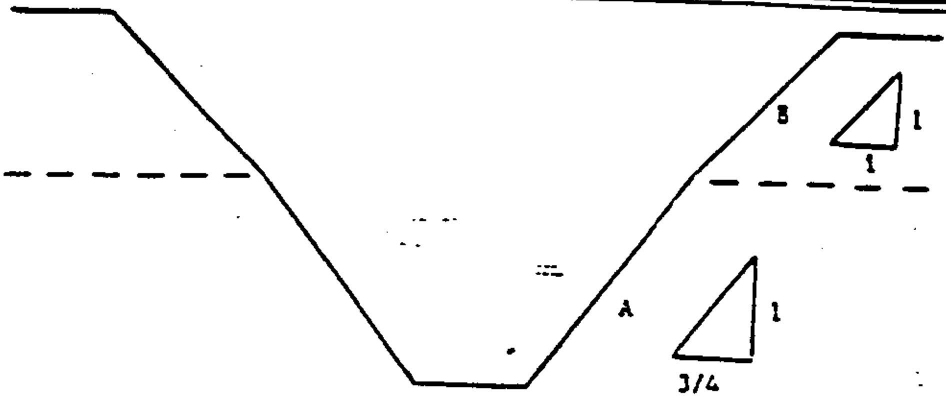


Vertical Sided Lower Portion

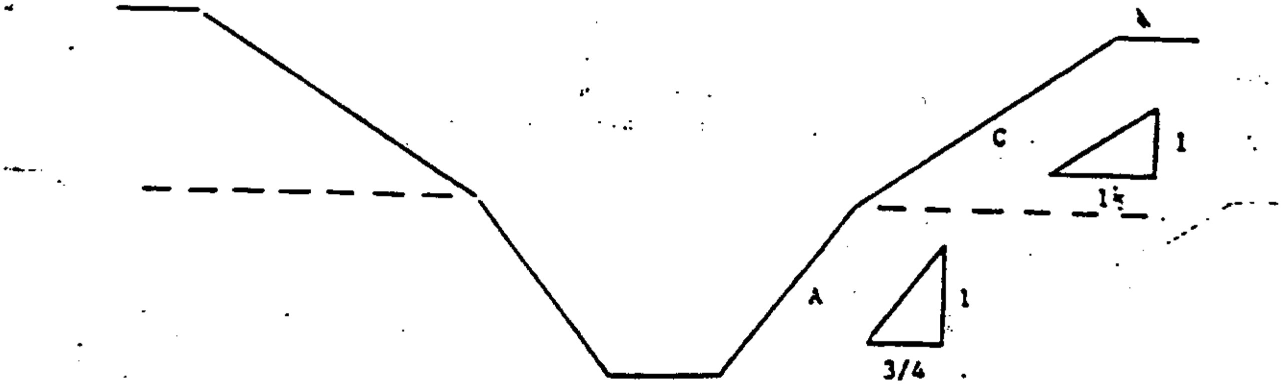
3. AL other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

B-1.4 Excavations Made in Layered Soils

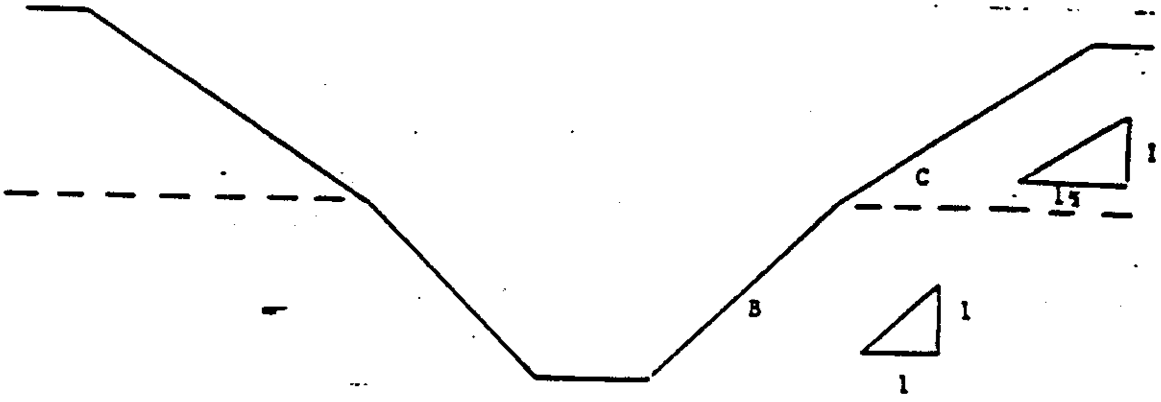
1. All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below.



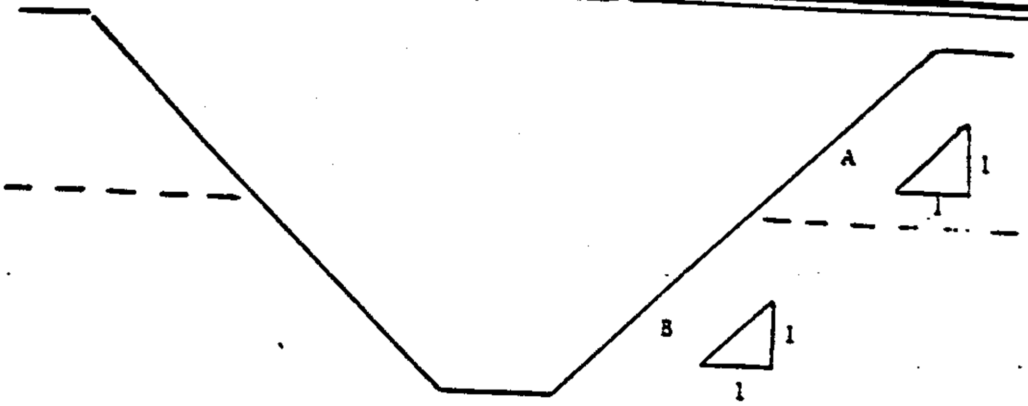
B OVER A



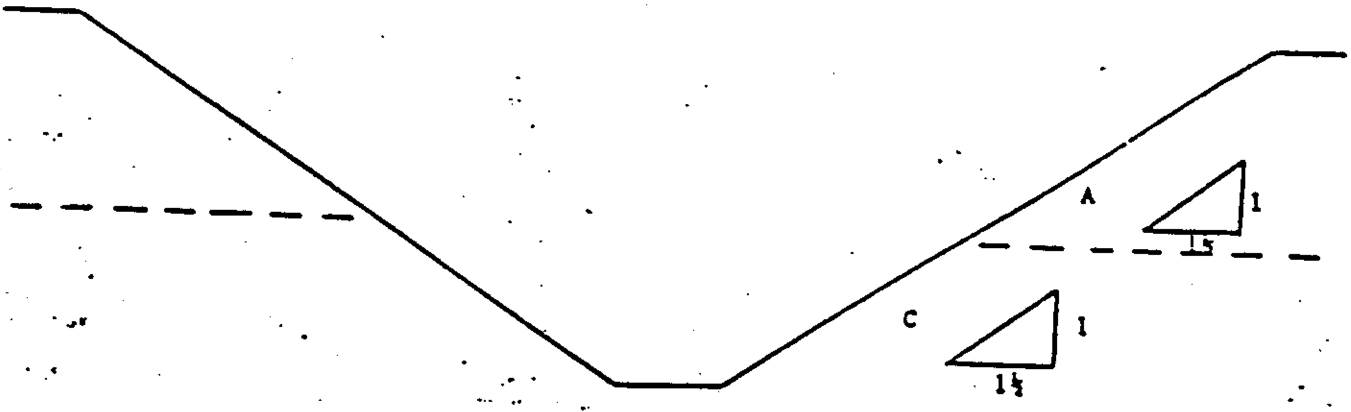
C OVER A



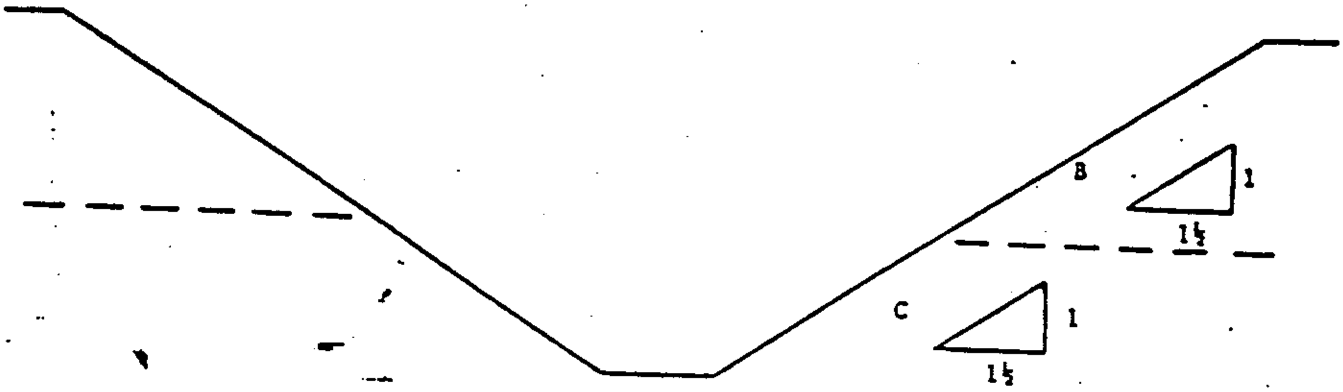
C OVER B



A OVER B



A OVER C



B OVER C

2. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

Appendix C to Subpart P

Timber Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with § 1926.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in § 1926.652(b) and § 1926.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil

Figure 3. Trench Jacks (Screw Jacks)

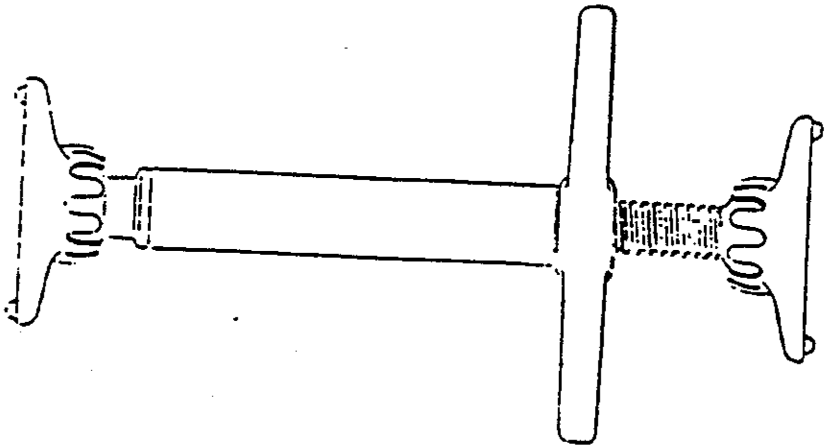
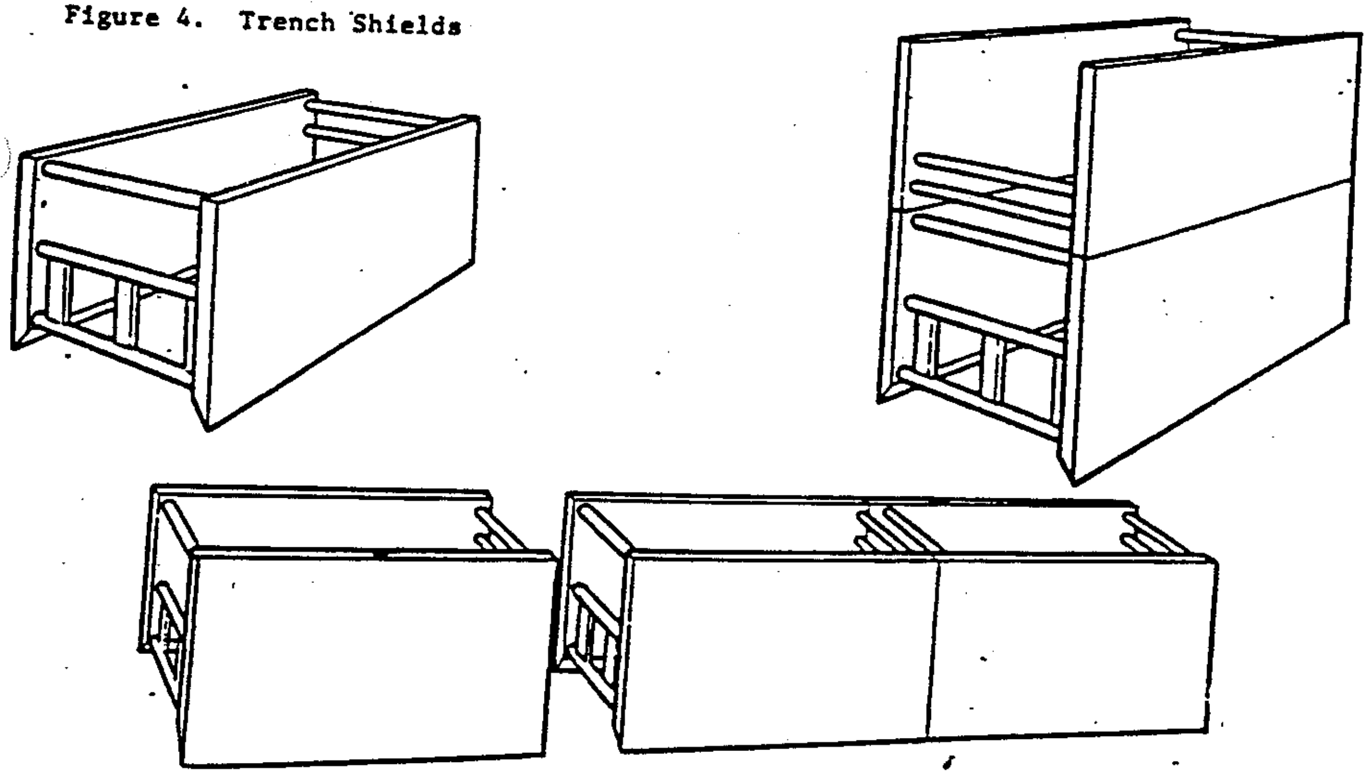


Figure 4. Trench Shields



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Appendix F to Subpart P—Selection of Protective Systems

The following figures are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in dept Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordan with § 1926.652 (b) and (c).

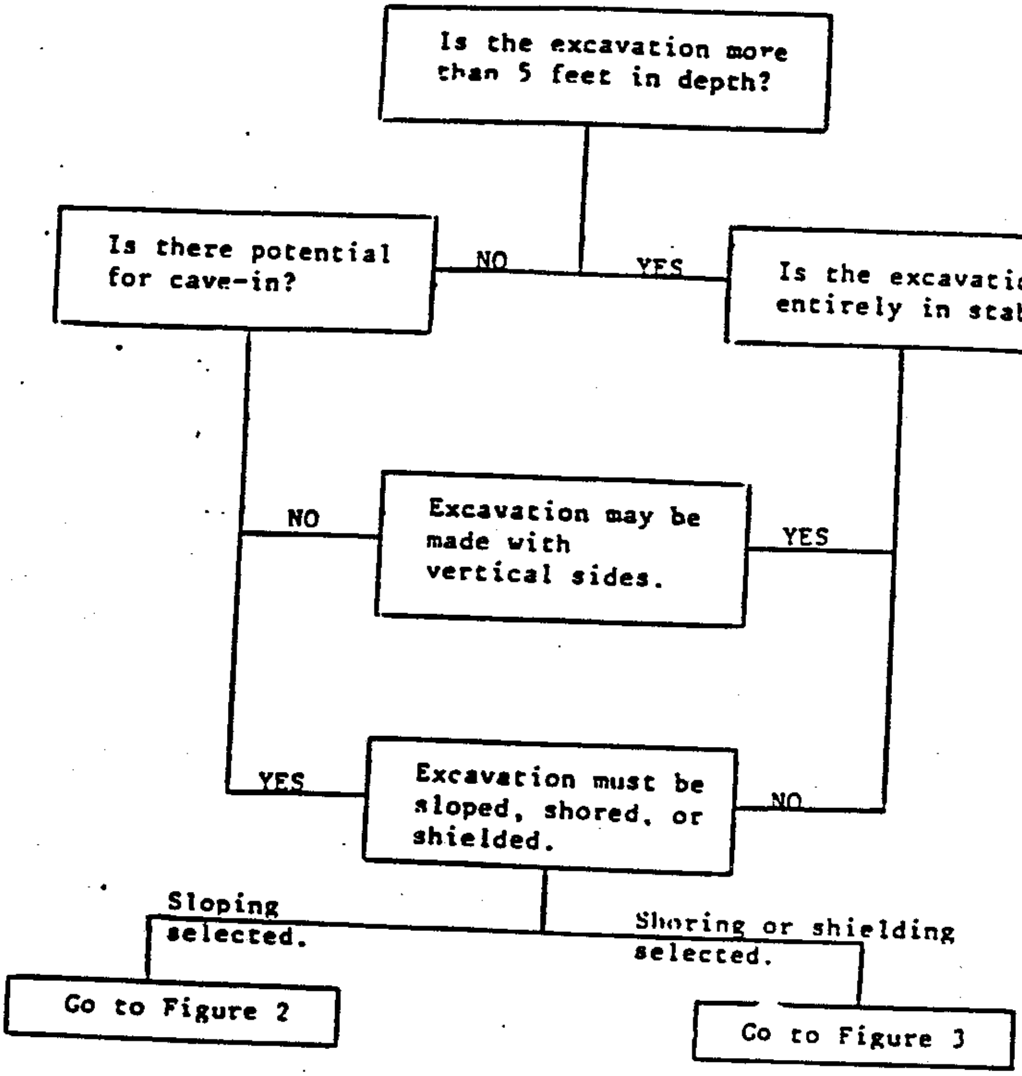

FIGURE 1 - PRELIMINARY DECISIONS

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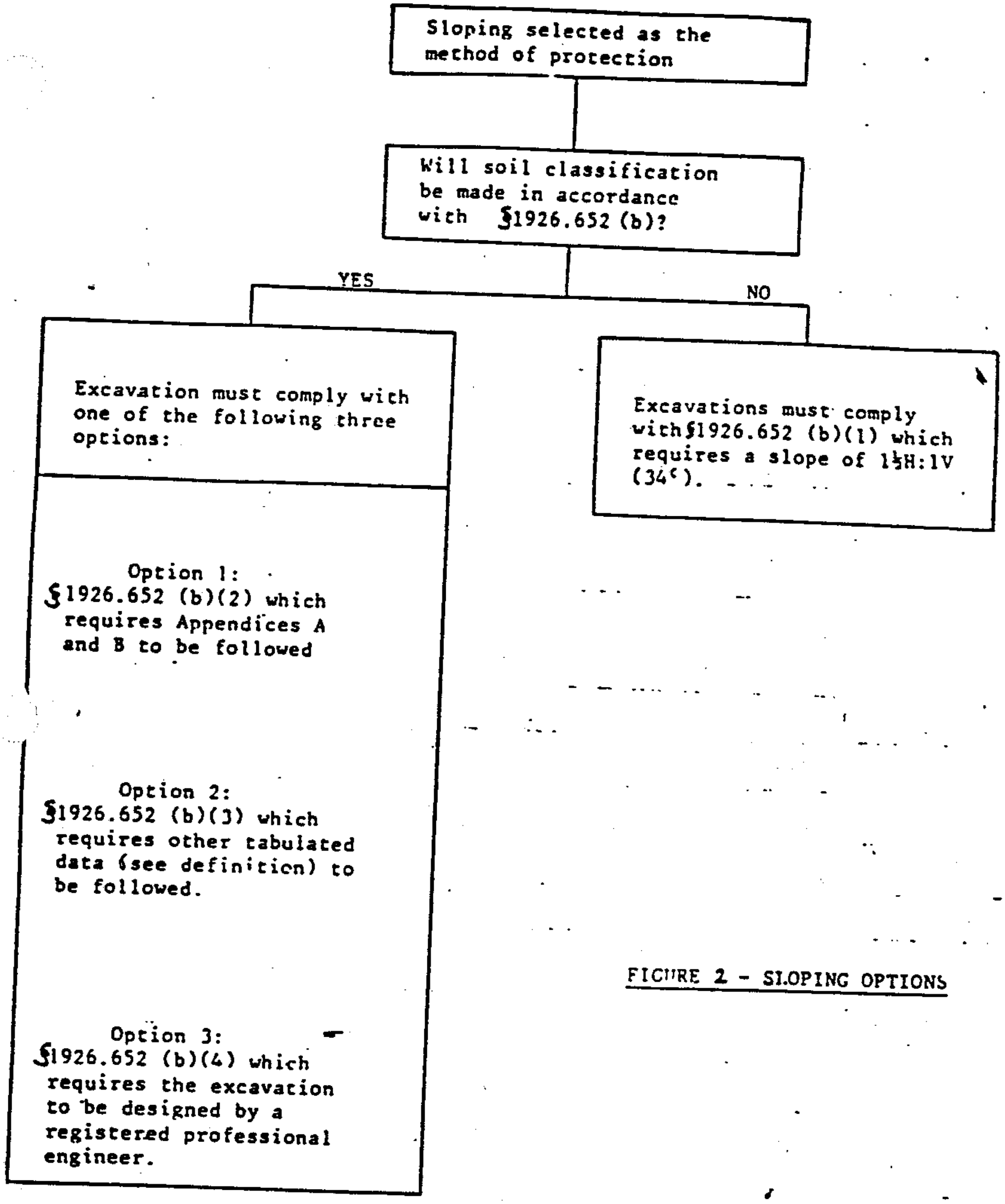
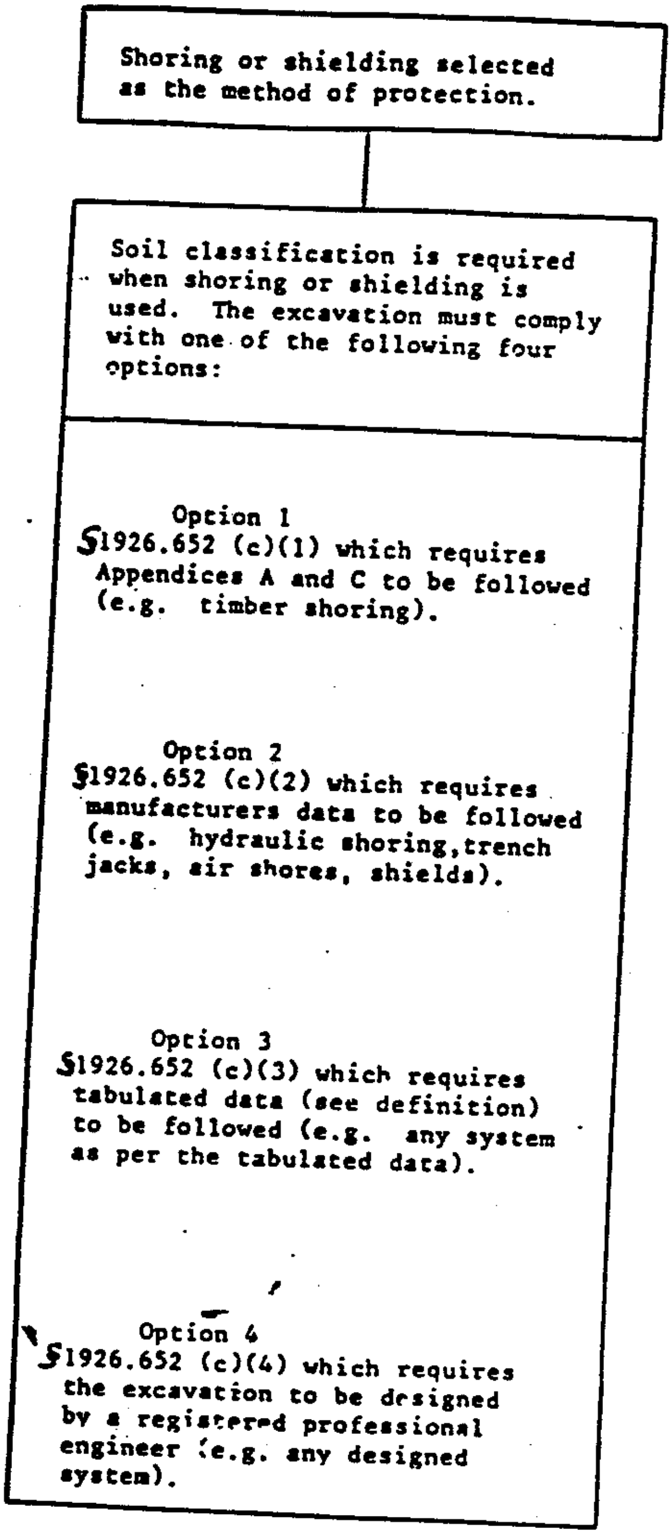


FIGURE 2 - SLOPING OPTIONS



Shoring or shielding selected as the method of protection.

Soil classification is required when shoring or shielding is used. The excavation must comply with one of the following four options:

Option 1
§1926.652 (c)(1) which requires Appendices A and C to be followed (e.g. timber shoring).

Option 2
§1926.652 (c)(2) which requires manufacturers data to be followed (e.g. hydraulic shoring, trench jacks, air shores, shields).

Option 3
§1926.652 (c)(3) which requires tabulated data (see definition) to be followed (e.g. any system as per the tabulated data).

Option 4
§1926.652 (c)(4) which requires the excavation to be designed by a registered professional engineer (e.g. any designed system).

FIGURE 3 - SHORING AND SHIELDING OPTIONS

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Safe Excavation and Trenching

Introduction

Implementing an effective excavation/trenching program is a key ingredient to ensure a successful construction project. Although hazards associated with excavation and trench work are recognized and preventable, and OSHA regulations mandate appropriate controls be established, accidents and fatalities resulting from cave-ins continue to occur at an alarming rate.

Excavation is defined as any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal. A trench is a narrow excavation (in relation to its length) made below the surface of the ground. Generally the depth of a trench is greater than the width and the width is not greater than 15 feet.

According to the NIOSH Fatality Assessment and Control Evaluation (FACE) Program, trenching and excavation hazards resulted in at least 542 construction fatalities from 1992 – 2001, or an average of over 54 deaths annually. Although cave-ins account for the majority of the fatalities (76% of the total according to the FACE Program), other causes include falls, struck-by, caught in, electrocution, drowning, and asphyxiation incidents. In addition, excavation and trenching hazards are prevalent causes of nonfatal lost time injuries in construction. Fatalities and severe injuries to construction workers are not the only concerns during excavation and trenching projects. A poorly planned excavation or trench can also result in significant property damage if an underground utility line is struck. Damage to an underground utility (i.e. electricity, water, sewage, natural gas, oil, telecommunications, cable, etc.) can cause significant damage, disrupt service, and may adversely affect the environment or the safety of the public.

According to *Dig Safely*, (http://www.digsafely.com/about.htm) a national campaign to address damage prevention to underground utilities administered by DOT's (Department of Transportation) Office of Pipeline Safety, utility strikes during excavation and trenching operations are the leading cause of service disruption to the nation's underground facilities. Excavation and trenching projects also may create a public safety and/or "attractive nuisance" exposure, which must be addressed. An unattended open trench or excavation is an invitation for disaster. Many states have public safety statutes that are designed to protect non-workers from trenching and excavation hazards

Develop an Excavation/Trenching Program

Construction employers should

- Preplan all excavation or trenching work
- Provide appropriate protective systems
- Ensure sufficient means of egress
- Include provisions for pre-inspection and continuous monitoring
- Control mobile equipment and vehicular traffic
- Provide employee training

With certain exceptions, OSHA Standard 1926.652 requires that employees be protected from cave-ins by an adequate protective system (refer to http://www.osha.gov/ for more information).

Preplanning

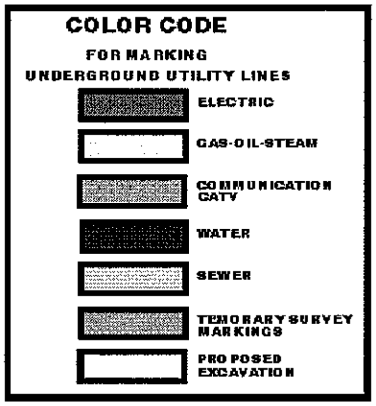
Preplanning an excavation or trenching project is necessary to ensure that workers are protected, utility lines are not struck, and the general public is protected. Planning should begin during the bidding process and should specifically identify the route of excavation, depths of cuts, protective system(s) to be used, means of egress, equipment use, location of underground utilities, traffic control, communication, and rescue provisions. Responsibilities for safety and health should be clearly identified before any project begins. Management should designate who will act as the "competent person" at each construction site. A competent person is one who is capable of identifying hazards in the workplace and who has the authority to take prompt corrective measures to eliminate them.

Notify Utility Companies

OSHA Standard 1926.651 and state laws require the notification of utility companies prior to digging. The National One-Call Directory provides the utility locators in each state; the directory can be found at http://www.digsafely.com. The excavator requests the location of underground utilities at a given site by notifying the appropriate utility company through the one-call system. The excavator receives and maintains a reference number from the one-call center that documents the request. The excavator is then notified by the appropriate utility company that a "no conflict" situation exists (negative response) or the tolerance zone of the underground utility is marked or flagged (positive response). Many states require the excavator to mark the route of excavation (commonly referred to as "white-lining") with white paint, flags, or stakes before the locator arrives at the site and/or participate in a pre-excavation meeting with the locator.

Utility companies, or contracted locators, utilize standard color-coding to identify the type of underground line as listed in figure 1. A proactive approach for excavators is to document utility markings using dated pictures, videos, or sketches with distance from markings to fixed objects recorded. If locate markings are adequately documented before excavation work begins, the excavator will be more successful resolving disputes if an underground line is damaged due to improper marking, failure to mark, or markings that have been moved, removed, or covered. This simple added step of documenting utility markings may help avoid unnecessary litigation and expensive legal fees for the excavator.

Another method to document or verify underground utilities is the use of portable mapping or locating equipment such as GPS (global positioning system), metal detectors, MF (magnetic field) detectors, acoustic detectors, and GPR (ground penetrating radar) detectors. Each of these devices has advantages and disadvantages associated with their use dependent upon the type of utility line (i.e. metallic vs. plastic pipe), depth of utility, and soil conditions. Always follow the manufacturer's recommendations regarding calibration, set-up, use, and results interpretations of any mapping or locating device.



- **Red - Electric**
- **Yellow - Gas, Oil, Steam**
- **Orange - Communication: Telephone, Fiber Optics, CATV, etc.**
- **Blue - Water**
- **Green - Sewer**
- **Pink - Temporary Survey Markings**
- **White - Proposed Excavation**

Figure 1: Color Code of Underground Utilities

Excavation Failure

When an excavation is cut, the system is disturbed and no longer stable. The combination of tension in the ground surface and shear stress causes cracks to form beyond the edge of the excavation. When cracks develop, the weight of the soil in the excavation wall causes great stress to the lower portion of the excavation wall. Since there is no lateral stress to prevent the failure, the bottom of the excavation fails, or "kicks", into the excavation and the failure begins. An excavation may fail from the top, in the middle (referred to as bulging), and/or at the bottom. Other external factors, besides the excavation itself, often contribute to the cave-in. External factors include water flow (precipitation, flooding, surface runoff), wind, freezing and thawing, vibrations from construction equipment and/or vehicular traffic, loads from spoil banks along the excavation edge, and excavating in previously disturbed soils.

Soil is a mixture of rock, water, air and trace amounts of other substances (i.e. organic material such as peat, roots, and other plant matter). Soil can be composed of various sized particles such as clay, silt, sand, gravel, and stone. The amount of water filling the air spaces in soil determines its percent of saturation. Engineering properties of soil vary based on particle size, shape, texture, and composition. In addition, soil properties will vary along the length and depth of an excavation. Undisturbed soil is usually made up of many layers of various compositions and is considered to be in equilibrium and is perfectly stable.

The average untrained laborer does not understand the danger of an excavation failure. Saturated soil weighs approximately 114 lbs per cubic foot, which equates to approximately 3,078 pounds per cubic yard, or a little over 1½ tons; roughly the weight of a small pick-up truck! An excavation failure will usually occur with no warning and will cause many yards of soil to fall in a matter of seconds. Statistics indicate that the majority of victims who are killed from excavation collapse will suffocate or be crushed by the soil around them.

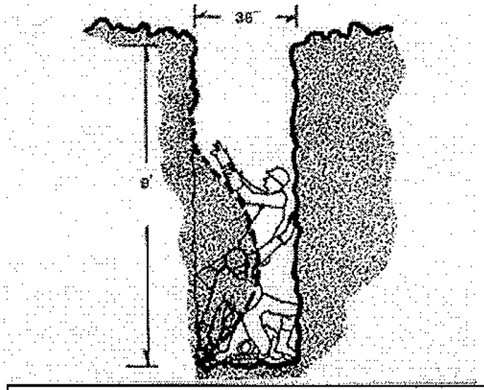


Figure 2: Diagram provided by the OSHA Office of Training & Education, Fatal Facts Summaries

Soil Classification

Soil classification of an excavation is one of the duties of the competent person. OSHA requires soil classification and testing in accordance with 1926 Subpart P, Appendix A. The classification of soil deposits must be made based on the results of at least one visual and at least one manual analysis. In a layered system, the system must be classified in accordance with its weakest layer. However, layers may be classified individually where a more stable layer lies under a less stable layer. Reclassification is required whenever conditions affecting its classification change in any way. OSHA 1926 Subpart P categorizes soil and rock as:

- **Stable Rock** – natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed. Examples include granite and sandstone.
- **Type A Soils** – cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (tsf) or greater. Examples include clay, silty clay, and clay loam.
- **Type B Soils** – cohesive soils with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf. Examples include angular gravel, silt, silt loam, and sandy loam.
- **Type C Soils** – cohesive soils with an unconfined compressive strength of 0.5 tsf or less. Examples include granular soils such as gravel, sand, and loamy sand, submerged soil, soil from which water is freely seeping, and submerged rock that is not stable.

Inspections

OSHA Standard 1926.651(k) requires inspection of excavations, the adjacent areas, and protective systems used. Inspections should be performed:

- Daily and before the start of each shift;
- As needed by the work being done;
- Following rainstorms;
- After other events that could increase hazards (i.e. snowstorm, windstorm, thaw, vehicle or equipment approaching the edge of an excavation);

- When fissures, tension cracks, sloughing, undercutting, water seepage, bulging at the bottom, or other similar conditions occur;
- When there is a change in the size, location, or placement of the spoil pile; and

When there is any indication of change or movement in adjacent structures. Inspections must be conducted by a competent person who:

- Has training in soil analysis;
- Has training in the use and limitations of protective systems;
- Is knowledgeable of the OSHA requirements; and
- Has authority to immediately eliminate hazards.

In order to properly document all inspections, records should be maintained. A sample excavation inspection guide, developed by OSHA, can be found at the following web-link.

http://www.osha.gov/SLTC/etools/construction/trenching/excavchec.html

Whenever an inspection reveals a condition that may lead to a possible cave-in, potential failure of a protective system, hazardous atmosphere, or any other hazardous condition, the competent person must immediately instruct the removal of all exposed employees from the excavation.

Egress

Inadequate access and egress to and from an excavation is the cause of many severe injuries from slips or falls and is one of the most commonly cited OSHA violations found at excavation projects. Proper access and egress is needed for normal entry and exit from the excavation as well as to facilitate a quick evacuation in the event of an emergency. Access/egress, in the form of stairways, ladders, or ramps, are required for all trenches or other excavations that are 4 feet or more in depth. Means of egress must be positioned within 25 feet of lateral travel for workers, thus two means of egress must not be positioned greater than 50 feet apart; see figure 3. All ladders must extend at least 36" above the landing. Metal ladders should be avoided, especially when electric utilities are present. Structural ramps used for access or egress from excavations must be designed by a competent person. Earthen ramps as a means of egress must be designed so a worker can walk them in an upright position. To protect employees from loose rock or soil falling or rolling from an excavation face, spoil and other equipment or materials must be kept at least 2 feet from the edge of excavations; see figure 4.

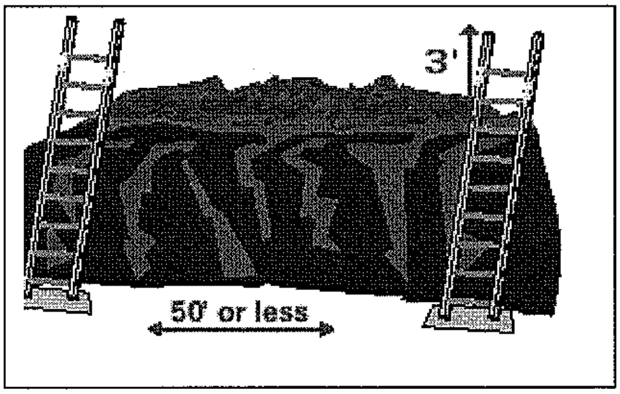


Figure 3

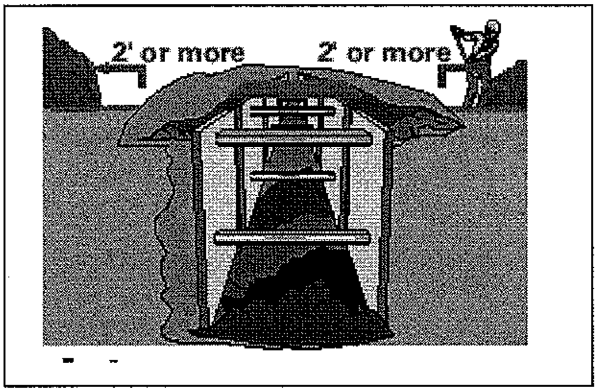


Figure 4

Surface Hazards

If surface hazards are not adequately controlled in the vicinity of an excavation, it may result in excavation failure. Mobile equipment must be kept away from an excavation edge by providing warning systems, erecting barricades, using equipment stop logs, and/or utilizing hand and mechanical signals. The vibration alone from mobile equipment can create an excavation failure. Soil should be graded away from an excavation to assist in vehicle control as well as help channel run-off water. Employees are not allowed to work under raised loads and must be instructed to stand away from equipment that is being loaded or unloaded. If vehicular traffic is nearby, employees must be provided with and required to wear reflective vests or other suitable garments marked with or made of reflectorized or high-visibility materials. In addition, trained flag persons, signs, signals, and barricades should be provided.

Surface crossing of trenches should be avoided unless absolutely necessary (i.e. no alternative access). However, if necessary, such crossings are permitted under the following conditions:

- Vehicle crossings must be designed by and installed under the supervision of a registered professional engineer.
- Walkways or bridges must be provided for foot traffic and:
  - Have a safety factor of 4;
  - Have a minimum clear width of 20 inches;
  - Be fitted with standard guardrails; and
  - Extend a minimum of 24 inches past the surface edge of the trench.

Protective Systems

OSHA Standard 1926.652 requires protective systems be used when an excavation is 5 feet or greater in depth (or less than 5 feet deep when conditions indicate a potential for cave-in); the exception being excavations made entirely in stable rock. Protective systems used in excavations with a depth of 20 feet or greater must be approved by a licensed professional engineer. Designing and/or selecting the appropriate protective system(s) for a project are one of the roles of the competent person. Factors that must be considered in choosing an appropriate system include soil classification, depth of cut, water content of soil, changes due to weather and climate, space limitations, and other operations in the vicinity. Protective systems are commonly categorized as:

- Sloping and Benching
- Shoring
- Shielding
- Engineered Design

Sloping and Benching

Sloping removes soil to an extent to maintain its stability, keeping forces in equilibrium, thus preventing it from caving under its own weight. Benching is similar to sloping except the sides of the excavation form a stair-stepping design. Both sloping and benching require a significant amount of space since the face of the excavation is cut back to an acceptable slope angle. Table 1 outlines the maximum slopes for each soil type when sloping or benching is used.

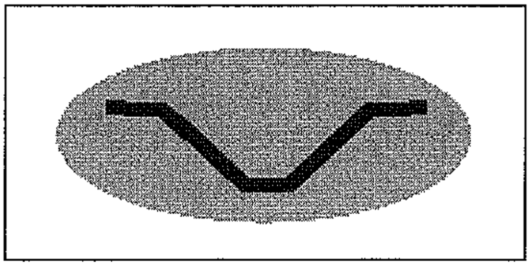


Figure 5 Sloping

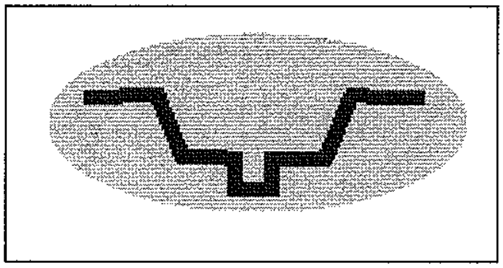


Figure 6 Benching

Table 1 Maximum Allowable Slopes

Soil or Rock Type	Maximum Allowable Slopes (H: V) for Excavations less than 20' deep
Stable Rock	Vertical (90°)
Type A Soil	0.75: 1 (53°)
Type B Soil	1: 1 (45°)
Type C Soil	1.5: 1 (34°)

When soil classification is not conducted the excavation walls should be sloped for type C soil (34° angle or less) unless written tabulated sloping/benching data is used or the system was designed by a registered professional engineer.

Shoring

Shoring excavated walls provides support to prevent soil movement. This type of protective system is used when the location or depth of cut makes sloping back to the maximum allowable slope impractical. Shoring systems consist of posts, wales, struts, and sheeting. They may run vertically or horizontally as in a waler system. Traditional timber shoring has generally been replaced with the lighter, easier to handle, aluminum hydraulic or pneumatic shoring. Pneumatic shoring works in a manner similar to hydraulic shoring but it uses air pressure instead of hydraulic pressure; thus an air compressor must be available on-site to use pneumatic shoring. The advantages of aluminum shoring include:

- Ease of use (light enough to be installed by one worker)
- Provides an even distribution of pressure along the excavation wall
- Can be adapted easily to various trench depths and widths
- Protective system of choice when obstructions (i.e. existing utility lines) traverse the trench

All types of shoring should be installed from the top down and removed from the bottom up. 1926 Subpart P Appendix C offers tabular data that can be used for installing timber shoring and Appendix D provides information for selection and installation of aluminum shoring.

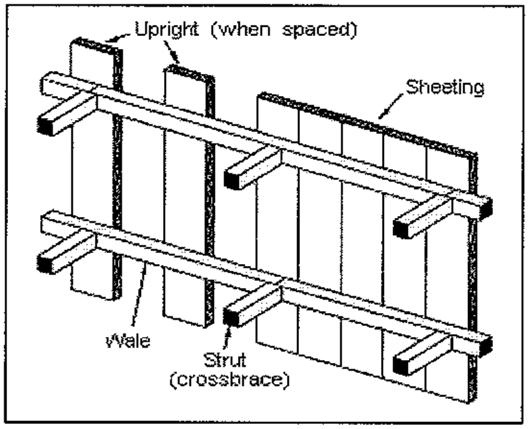
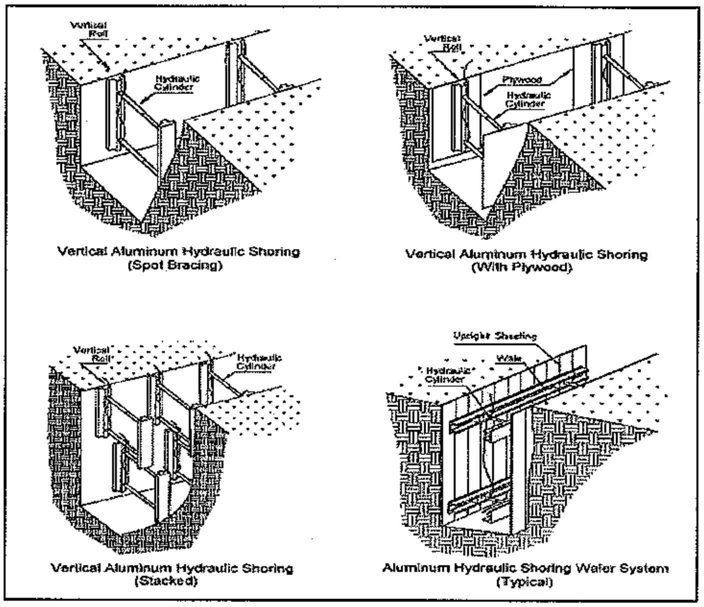


Figure 7 Timber Shoring



Vertical Aluminum Hydraulic Shoring (Spot Bracing)

Vertical Aluminum Hydraulic Shoring (With Plywood)

Vertical Aluminum Hydraulic Shoring (Stacked)

Aluminum Hydraulic Shoring Waler System (Typical)

Figure 8 Aluminum Hydraulic Shoring

Shielding

Shielding provides a safe work area within an excavation, even if the soil fails. Trench shields, commonly called trench boxes, do not prevent soil movement but are designed by manufacturers to be strong enough to withstand the lateral earth pressure from a failure. The excavated area between the outside of the trench box and the excavation face should be as small as possible. The competent person must ensure the trench box used is rated for the type of soil and depth of cut. Instruct employees to stand away from a trench box being set or removed, provide proper access/egress to and from the trench box, and prohibit employees from staying in the trench box when it is being moved vertically. Any structural modifications to the trench box must be approved by a licensed professional engineer. Trench boxes can be used alone, in series, stacked, or in combination with sloping and benching. The trench box must extend at least 18 inches above the surrounding area if there is sloping toward the excavation. Since OSHA 1926 Subpart P does not address trench shield design, contractors must rely upon data from the supplier or manufacturer.

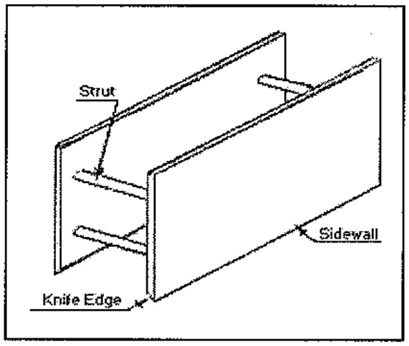


Figure 9 Trench Shield

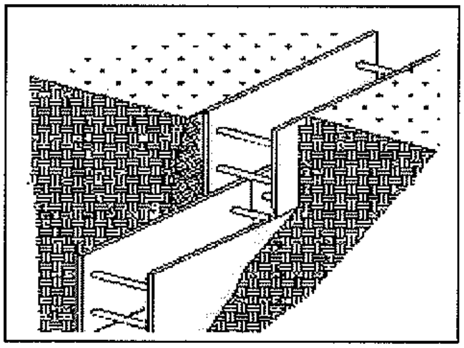


Figure 10 Trench Shields Stacked

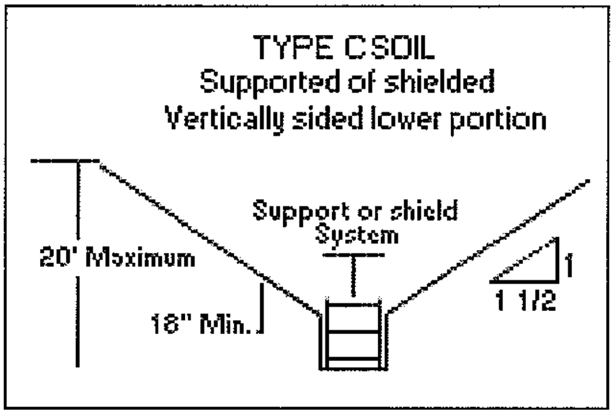


Figure 11 Trench Shield Used with Sloping

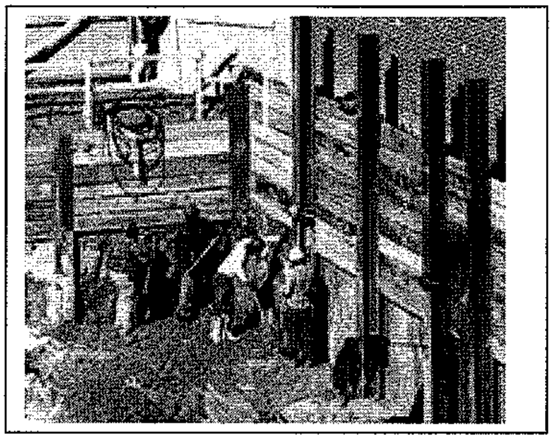


Figure 12 Installation of Soldier Pile System

Engineered Design System

Other protective systems not addressed in OSHA 1926 Subpart P are categorized as a site-specific engineered design system. Examples include steel sheet piling systems, soldier pile systems, screw jack systems, tie back systems, and rock bolting systems. The installation of a soldier pile system is illustrated in figure 12.

As previously mentioned, the competent person must choose the appropriate protective system(s) for a project. Although the protective system most often used is the trench shield, it should not be the only system considered. In the event a trench box is not practical (i.e. trench box is too large for the excavation, will not fit around existing utilities, the surface area doesn't allow enough space to set the trench box, etc.) a secondary system should be readily available to all excavation work crews. Aluminum hydraulic shoring is a very good selection for a secondary system since it is lightweight, portable, easy to install, and works well in confining spaces.

Water Accumulation

Surface water should always be diverted away from a trench and employees should not be allowed to work in excavations during a rainstorm or when there is accumulated water. Excavations must be carefully inspected by a competent person after each rainstorm before employees are permitted to re-enter. Whenever water removal equipment is needed, it must be monitored by a competent person.

Water is almost always damaging to an excavation and is the cause of many excavation failures. Water can alter the soil's weight, density, and lateral pressure by entering the air voids of the soil. Water also reduces soil's shear strength by decreasing its internal friction, disrupting the particle-to-particle attraction (cohesion) between clay particles, and may cause soil to expand. The dipolar nature of water allows it to travel upward against gravity by means of surface tension and capillary action to disrupt the cohesion of sand and silt particles. Surface water run-off quickly fills tension cracks exerting downward and lateral pressure that forces the cracks to become deeper and wider. Frozen soil will quickly lose its cohesion and shear strength when it starts to thaw. Since rain and other storm events can cause such devastating effects to an excavation, supervisors of an excavation project should stay updated on local weather forecasts.

Hazardous Atmospheres

Employees should not be permitted to work in hazardous and/or toxic atmospheres. Such atmospheres include those with:

- Less than 19.5% or more than 23.5% oxygen;
- A combustible gas concentration greater than 20% of the lower flammable limit; and
- Concentrations of hazardous substances that exceed those specified in the Threshold Limit Values for airborne contaminants established by the ACGIH® (American Conference of Governmental Industrial Hygienists).

Where oxygen deficiency or a hazardous atmosphere exists or could reasonably be expected to exist, OSHA requires the competent person to test the excavation before allowing employees to enter and to retest thereafter to ensure that the excavation remains safe. Conditions that may warrant atmospheric testing would be excavations made in a landfill area or if the excavation crossed, was adjacent to, or contained pipelines with a hazardous material (i.e. natural gas). Atmospheric testing may also be warranted if welding, cutting, burning, or painting is performed within the excavation or if equipment used within the excavation may produce byproduct emissions (i.e. carbon monoxide). Some trenches qualify as confined spaces. When this occurs, the OSHA Permit-Required Confined Space Standard would apply.

Rescue

Preplanning for rescue should be performed for all excavation projects even if the risk of excavation failure is minimized with the use of an appropriate protective system. Work related injuries such as a fall, struck-by, caught in, and electrocution, as well as non-occupational injuries (i.e. heart attack, seizure, etc.) may necessitate emergency rescue from an excavation. In addition, emergency rescue provisions are required for deep trenches or excavations in which a hazardous atmosphere may exist.

Rescue procedures to safely evacuate personnel from an excavation site should be included in the company's emergency action plan and should specify means of communication, emergency notification, rescue equipment, personnel training, and coordinating off-site emergency medical services. The competent person should ensure that each excavation site is readily accessible for rescue vehicles or preplan other means to transport injured personnel in the event of an emergency incident.

If an excavation failure partially buries a worker, never attempt to pull the person out using a rope, belt, sling, or chocker. Rescue attempts are typically performed by hand to avoid causing additional damage. Emergency rescue personnel must also be protected from excavation failure (i.e. with the use of aluminum shoring) since removing a partially buried victim often loosens surrounding soil creating another collapse. The competent person is responsible for ensuring that all emergency equipment and supplies are on-site and in good condition.

Training

The designated competent person on an excavation site must be trained, and have experience in soil analysis, use of appropriate protective systems, and OSHA 1926 Subpart P. In addition, the competent person must be able to detect:

- Conditions that could result in cave-ins;
- Failures, defects, and limitations of protective systems;
- Hazardous atmospheres; and
- Other hazards including those associated with confined spaces.

Remember, the competent person must also have the authority to take prompt corrective measures to eliminate existing and predictable hazards and to stop work when required.

Involving all employees associated with an excavation project is a critical component in keeping the jobsite safe. Emphasize specific rules and job responsibilities during regular training sessions. These rules may include requirements that workers:

- Remove or minimize all surface obstacles;
- Wear warning vests or other reflective or high-visibility clothing;
- Wear or use prescribed protective gear and equipment correctly;
- Operate equipment only after being properly trained;
- Stay alert for potential excavation failure and other worksite hazards; and
- Follow safe work practices.

Enforcement

A contractor's excavation/trenching program is only as good as its enforcement program. A program that mandates the use of protective systems is worthless without the means to enforce it. Many excavation fatalities occurred with contractors that had an established excavation/trenching program but a single shortcut or error in judgment resulted in a catastrophic event. If all employees and supervisors are not held accountable for safe excavation, then excavation failures will inevitably occur. Excuses such as "the trench box didn't fit", "we only had to access the trench for a very short time", or "it never collapsed before" should never be tolerated. A written disciplinary/enforcement policy specific for the use of excavation protective systems should be developed and implemented. The policy should be introduced to new employees during orientation training, clearly communicated to all employees on a regular basis, and enforced fairly amongst all employees and supervisors. Allowing exceptions to the enforcement policy will eventually lead to an ineffective program.

For More Information

For additional information specific to your need, please contact your Hartford loss control consultant, or visit us at http://www.thehartford.com/corporate/losscontrol/

The information provided in this document is of a general nature, based on certain assumptions, and is intended as background material. The contents of this document may omit certain details and cannot be regarded as advice that would be applicable to all businesses. The background presented is not a substitute for a thorough loss control survey of your business operations. Readers seeking resolution of specific safety issues or business concerns regarding this topic should consult a professional safety consultant. We do not warrant that the implementation of any view or recommendation contained herein will result in the elimination of any unsafe conditions at your business locations or with respect to your business operations. Further, we do not warrant that the implementation of any view or recommendation will result in compliance with the health, fire, or safety standards or codes of any local, state, or federal ordinance, regulation, statute or law. We assume no responsibility for the control or correction of hazards, and the views and recommendations contained herein shall not constitute our undertaking, on your behalf or for the benefit of others, to determine or warrant that your business locations or business operations are safe or healthful, or are in compliance with any law, rule or regulation. Accordingly The Hartford disclaims any liability for loss, damage or injury to you, your employees, invitees, or any third parties, as a result of any views or recommendations expressed herein.

APPENDIX H

BIOLOGICAL HAZARDS

I. ENDEMIC HAZARDS

Personnel may come into contact with indigenous hazardous such as ticks, animals, and plants.

1.0 TICKS AND TICK-BORNE DISEASES

Field personnel should be aware of an increased occurrence of tick-borne disease in the United States. In the northeast, the most likely carriers are the white-footed mouse and the white-tailed deer. These animals are most prevalent in areas where suburban environments abut open fields or woodlands. Although exposure is increased in these areas, other carriers, such as dogs and horses, can be found in a variety of environments.

Lyme disease, which is caused by bites from deer ticks and lone star ticks which have become infected with spirochetes, is becoming more common. These ticks live in and near wooded areas, tall grass, and brush throughout the spring and summer. These ticks may be hard to see due to their size, which can range from about the size of a comma at the larval stage to about one-quarter inch for an adult tick.

Protective measures to be taken to prevent or minimize tick bites include the use of standard field gear (work boots, long pants, socks), spraying clothing (not skin) with insect repellant containing permethrin, and covering clothing openings with tape. Contact with bushes and weeds should be avoided as much as possible, and a check for ticks should be conducted frequently. Wearing light-colored clothing helps in checking for ticks.

Not all ticks carry spirochete diseases, and being bitten does not necessarily mean the individual will become infected. In general, a tick must be attached for at least 24 hours to pass along the infecting bacteria, so prompt tick removal will cut down the chances of becoming infected. If a tick has been found embedded in the skin, it should be gently removed taking care to remove the whole tick. Once removed, the tick should be placed in a Ziplock bag to keep, in case of the onset of Lyme disease symptoms. The bite area should be checked for several days for a rash that looks like a bulls-eye or a red circle surrounding a light area, or other symptoms such as flu-like chills, fever, headache, dizziness, fatigue, stiff neck, or bone pain. A physician should be visited for an examination if such symptoms occur.

2.0 ANIMALS

Animals represent hazards because of their poisons or venoms, size and aggressiveness, diseases transmitted, or the insects they may carry.

Poisonous snakes are common across the U.S. The major variables are the likelihood of encounter and the snake likely to be encountered. Encounters with snakes may be caused by moving containers, reaching into holes, or just walking through high grass, swampy areas, or rocks.

Key factors to working safely include being alert, using care when reaching into or moving containers, and being familiar with the habits and habitats of snakes in the vicinity of an incident or site. A snake bite warrants medical attention after administration of proper first aid procedures.

Landfills and abandoned buildings often attract stray or abandoned dogs. These animals often become pack oriented, very aggressive, and represent serious risk of harm to unprotected workers.

Animal-borne diseases include rabies (generally found in dogs, skunks, raccoons, bats, and foxes). Rabies varies from area to area as do the animals most likely to be rabid. Rabies is a viral infection most often transmitted by bites of animals infected with the virus.

Rabies infection is not always apparent. Signs to look for in wild animals are over aggressiveness or passivity. Spotting animals which are normally nocturnal (active at night) during the day and being able to approach them would be an example of unusual behavior. Finding a bat alive and on the ground is abnormal. The best precaution, however, is to observe wild animals from a safe distance, even if they are injured. Avoid dogs and cats that you do not know.

If bitten by an animal suspected to be infected with rabies, as quickly as possible, wash the bite area with soap and water, then disinfect with 70% alcohol and seek medical attention for follow-up. Try to capture the animal. Avoid being bitten again or contacting the mouth or any saliva of the animal. Keep the animal under surveillance and call the police for assistance to capture it. Have the animal tested. A dead animal believed to be infected should be preserved and tested for rabies. Health departments are often sources where information can be found regarding testing.

Rabies is preventable, even after being bitten, if treatment is begun soon enough. Getting prompt medical attention and confirming the rabies infection of an animal are very important. Rabies is not curable once symptoms or signs of rabies appear.

3.0 PLANTS

Toxic effects from plants are generally caused by ingestion of nuts, fruits, or leaves. Response personnel should also be concerned with plants like poison ivy, poison oak, and poison sumac that produce adverse effects from direct contact. The usual effect is dermatitis or inflammation of the skin. The protective clothing and decontamination procedures used for chemicals also reduce the exposure risk from the plant toxins. Risk can be reduced by cleaning the skin thoroughly with soap and water after contact.

II. BLOOD-BORNE PATHOGENS

1.0 EXPOSURE CONTROL

Personnel are not expected to have direct exposure to blood-borne pathogens except when conducting first aid treatment or assisting during medical emergencies. First aid-trained employees must take adequate protective measures before administering first aid. All employees with potential exposure are eligible to receive the Hepatitis B vaccine as part of the annual physical evaluation or as needed. Employees have the right to refuse the vaccine but must sign a form included as Appendix A in this section. All employees are required to observe "Universal Precautions" and assume that all human body fluids are potentially infected with blood-borne pathogens. All first aid kits are equipped with latex gloves to be used while administering first aid. Eye protection should also be worn and any material or items that comes in contact with blood or other body fluids should be assumed contaminated regardless of the amount of PPE worn or used.

1.1 Exposure Determination

Exposure to blood-borne pathogens will most likely occur during the administration of first aid, responding to injured employees or working in client areas regulated by the blood-borne pathogen standard. Personnel with potential exposure to blood-borne pathogens regardless of the types of protective equipment worn include:

Project Managers
Site Health and Safety Officers
First aid trained employees
Health and Safety Personnel

2.0 TRAINING

All covered employees are required to be trained prior to assignment and at least annually thereafter. Client areas with biological hazards should be labeled with the Biohazard Symbol, that includes the name of the infectious agent, special requirements for entering the area and telephone number of the person responsible for the area. Personnel are required to adhere to client requirements when entering these areas. First aid training provided by the American Red Cross provides information on blood-borne pathogens and protection during the application of first aid to victims. Blood-borne pathogens are microorganisms carried by human blood (and other body fluids) and cannot be seen with the naked eye. They can be spread through contact with infected blood. If they get into the bloodstream, an individual may become infected and sick.

Most personnel cannot reasonably anticipate coming into contact with blood during their day-to-day work duties. That's why it's imperative that all personnel understand the danger of exposure to blood-borne pathogens and ways to minimize their risk.

Blood-borne pathogens may be present in blood and other materials, such as:

a. Body fluids containing visible blood
b. Semen and vaginal secretions
c. Torn or loose skin

Blood-borne pathogens can cause infection by entering the body through:

a. Open cuts and nicks
b. Skin abrasions
c. Dermatitis
d. Acne
e. Mucous membranes of the mouth, eyes or nose

All materials including samples, first aid supplies, surfaces and waste that has come into contact with human body fluids is considered infectious and is to be treated accordingly. Waste materials are to be place in a red bag labeled with the Biohazard Symbol:

BIOHAZARD

note: Biohazard labels are fluorescent orange or red and have the symbol in a contrasting color.

2.1 Training Records

Records of all employees receiving blood-borne pathogen training will be maintained at designated location within each contracted company. These records will include the dates of the training, content of the training class, job titles and names of the persons attending. Records will be maintained for at least three years.

2.2 Medical Records

All occupational medical records are maintained in confidence by a party designated by each contracted company. Written consent from the employee must be obtained before records can be released to the contracted company or through an agency request.

3.0 WORKPLACE TRANSMISSION

The most common blood-borne pathogens are HIV, Hepatitis B, and Hepatitis C. All of these pathogens are transmitted by contaminated human blood. A brief summary of each pathogen is included below.

3.1 HIV (AIDS)

HIV, the human immuno-deficiency virus, attacks the body's immune system causing it to weaken and become vulnerable to infections that can lead to a diagnosis of acquired immune deficiency syndrome or AIDS.

HIV is transmitted mainly through sexual contact and sharing contaminated needles, but also may be spread by contact with infected blood and body fluids. HIV is NOT transmitted indirectly by touching or working around people who are HIV-positive.

Employees can prevent getting HIV by stopping the passage of the virus from a person who has HIV to them. In many instances, the employee has control over the activities that can transmit HIV. Since HIV is most frequently transmitted by sharing needles or through sexual intercourse, employees can stop transmission by refusing to engage in these behaviors.

The most common blood-borne pathogens are HIV, Hepatitis B, and Hepatitis C:

3.2 HEPATITIS B

Hepatitis is a general term used to describe inflammation (swelling) of the liver. Alcohol, certain chemicals or drugs, and viruses such as hepatitis A, B, C, D, E and G may cause hepatitis.

a. Hepatitis B is a serious, sometimes fatal disease, caused by a virus that infects and attacks the liver. The virus is transmitted through direct contact with infected blood, semen, or vaginal fluid. It is primarily spread through sexual contact.

b. In studies that examine transmission following injections into the skin, HBV is 100 times more contagious than HIV.

c. **HBV can also be transmitted indirectly because it can survive on surfaces dried and at room temperature for at least a week!** That's why contaminated surfaces are a major factor in the spread of HBV.

d. Each year there are up to 200,000 new infections and 5,000 hepatitis B related deaths in the U.S. (compared to 40,000 new HIV infections per year.

- One in approximately 20 persons now has, or will one day have, hepatitis B
- Transmission of hepatitis B is preventable:
- Use latex condoms during sex
- Do not share needles
- Use universal precautions in the workplace
- Get the hepatitis B vaccination

HAZARDS OF TRENCHES, TEST PITS AND EXCAVATIONS

Many of the on-site activities conducted during environmental assessment and remediations involve excavation and trenching operations.

These include;

- * exploratory test pits
- * underground storage tank excavation
- * drum and soil removal
- * settling basin removal
- * remediation system construction

OSHA Standard 1926.650 provides the minimum safe practices applied to all open excavation in the earth's surface to protect workers from cave-in and hazardous atmospheres. The following provides a brief overview of the OSHA standard.

Key Definitions:

Benching means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps.

3.3 HEPATITIS C

Hepatitis is a general term used to describe inflammation (swelling) of the liver. Alcohol, certain chemicals or drugs, and viruses such as hepatitis A, B, C, D, E and G may cause hepatitis.

a. Hepatitis C is a serious, often fatal disease, caused by a virus that infects and attacks the liver. HCV is more common than hepatitis B and ranks slightly below alcoholism as a cause of liver disease.

b. However, HCV is not as infectious as HBV because there are generally lower levels of the hepatitis C virus in the blood than of the hepatitis B virus

c. HCV is primarily transmitted through blood-to-blood contact -- most commonly through shared needles. The risk of transmitting HCV through sexual contact appears to be low, but precautions should be taken anyway. HCV cannot be transmitted by casual contact such as shaking hands or sharing bathroom facilities.

d. Up to 180,000 people may become infected with HCV each year in the U.S.

e. Transmission of hepatitis C is preventable:

- Use latex condoms during sex
- Do not share needles
- Use universal precautions in the workplace

Unlike hepatitis B, currently there is NO VACCINE for hepatitis C. And also unlike HBV, there is no drug to prevent HCV infection after an exposure.

4.0 GUIDELINES FOR HANDLING BLOOD AND OTHER BODILY FLUIDS

Many personnel are concerned that HIV may be spread through contact with blood and other body fluids when an accident occurs at work.

HIV, as noted earlier, has been found in significant concentrations in blood, semen, vaginal secretions, and breast milk. Other body fluids, such as feces, urine, vomit, nasal secretions, tears, sputum, sweat, and saliva do not transmit HIV unless they contain visible blood. However, these body fluids do contain potentially infectious germs from diseases other than AIDS. **If an individual has contact with any of these body fluids, they are at risk of infection**. It should be remembered that the risk of transmission of these germs depends on many factors, including the type of fluid contacted, the type of contact made, and the duration of the contact.

Very simply, it is good hygiene policy to treat all spills of body fluids as ***infectious*** in order to protect personnel from becoming infected with any germs and viruses. The procedures outlined below offer protection from all types of infection, and should be followed routinely.

4.1 Engineering Controls

Generally it is impracticable to utilize engineering controls for routine first aid and emergency response. First Aid kits are to be equipped with one-way valve airway devices to reduce direct mouth to mouth contact with a victim while administering CPR.

5.0 WORK PRACTICE CONTROLS

Whenever possible, employees shall wear disposable, waterproof gloves and eye protection when they expect to come into direct hand contact with body fluids (when administering first aid, treating bloody noses, handling clothes soiled by incontinence, or cleaning small spills by hand). Gloves used for this purpose shall be put in a red plastic bag or lined trashcan, secured, and disposed of daily. Hands should always be washed after gloves are removed, even if the gloves appear to be intact.

Tyvek suits are available to cover employees clothing when necessary.

Contaminated materials and clothing should be removed and placed in the red biohazard bag for disposal

After administering first aid treatment the area with visible evidence of spillage should be cleaned using a disinfecting chlorine solution and rinsed until no visible traces remain

5.1 Unexpected Exposure

If an employee has unexpected contact with body fluids or if gloves are not available (for example, applying pressure to a bleeding wound), the employee shall wash their hands and other affected skin for at least 10 seconds with soap and water after the direct contact has ended. This precaution is recommended to prevent exposure to other pathogens, not just HIV. As has been discussed, blood, semen, vaginal secretions, and blood-contaminated body fluids transmit HIV. Wiping a runny nose, saliva, or vomit is not believed tot pose a risk for HIV transmission. All exposure incidents are to be reported to the Health and Safety Office as soon as possible. Employees may obtain a follow-up examination at no cost to the employee. The exam will be conducted confidentially and include: Exposure documentation, baseline blood screening and a confidential post-evaluation report within 15 days of the evaluation. Testing will only be performed with the employee's written consent. Copies of the results will be provided to the tested employee.

6.0 HANDWASHING

Proper handwashing requires the use of soap and warm water and vigorous washing under a stream of running water for at least 10 seconds. If hands remain visibly soiled, more washing is required. Scrubbing hands with soap will suspend easily removable soil and microorganisms, allowing them to be washed off. Running water is necessary to carry away dirt and debris. Rinse your hands under running water and dry them thoroughly with paper towels or a blow dryer. When hand-washing facilities are not available, use a waterless antiseptic cleanser, following the manufacturer's directions for use.

7.0 DISINFECTANTS

An EPA approved germicide or a solution of 99 parts water to 1 part household bleach (or ¼ cup bleach to one gallon of water) will inactivate HIV, and should be used to clean all body fluid spills. Higher concentrations of bleach can be corrosive, and are unnecessary. Surfaces should be cleaned thoroughly prior to disinfection.

8.0 DISINFECTING HARD SURFACES AND CARING FOR EQUIPMENT

Although hard surfaces have not been found to be a means of transmitting HIV, it is good hygiene policy to clean any soiled hard surfaces thoroughly. To do this, scrub the surface to remove any soil and apply a germicide (like the bleach/water solution described above) to the equipment used. Mops should be soaked in this solution after use and rinsed thoroughly with warm water. The solution should be promptly disposed of down a drainpipe. Remove gloves and discard them in appropriate receptacles, and wash hands as described above.

9.0 LAUNDRY INSTRUCTIONS FOR CLOTHING SOILED WITH BODY FLUIDS

It is important to remember that laundry has never been implicated in the transmission of HIV. To ensure safety from transmission of other germs, contaminated clothes must be laundered with soap and water to eliminate potentially infectious agents. The addition of bleach will further reduce the number of potentially infectious agents. Clothing soaked with body fluids may be washed separately from other items. Pre-soaking may be required for heavily soiled clothing. Otherwise, wash and dry as usual, following the directions provided by the manufacturer of the laundry detergent. If the material can be bleached, add ½ cup of household bleach to the wash cycle. If the material is not colorfast, add ½ cup of non-chlorine bleach to the wash cycle.

10. IT IS GOOD HYGIENE TO TREAT ALL BODILY FLUIDS AS INFECTIOUS.

All employees with direct exposure will be trained and records of the training maintained. Medical records will be kept by a party designated by each contracted company. Training records will be maintained at a designated location within each contracted company.

Appendix G

I ____________________understand that due to my occupational exposure to blood or other potentially infectious materials I may be at risk of acquiring hepatitis B virus (HBV) infection. I have been given the opportunity to be vaccinated with hepatitis B vaccine at no charge to myself, However, I decline the hepatitis B vaccination at this time. I understand that by declining this vaccine I continue to be at risk of acquiring hepatitis B, a serious illness. If in the future I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with the hepatitis B vaccine I can receive the vaccine at no charge.

Signed ____

Date________________________________

APPENDIX I

DUST EXPOSURE CALCULATION WORKSHEET

DUST EXPOSURE CALCULATION WORKSHEET

South Bay III

Safety Factor for this site = 4

Chemical	Exposure Limit (mg/m3)	Maximum Soil Concentration (mg/kg)	Exposure Limit Based on Single Compound (EL Mix, mg/m3)	Dust Quotient for Each Compound (level/limit)	Problem from Single Compound [5mg/m3)/ELmix]
Aluminum	5	1.E-9	1.25E+15	2.00E-10	0.000
Antimony	0.5	161	776.4	3.22E+02	0.006
Arsenic	0.01	21	119.05	2.10E+03	0.042
Barium	0.5	1.E-9	1.25E+14	2.00E-09	0.000
Beryllium	0.002	1.E-9	5.E+11	5.00E-07	0.000
Cadmium	0.005	5	250.	1.00E+03	0.020
Chlordane	1	1.E-9	2.5E+14	1.00E-09	0.000
Chromium	0.5	64	1,953.13	1.28E+02	0.003
Chrome (hex)	0.01	63	39.68	6.30E+03	0.126
Cobalt	0.02	1.E-9	5.E+12	5.00E-08	0.000
Copper	1	620	403.23	6.20E+02	0.012
Cyanides	5	1.E-9	1.25E+15	2.00E-10	0.000
Endosulfan	0.1	1.E-9	2.5E+13	1.00E-08	0.000
Fluorides	2.5	1.E-9	6.25E+14	4.00E-10	0.000
Lead	0.05	250	50.	5.00E+03	0.100
Manganese	1	1.E-9	2.5E+14	1.00E-09	0.000
Mercury	0.05	62	201.61	1.24E+03	0.025
Nickel	1	50	5,000.	5.00E+01	0.001
Oil Mist	5	1.E-9	1.25E+15	2.00E-10	0.000
PCBs	0.5	1.E-9	1.25E+14	2.00E-09	0.000
PNAs	0.2	2,542	19.67	1.27E+04	0.254
Phthalates	5	1.E-9	1.25E+15	2.00E-10	0.000
RDX	1.5	1.E-9	3.75E+14	6.67E-10	0.000
Selenium	0.2	1.E-9	5.E+13	5.00E-09	0.000
Silica	0.05	1.E-9	1.25E+13	2.00E-08	0.000
Silver	0.01	1.E-9	2.5E+12	1.00E-07	0.000
Thallium	0.1	1	5.E+4	5.00E+00	0.000
Tin	2	1.E-9	5.E+14	5.00E-10	0.000
Titanium	10	1.E-9	2.5E+15	1.00E-10	0.000
Trinitrobenzene	0.07	1.E-9	1.75E+13	1.43E-08	0.000
Trinitrotoluene	0.5	1.E-9	1.25E+14	2.00E-09	0.000
Vanadium	0.05	1.E-9	1.25E+13	2.00E-08	0.000
Zinc	5	450	2,777.78	9.00E+01	0.002
			Sum	2.96E+04	
Dust Exposure Level at Mixture PEL =			8.456		0.591

EQUATIONS USED IN THIS CALCULATION

Dust action level =
(For one dust)

$$\frac{(1E+6)(\text{Exposure Limit mg/m3})}{(\text{Concentration mg/kg})(\text{Safety Factor})}$$

Dust action level =
(For mixed dusts)

$$\frac{(1E+6)\ /\ (\text{Safety Factor})}{\text{Sum of }[(\text{Concentration mg/kg})\ /\ (\text{Exposure Limit})]}$$

Spreadsheet: Dustlevl.xls

Author: Chris Marlowe
908 / 225 - 7000

Name of Site

Radionuclide	Airborne Limit (pCi/l)	Maximum Soil Concentration (pCi/g)	Action Level f. Single Compound (mg/m3)	Quotient for Each Compound (level/limit)	Problem from Single Compound [5mg/m3)/ELmix]
Americium-241	0.003	0.00	7.5E+11	3.33E-07	0.000
Carbon --- 14	1000	0.00	2.5E+17	1.00E-12	0.000
Cesium -- 137	60	1,300,000.00	1.2E+01	2.17E+04	0.433
Cobalt --- 60	10	100.00	2.5E+04	1.00E+01	0.000
Iodine -- 131	20	0.00	5.0E+15	5.00E-11	0.000
Lead -- 210	0.1	0.00	2.5E+13	1.00E-08	0.000
Lead -- 212	10	0.00	2.5E+15	1.00E-10	0.000
Manganese--54	300	1.00	7.5E+07	3.33E-03	0.000
Molybdenum-99	1000	0.00	2.5E+17	1.00E-12	0.000
Phosphorus-32	200	0.00	5.0E+16	5.00E-12	0.000
Plutonium-238	0.003	1.00	7.5E+02	3.33E+02	0.007
Plutonium-239	0.003	600.00	1.3E+00	2.00E+05	4.000
Polonium--210	0.3	0.00	7.5E+13	3.33E-09	0.000
Potassium--40	200	11,000.00	4.5E+03	5.50E+01	0.001
Radium -- 226	0.3	15,000.00	5.0E+00	5.00E+04	1.000
Radium -- 228	0.5	0.00	1.3E+14	2.00E-09	0.000
Sodium --- 22	300	0.00	7.5E+16	3.33E-12	0.000
Strontium- 90	8	95,000.00	2.1E+01	1.19E+04	0.238
Technetium-99	300	0.00	7.5E+16	3.33E-12	0.000
Tellurium-132	90	0.00	2.3E+16	1.11E-11	0.000
Thorium - 230	0.003	0.00	7.5E+11	3.33E-07	0.000
Thorium - 232	0.003	0.00	7.5E+11	3.33E-07	0.000
Tritium - H3	20000	6.00	8.3E+08	3.00E-04	0.000
Uranium - 234	0.02	0.00	5.0E+12	5.00E-08	0.000
Uranium - 235	0.02	1.00	5.0E+03	5.00E+01	0.001
Uranium - 238	0.02	1.00	5.0E+03	5.00E+01	0.001
Yttrium -- 91	300	95,000.00	7.9E+02	3.17E+02	0.006
Zirconium- 95	50	0.00	1.3E+16	2.00E-11	0.000
			Sum	2.84E+05	
sure Level at PEL for Mixture =				0.87917755	

APPENDIX J

NJ/NY SURVEY PROCEDURES

NJ/NY EXPANSION PROJECT
SURVEY PROCEDURES
December, 2009

SAFETY

Safety of field crews and the general public is of utmost importance in completion of the various surveys required for the project. Please conduct all activities in a safe, responsible manner.

GENERAL

- The NJ/NY Expansion Project pipelines are in *very congested and densely* populated areas. When working in these urban areas, *do not leave survey equipment unattended, keep your vehicle locked when you are away from it and always keep your co workers in sight.*

- *Use common sense*. Avoid hazardous situations. No horseplay or fooling around.

- *Be a Buddy…Work in pairs* – do not separate from your work partner, unless an injury necessitates separation.

- Use/share your instincts regarding questionable situations. Go with your gut feelings, hesitations, and apprehensions. Create a pre-arranged distress signal within your group.

- *Have an outside contact knowing your whereabouts*. Contact someone before/after entering the field. Make mid-day contact if possible and if field conditions justify, an extra contact. This is especially important in more remote areas along the project route.

- *Bring cellular phone* or walkie-talkie into the field. If phone access is not available in the field, keep the phone in the vehicle located closest to field activities. *Keep phone numbers for emergency medical assistance with your cellular phone, as well as the appropriate Texas Eastern contacts*. If a helicopter medical evacuation service is available for the area, also keep that number with your cellular phone. (SEE ENCLOSURE OF PHONE LISTS.)

- Survey party chief is responsible to insure that all personnel have been transported off the Right-of-Way at the end of the day.

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- *Bring water and food into field*. Remember that during hot weather, as much as 1 gallon of water will need to be replaced.

- *Remember that all trash* needs to be stored and hauled out at the end of each day. Do not leave any refuse on the Right-of-Way.

- *Step carefully*. Always watch where feet are going, not your toes. One false step is *all it takes for a sprain or break to occur*. Also, be on the lookout for insect or animal nests.

- When *working off of a defined path, bring a compass or GPS unit into the field*. Include compass readings in your notes. Bring a topographical map of the area also.

- *Have a first aid kit available*. The first aid kit should be adequate for dealing with injuries that may occur in the field. *If an injured person must be left behind, leave them lying down on their side. This position will minimize the chances of their airway getting blocked off.*

WHAT TO WEAR

- *Work apparel shall consist of sturdy work shoes or boots, long pants or jeans in relatively good repair, and shirts with sleeves (no vulgar messages).* Please remember that you are representing Texas Eastern to the public as well as accomplishing your assigned tasks.

- All *survey personnel must wear Spectra Energy Safety vests, hardhats and safety glasses* while working in the field on this project.

- The *field work* for this project will be accomplished *during the winter months*. Field personnel *must prepare for and dress appropriately for the cold temperatures.* In extremely cold temperatures, *take warm up breaks* in the survey vehicle. Bring *extra clothing into the field, such as a wool sweater or fleece jacket in case of cool weather or rain*. Also, have *extra clothing* in vehicle to change into so that you don’t have to travel in wet/sweaty clothing. .

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NATURE ISSUES

- Wear *insect repellant* when necessary.
- Check at the end of each day and preferably mid-day for ticks during the warmer months. Also wear long light-colored pants. The light color is for easier detection of ticks. Preferably, pants would be tucked into socks. That precaution is most necessary until the end of September.
- If bitten by a tick, pull gently but firmly to remove the tick. Try to save the tick in a container for a doctor to examine, if necessary. Be alert for any unusual symptoms after being bitten, such as a rash, fever, joint pain, and tenderness.
- *Leave field immediately if a storm is approaching*. If caught in the field during an electrical storm, do not walk in a way that makes you the target of lightning strike, i.e., do not walk in the open and do not find shelter under a lone tree or in a high spot.
- *Wear sunscreen* on exposed skin areas when conditions mandate.
- *Beware of wild animals* behaving in a strange or unusual manner.

DRIVING/ROADWAYS

- *Use extreme caution when exiting or entering a roadway*. Heavy traffic along many of the public roads in the area makes vehicle safety a prime consideration. Park well off the roadway or on Texas Eastern's Right-of-Way, if possible. ***Do not trespass***. *Use a spotter, if necessary, to safely leave or enter a roadway*.
- *Rotating* orange safety beacons *shall be mounted on all vehicles and used whenever the vehicle is parked on or near a street*. -
- *Drive defensively*; be aware of other drivers at all times. Be alert of drivers not paying attention due to cell phone use. .
- In New Jersey and New York using a *hand held cellular phone while driving is against the law.* This law has been strictly enforces. Pull to the side of the roadway and stop in a safe area before placing or receiving cellular calls.

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- *Be alert of the conditions* of country roads; pay attention to sharp curves; roads with no shoulder; or other local conditions affecting safety.

- Be aware of any local and state laws when driving in those areas. *As an example, in the States of New Jersey and New York, it is law that headlights must be on when windshield wipers are in use. Again, this law is strictly enforces. "Wipers on, lights on."* Ignorance of state and local laws is not an excuse when driving within their jurisdiction.

RAILROADS

- Work along the railroads can be especially hazardous since the trains make very little noise during their approach down the tracks. The following provisions shall apply when working along railways:

  1. *Survey may only be accomplished upon notice from right-of-way* that permission has been obtained, and flagman is present.
  2. The *safety vests **MUST** be worn at all times by all personnel* when work is in progress anywhere along this corridor.
  3. A *method of communication MUST be with each crew (i.e., walkie-talkie, cell phone or hand held radio*).
  4. Be certain that you have made notification to a responsible party of your work location and how long you will be working. Be certain that you notify that same person when your have finished for the day.
  5. *No vehicles should be parked on or near bridges*
  6. All personnel working at a railroad crossing must have *current rail road safety training*

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ACCESS

- Access to and from the Right-of-Way, or area to be surveyed, is done with the permission of the Landowner. *It is a privilege not always a right. Please respect the landowner's property and privacy*. Do not use any private road without specific authorization that has been received from the landowner and documented by the Right-of-Way Department.

- *The Project Chief Inspector and or the Survey Coordinator will prepare* a survey schedule based on the current Landowner Survey Restrictions and provide such to the Right-of-Way Agent as necessary for review and clearance on a daily bases. In addition they will provide a tentative look ahead schedule reflecting locations to be surveyed 4 days in advance.

- *Notice requirements;* 24, 48 or 72 hour or business hour (which excludes weekends) notice is required by many landowners PRIOR to entering their property. Some Landowners require that they be present during the survey. That means advance notice will need to be built-in to the Chief Inspectors Survey schedule which has been given to the Right-of-Way Agent. Coordination and communication between the Chief Inspector, Survey Coordinator and the assigned Right-of-Way Agent is crucial in developing a survey schedule.

- *The Project Chief Inspector or Survey Coordinator will provide work areas daily* for each survey crew based on the schedule that was provided to the Right-of-Way Agent for clearance. Prior to beginning the survey work the Chief Inspector will validate with the Right-of-Way Agent that all available tracts are cleared for survey and that all notifications have been made. Party Chiefs will meet with the Chief Inspector, Survey Coordinator, and Right-of Way Representative, daily, who will insure that each survey crew has a complete understanding of the restrictions and conditions for entry.

- *Specific commitments have been made to each property owner by the Right-of-Way Agents* with respect to the cutting of trees; removal of brush, excavation, etc. IN ADDITION, some landowners have placed additional conditions and restrictions upon granting access to their properties. Be certain that these e restrictions are reviewed and understood before the crew leaves for the field that day. If you have questions during the day please direct those questions to the onsite Right-of-Way Agent and the inspector on site. BEFORE you access the property.

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- *Do not excavate on any property without notice* to the Chief Inspector who will coordinate with the Right-Of-Way Agent to confirm we have permission from the landowner..

LINE MARKING

- *Limit number of stakes placed in yards and cultivated fields*. Stakes may need to be removed to allow cultivation, etc. at the request of the landowner. Remove all stakes after the final survey crew has completed their field work. The Chief Inspector and Utility Inspectors will ensure that the final crew on the tract has addressed these requests.

- *No paint is to be used during survey activities*.

- Follow flagging conventions established for project.

- No steel nails in trees for Bench Marks or Control Points.

TREE CUTTING

- ***NO** trees or shrubs will be cut in yards.*

- Cutting in wooded/brushy areas if permitted by the landowner(does the ROW list clearing indicated yes or no to tree trimming? Or will the agent make this determination?)) will be limited to small trees no greater than **2” in diameter** and small limbs or branches as may be required to obtain line of sight. No limbs will cut on trees planted along roadways.

- Cutting of small trees will be done such that the stumps do not leave a sharpened projection above ground.

RESTORATION

- Remove flagging and/or stakes as soon as possible.

- Remove flagging from ANY property that has requested the removal as soon as possible after the GPS co-ordinates or locations have been surveyed.

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- On tracts where requested, and in close view of residential areas, make certain that all brush, trees and other debris is removed from the property each day. Texas Eastern representatives will assist in there removal and disposition in cases where excessive brush and other cuttings debris have been created.

- Fill in ALL holes or excavations daily.

- Close ALL gates and lock/latch them behind you.

- Leave the property the way you found it. Remove all soda cans, cups, bottles, paper, food, and waste on a daily basis. No personal trash from our survey crews is to ever to be left on a landowner's property.

- Leave no excrement on any property.

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CONFIGURATIONS

- (TO BE PROVIDED)

MAPPING/SKETCHES

- 200 Scale aerials of the study corridor

FLAGGING

PROPOSED PIPELINE INSTALLATIONS (RE-STAKE) - WHITE

PROPOSED FACILITY INSTALLATIONS - BLUE

EXISTING IN-SERVICE PIPELINES(COMPANY) - YELLOW

EXISTING PIPELINES IDLE OR NOT IN SERVICE & FOREIGN - YELLOW & RED

PROPOSED PIPELINE REPLACING EXISTING - GLOW ORANGE & WHITE

TEST MANIFOLD SITES - BLUE & GLOW PINK

POINT OF INTERSECTION (P.I.) - GLOW ORANGE & BLUE

ROW LIMITS, PROPERTY CORNERS & EXTRA WORK ROOM - RED

OFF ROW REFERENCE POINTS, I.E., REFERENCE STAKES AND TEMPORARY BENCH MARKS - GLOW PINK

SPECIAL CONSTRUCTION REQUIREMENTS - BLUE
A. BEGIN & END POINTS REMOVAL - BLUE & YELLOW
B. BEGIN & END POINTS RESTAKE - BLUE & GLOW ORANGE
C. WALL THICKNESS CHANGE - BLUE & WHITE
D. WIPE TEST LOCATIONS - WHITE

SENSITIVE AREA SITE - BLUE, YELLOW & RED

ENVIRONMENTAL - PINK

APPENDIX K

SPECTRA’S MINIMUM CONTROL STANDARDS

Spectra Energy	**Safety Program – Minimum Control Standards**	
	H&S-112	SET E&C Contractor Safety Management Program

Minimum Control Standards Update 2009

The Spectra Energy Transmission (SET) Engineering and Construction (E&C) safety program uses a performance based approach designed to allow contractors to "make the case" for their H&S programs' ability to manage safety performance on SET E&C projects. On balance, performance-based systems are simpler to administer and, when managed with discipline by all parties, are much more effective than traditional compliance-based approaches that can rely too heavily on lists of "Do's and Don't's".

To support the performance based system, we require clear minimum expectations of control for some specific issues facing our construction projects. The following are a set of clarifications or points of emphasis on minimum control expectations, but do not represent all controls that must be employed including company specific, regulatory required and pipeline construction industry best practices and guidelines.

SET E&C H&S expects that submitted Project Specific Health and Safety Plans will describe how the contractor will manage and enforce these expectations, including subcontractors. Contractor shall ensure that all employees (including subcontractors) are made aware of these expectations during site orientation. This list of controls will be updated as necessary, based on feedback, incident investigations, or emerging issues.

***Note**: These minimum control standards do not replace the Contractors obligations to identify and control hazards based on site specific conditions and hazards.*

Minimum Control Standards:

Overhead Utility Lines

- At least 3 layers of safety controls at all locations where construction activities could occur within the unsafe distance from overhead utility lines.
- There are 5 families of controls from which to select the 3 layers of controls that need to be applied: Signage, Physical Barriers, Dedicated Spotter, Proximity Alarms, and Utility Controls.
- Refer to the SET E&C H&S SharePoint site for access to this Minimum Control Standard.

Heavy Equipment

- DOT or CSA approved safety helmets shall be worn when driving ATV's in the construction yard or on any area of the ROW.
- Truck ramps for loading or unloading ATV's shall be designed for fit and purpose. A high visibility flag (i.e., "whip") will be affixed to ATV's and a driver certification of operation is required for all ATV operators from recognized organizations such as the American ATV Safety Institute or Canada Safety Council.
- Seatbelts shall be worn and maintained on vehicles originally equipped with manufacture installed seatbelts, when the vehicle is in operation.
- Heavy equipment and off road equipment (other than ATV's) will have functional and audible back-up alarms installed.
- Areas using radioactive sources will have very clear signage that identifies restricted entry into unsafe zones.
- Trucks installed with auxiliary powered generators will have CO monitors installed inside the trucks operating spaces.
- Qualified equipment operator records and applicable records of inspection shall be retained on file at the worksite and made available upon request.

Form Usage Notes: *Purpose – Clarification of safety control expectations.* *Disposition of Document – Project Specific Safety Plans, and Inspector Handbook*	Version/ Date: 3/13/2009	Page: 1 of 2
	Form Owner: E&C H&S Department	
	The current version of this form is located on "The Source"	

Grinding

- Dual eye protection (face shield & safety glasses with side shields) required during grinding operations.
- Only approved head-gear (ANSI Z87.1-2003 or equivalent standard) will be used for welding and grinding shields.
- Arms & upper body will be covered with long sleeve cotton shirt or jacket during welding and grinding.
- Factory installed grinder guards will not be removed or otherwise altered. **Please note**, SET E&C will not allow the use of modified grinders even if a deviation for this alteration was granted from the regulating agency.

General

- Safety glasses with side shields (including prescription eyewear) shall be worn at all times, except when in vehicles and administrative areas.
- Hard-hats shall be worn at all times except when in vehicles and in administration offices. Hard hats may be removed by welders during welding operations, ONLY if all overhead hazards have been eliminated from the immediate work area.
- Safety-toed boots (i.e. above the ankle and including rubber boots) shall be worn at all times. In addition, safety boots worn at designated sites will conform to applicable electrical rating standards.
- Reflective tear-away traffic vests shall be worn when working on or immediately around public roadways and highways, and at all times by Spectra employees, visitors and Spectra representatives, except when in vehicles and administrative areas. Consult local rules and regulations to ensure appropriate color and style.
- Leather gloves will be used at all times when welding and grinding.
- Truck drivers are required to follow site PPE requirements when outside of their vehicles on construction sites.
- A Traffic Plan, which includes a site parking plan with posted speed limits; limits of ROW parking; and employee transportation to work sites, will be developed and implemented prior to mobilization.
- On all E&C project sites, vehicles shall be parked in such a manner that backing out is avoided.
- There is no standing or walking on pipe during construction activities.
- Provide a continuous monitor with alarm against carbon monoxide (CO) in areas where exhaust may provide a hazard to employees (i.e. supplied breathing air intakes, enclosed spaces, x-ray vehicles).
- Temporary constructed walkways & stairways will meet applicable construction regulations and be adequately lit.
- PPE requirements and directions for using the product identified in the Material Safety Data Sheets shall be followed.
- Tag lines shall be used to stabilize the movement of all loads. (i.e., pipe movement, bending)
- Trained, equipped & competent fire watches required at each permit required hot-work operation.
- Contractor will implement a formal Heat Stress Management Program when applicable.
- All E&C projects require an emergency plan which includes, at a minimum, the following procedures: employee head counts, the ability to communicate, evacuation process, notification process and information on available emergency services.

Questions and Guidance

If you have questions contact your E&C H&S representative, or email us at aske&ch&s@spectraenergy.com. Email us at aske&ch&s@spectraenergy.com, and we will send you a user name and password to gain access to the portal which contains an abundance of guidance and reference material.

Spectra Energy

Minimum Safety Standard

Engineering & Construction

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Discussion

This year, there have been a disturbing number of incidents and near misses across our projects where overhead utility lines have been contacted. Some of these incidents have caused injury and in one case, a fatality.

Spectra Energy Transmission Engineering & Construction (E&C) is taking a strong stand to demand that every reasonable effort and control is implemented to ensure the safety of personnel on our projects. We find it necessary to focus our efforts on layering the controls (e.g. double, triple or quadruple control contingencies or redundancies).

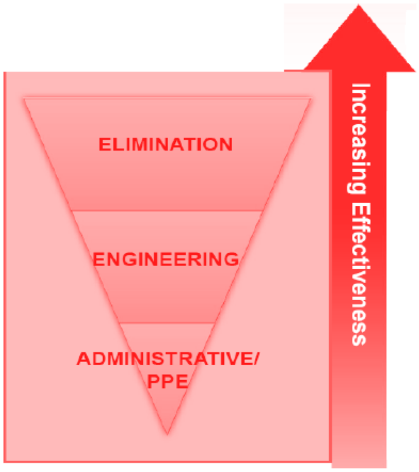
Mandatory controls to prevent overhead utility strikes

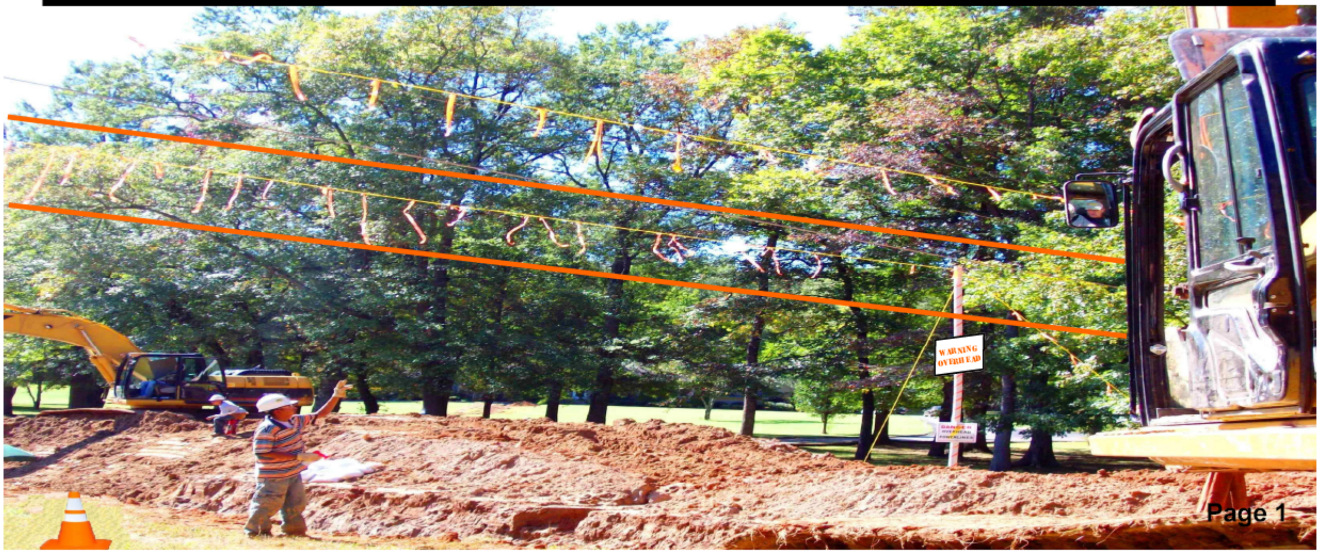
E&C is requiring at least 3 layers of safety controls at all locations where we can reasonably foresee that our construction activities could bring us within the unsafe distance to overhead utility lines.

There are 5 families of controls from which to select the 3 layers of controls that need to be applied: Signage, Physical Barriers, Dedicated Spotter, Proximity Alarms, and Utility Controls. Each are discussed in detail on page 2 and 3.

Support

If you have any questions, you can contact an E&C Senior H&S Specialist at (713) 627-5448, or email us at aske&ch&s@spectraenergy.com.





Think “3” for Electricity

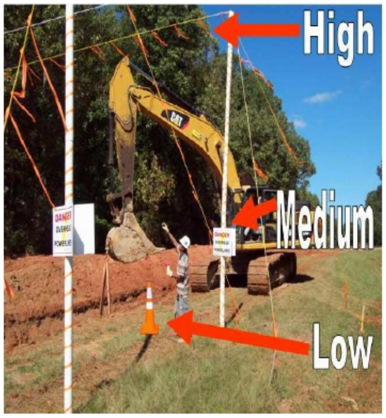
Mandatory Controls to prevent Overhead Utility Strikes

As discussed on page 1, E&C is requiring **at least 3 layers of safety controls at all locations where we can reasonably foresee that our construction activities could bring us within the limits of approach of overhead utility lines**.

There are 5 families of controls from which to **select at least the 3 layers** (“*Think 3 for Electricity*”) of controls that need to be applied:

1. **SIGNAGE** – signage shall cover three parts of the view plane:
HIGH (e.g. ribbon tied to overhead goal posts),
MEDIUM (e.g. “Beware of overhead lines” sign at eye level) and
LOW (e.g. cones on the ROW).

1. Signage



2. **PHYSICAL BARRIERS** – a non-conductive barrier (e.g. goal posts with rope extending across the ROW) set outside the limit of approach (these limits vary by jurisdiction and voltage) on both the upstream AND downstream sides. Breaking/broaching this barrier would constitute a significant near miss under our contract safety Terms and Conditions.

2. Physical Barriers

3. **DEDICATED SPOTTER** – a trained, dedicated employee, not engaged in any other duties (e.g., swamping) while performing spotter duties. Their task is to monitor and direct traffic around lines, and shall use an appropriate audible alarm (air horn for example) to warn the driver of potential danger.

3. Dedicated Spotter

Spectra Energy

Minimum Safety Standard

Engineering & Construction

Think "3" for Electricity

Mandatory Controls to prevent Overhead Utility Strikes (continued)

4. **PROXIMITY ALARMS** – alarms that set off once equipment approaches too close to energized sources. (e.g. for reference purposes only – not a product endorsement - http://sigalarminc.com/PricnOfOperation.htm)

4. Proximity Alarms

5. Utility Controls

5. **UTILITY CONTROLS** – site specific controls (e.g. line cover-up, line raising/relocation, outage(s), etc.,) arrived at in consultation with a local utility or specialized safety professional.

STANDARDIZED LIMITS OF APPROACH

When using physical barriers such as goalposts as a layer of control, barriers shall be placed in all directions from which a vehicle may approach. See example below. The barrier shall be set back at a standard limit of approach distance of no less than 10 feet unless a greater distance is required by jurisdiction or voltage (see 29 CFR 1926.550 or visit http://www.osha.gov for details).

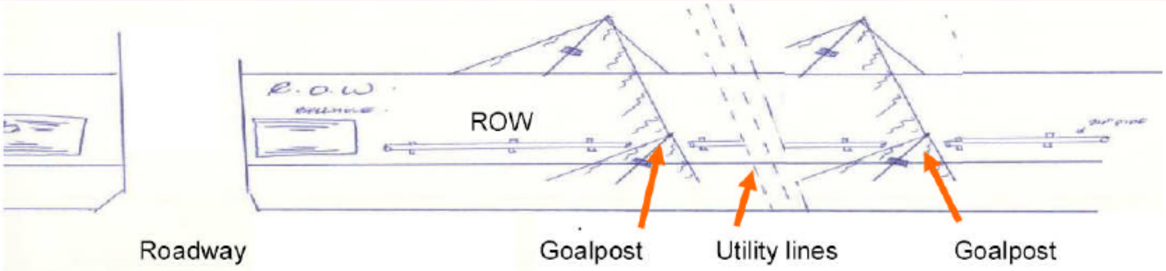


Diagram of overhead power-line barriers perpendicular to roadway <u>and</u> on each side of hazard.

Page 3

ATTACHMENT 1

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS