

**RETEC**

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**REMOVAL ACTION  
HEALTH AND SAFETY PLAN**

**RELIEF AND GAS HOLDER REMEDIATION**



SDMS DocID 2079896

**UGI COLUMBIA GAS PLANT SITE  
Columbia, Pennsylvania**

*Prepared for:*

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**Project No. 3-1612-200**

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**REMOVAL ACTION  
HEALTH AND SAFETY PLAN  
RELIEF AND GAS HOLDER REMEDIATION  
UGI COLUMBIA GAS PLANT SITE  
Columbia, Pennsylvania**

**FOR**

**Removal Action at the Columbia, Pennsylvania  
Manufactured Gas Plant Site**

**RETEC Project No.:**

**3-1612-200**

<b>Plan Written By: Jason A. Gerrish</b>	<b>Date: September 27, 1995</b>
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**Plan Approved By:** \_\_\_\_\_ **DATE**  
William A. Odenthal  
Corporate Health and Safety Officer

**Note: This plan supercedes the HASP dated 11/17/94.**



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## 1.0 INTRODUCTION

This document describes the Health and Safety (H&S) protocols developed for the Columbia Manufactured Gas Plant Site, located in Columbia, Pennsylvania. This plan was developed to protect on-site personnel, visitors, and the public from known or suspected health and safety hazards during design and removal action activities. This Removal Action will be performed according to guidance from EPA Region III and the Pennsylvania Department of Environmental Resources (PADER). This site specific health and safety plan has been prepared for the Non-Time Critical Removal activities in accordance with OSHA regulations (29 CFR 1910.120). The procedures and guidelines contained herein are based on the most up-to-date information available at the time of the drafting of this document. Specific sections of this plan will be changed or revised when or if additional information is received or when conditions at the site change. Any changes or revisions to this plan will be by a written amendment which will become a permanent part of this plan and placed in Appendix A. Where appropriate, specific OSHA or other standards will be cited.

The scope of work for the site activities will include removal activities in a gas and relief holder.

### 1.1 Project Description

The removal action at the Columbia Site, Columbia, Pennsylvania, will consist of the following unit operations: installation of extraction and injection wells, recovery of coal tar and process water from the subsurface using enhanced recovery technology, separation of the coal tar from the process water, treatment of the excess process water, discharge of treated process water, disposal of the recovered coal tar, stabilization of the relief and gas holders, and site restoration.

The CROW™ (Contained Recovery of Oily Wastes) Process will use proven enhanced oil recovery technology to recover organic liquids from subsurface oily waste accumulations. The oily waste is mobilized by controlled heating and is displaced to one or several recovery wells by sweeping the coal tar with steam. The produced fluids will be treated in an oil/water separator to remove the coal tar. The produced water will subsequently be recycled in the system. Once coal tar is removed from the relief holder, the holder will be dewatered and subsequently grouted in place. The produced water recovered in the dewatering step will be treated in carbon adsorption units prior to discharge to the Susquehanna River.

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The CROW™ process will use injection and recovery wells drilled into the relief holder. Steam is injected into the holder to heat and mobilize accumulations of coal tar. Heating the coal tar reduces both the density and viscosity of the tar such that the tar will migrate. Steam injection and product recovery rates will be controlled to sweep accumulated coal tar through the holder contents. Recovering subsurface deposits of coal tar to residual saturation levels will reduce the volume, mobility and toxicity of coal tar.

Oily waste mobility is improved significantly in the CROW™ process by increasing temperature to reduce the viscosity of the oil phase. Heating oily waste accumulations also reverses the density difference between the oil phase and water. The density of heavy organics is nearly equivalent to the density of water at a temperature of about 100°F. At higher temperatures, the oil phase has a lower density than water because water is more polar and resists thermal expansion.

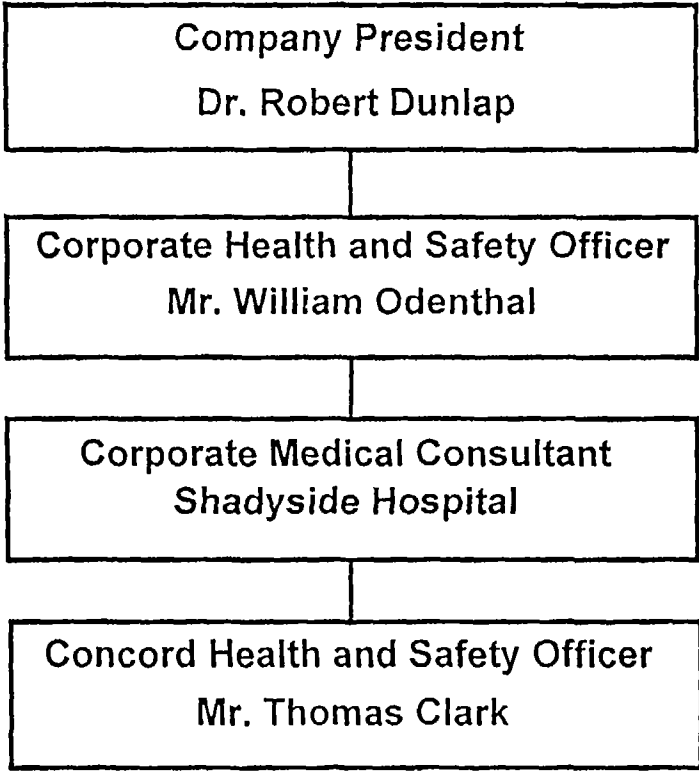
The CROW™ system at the Columbia Site is designed to extract coal tar and water at 10 gpm from the center of the relief holder. The extracted coal tar/water mixture will be passed through a vertical separator. The separated coal tar will be stored at the site in a 5,000 gallon tank until it is shipped off site for proper disposal. After the oil phase is grossly separated from the aqueous phase, the water will be recycled through a boiler and reinjected to the holder through the injection wells at a rate of 2.5 gpm or 20 lbs H<sub>2</sub>O/minute/well.

Once the coal tar has been recovered from the relief holder, both the relief and gas holders will be dewatered. Carbon adsorption units will be used to treat the water to levels required for direct discharge. The treated water will then be discharged at a constant rate to the Susquehanna River.

## 1.2 Responsibilities

RETEC has a written corporate health and safety policy which establishes specific responsibilities on a company-wide and project specific basis. Figure 1-1 presents a chart showing RETEC's health and safety organization. The specific responsibilities of the personnel shown on the chart are presented below.





## **1.2.1 Corporate Health and Safety Staff**

### **1.2.1.1 Company President**

The Company President has ultimate responsibility for all corporate health and safety policy. This responsibility includes approval of new policies and final resolution of disputes involving established policy. The Corporate Health and Safety Officer reports directly to the president. RETEC's Company President is Dr. Robert Dunlap.

### **1.2.1.2 Corporate Health and Safety Officer**

The Corporate Health and Safety (HAS) Officer is responsible for the development and implementation of the Corporate Health and Safety Plan, maintenance of all health and safety personnel files including medical and training records, establishment and supervision of training programs including presentation of the annual OSHA required 8-hr. refresher course, and review and approval of site-specific health and safety plans. In addition, the Corporate HAS officer is responsible for the maintenance of a complete inventory of all corporate-owned health and safety equipment, tracking and reporting of occupational injuries and illnesses, providing technical assistance to project managers in developing site-specific health and safety plans, periodic evaluation of the effectiveness of the corporate health and safety plan, presentation of health and safety "kick-off" meetings as required, and periodic site health and safety audits to ensure that all health and safety policies and procedures are being followed. The Corporate Health and Safety Officer will be ultimately accountable for all corporate health and safety policies and directives. RETEC's Corporate Health and Safety Officer is Mr. William Odenthal.

### **1.2.1.3 Corporate Medical Consultant**

An Occupational Health Physician has been retained by RETEC to provide medical oversight to the medical surveillance program. The reviewing physician will receive copies of all medical questionnaires, exams, and test results from physicians conducting the examinations at various specified locations around the country, and determine an employee's fitness for work. RETEC's Corporate Medical Consultant is Shadyside Hospital, 5230 Centre Avenue, Pittsburgh, 15232 (412) 623-1070.

#### **1.2.1.4 Office Health and Safety Officer**

Each of RETEC's offices has an office Health and Safety Officer. This person's responsibility is to act as an information resource, transmit corporate policy, maintain office health and safety files and enforce the corporate Hazard Communication Policy within the office. The Health and Safety Officer for RETEC's Concord, Massachusetts office is Mr. Thomas Clark.

### **1.2.2 Project Health and Safety Staff**

#### **1.2.2.1 Project Manager**

The project manager is responsible for writing, interpreting and enforcing a site specific health and safety plan consistent with corporate policy, OSHA and EPA regulations and the provisions of the SOW. The Project Manager for the removal action at the Columbia, PA manufactured gas plant site is Mr. Alfred Leuschner.

#### **1.2.2.2 Site Health and Safety Officer**

The Site Health and Safety Officer is responsible for implementing the Site Health and Safety Plan by providing on-site training and regular site safety inspections, maintaining project health and safety records and files, and submitting required documentation. The Site Health and Safety officer is Mr. Jason A. Gerrish.

#### **1.2.2.3 Field Supervisor**

Whenever field activities take place, one qualified person on-site will be designated as the field supervisor. This person will be responsible for enforcing the provisions of this plan, maintaining required records and documentation, and supervising field staff and subcontractors to make sure they are in compliance with the Site Health and Safety Plan.

#### **1.2.2.4 Project Field Staff**

In addition to RETEC staff, all onsite personnel are responsible for reading and becoming thoroughly familiar with this manual. All personnel are required to abide by the policies and procedures described herein and are encouraged to offer recommendations concerning any aspect of this document which they feel to be beneficial to the program. Employees should continually be thinking health and safety, not only for themselves, but for fellow employees and others that may be involved in various field activities from time to time. Any employee who is uncertain regarding any aspect of health and safety practice or policy is responsible for checking with appropriate personnel before acting.

#### **1.3 Site Safety Plan Acknowledgment and Acceptance**

The project manager, site engineer, site health and safety officer or other designated representative shall be responsible for informing all individuals assigned to or visiting the site of the contents of this plan and ensuring that each person signs the Safety Plan Acknowledgment Form in Appendix B. By signing the Safety Plan Acknowledgment Form, individuals are recognizing the Health and Safety hazards, known or suspected on-site and the protocols required to minimize exposure to such hazards.

#### **1.4 Site Health and Safety Meetings**

An initial safety indoctrination and training "Kick-off" meeting shall be held on the first day of mobilization to the site and prior to the commencement of any work activities. Mandatory attendance is required for all personnel initially assigned to the site. At the conclusion of the "Kick-off" meeting, personnel are to sign the Safety Plan Acknowledgment Form in Appendix B indicating their attendance and understanding of the Health and Safety protocols. As additional personnel are assigned to the site, it is the responsibility of the project manager/site engineer to ensure that the personnel are briefed on health and safety protocols and that they also sign the Safety Plan Acknowledgment Form.

Additional health and safety meetings will be held on a regularly scheduled basis throughout the duration of the project. In no case shall more than one month elapse between health and safety meetings. These meetings shall be scheduled to inform all personnel of changing

site conditions, to ensure that personal protective equipment is being used properly and sufficiently stocked, and to address worker health and safety concerns.

### **1.5 Training Requirements**

All personnel assigned to the site must have completed 40 hours training for hazardous waste site work in accordance with OSHA 29 CFR 1910.120(e)(3) and be current with their 8-hour refresher training in accordance with OSHA 29 CFR 1910.120(e)(8). Documentation of OSHA training will be kept onsite and is required prior to personnel being permitted to work on-site.

### **1.6 Medical Monitoring Requirements**

All personnel assigned to the site must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Documentation of personnel being enrolled in a medical surveillance program will be kept onsite and is required prior to personnel being permitted to work on-site.

### **1.7 Fit Testing Requirements**

All personnel assigned to the site who must wear a respirator must have successfully passed a respirator fit test within the past 12 months. Documentation of a successful respirator fit test for the appropriate type of respirator needed for work on this specific site (half-face or full-face) will be required. The project manager, project site engineer, or site health and safety officer is to ensure that the respirator being worn by personnel is the same size, make, and model as that specified on any respirator fit test records from the past twelve month period.

### **1.8 Responsibilities**

The Project Manager or Site Engineer is responsible for overall project administration and for coordinating health and safety protocols and procedures for all personnel on-site at all times. All U.S. EPA health and safety requirements and all pertinent OSHA standards shall be applicable. This health and safety plan covers all personnel on-site, however, each sub-contractor

is also responsible for the health and safety of its employees and for insuring that this plan is followed while on site. If there is a dispute with regards to health and safety, the following procedures shall be followed:

- (1) Project Manager or Site Engineer shall attempt to resolve the issue with a complete written follow-up to RETEC's Corporate Health and Safety Officer; or
- (2) If the issue cannot be resolved, the Project Manager shall consult the Corporate Health and Safety Officer immediately and the specific task operation in dispute shall be discontinued until the issue is resolved.

Any persons who observes health and safety problems or infractions should immediately report the problem or infraction to the appropriate personnel.

### **1.9 Access to Employee Exposure and Medical Records**

The Occupational Safety and Health Act provides employees and their designated representatives a right of access to relevant exposure and medical records (29 CFR 1910.20). The "notification" of access to employee exposure and medical records (Appendix H) is to be posted in a prominent location in all RETEC offices and at all RETEC field operations.

### **1.10 Project Files**

Copies of all field notes and other field health and safety documentation will be kept in the project files, along with copies of Health and Safety training and fit test certifications for all on-site personnel, listed in Table 1-1. Medical clearance certificates for site personnel will be kept in confidential medical files maintained by the Corporate Health and Safety Officer.



## 2.0 HEALTH AND SAFETY RISK ANALYSIS

This analysis identifies the general hazards associated with specific site operations and presents an analysis of documented or potential chemical hazards that exist at the site. Every effort must be made to reduce or eliminate these hazards. Those which cannot be eliminated must be guarded against by use of engineering controls and/or personal protective equipment. The most prominent hazards expected at this site include hazards associated with circulated hot water, hazards associated with heavy equipment, hazards associated with electricity, hazards associated with chemical exposure and general site hazards. Table 2-1 presents the general site hazard background data.

### 2.1 Hazards Associated with Hot Water and Steam

The CROW™ process includes injecting steam into the subsurface and extracting the heated liquids from the subsurface. The water will be heated by a boiler. The boiler will be operated and monitored by trained personnel only. The system design calls for these water and steam pipes to be insulated for two reasons:

- insulating the pipes will minimize heat loss in the steam as it is pumped from the boiler into the injection wells; and
- insulating the pipes will minimize the hazards associated with contacting the hot pipes.

If a steam pipe were to leak or break, the water pump and boiler will be automatically shut off and the piping will be allowed to cool before repairs are made. It will be the responsibility of the operator to ensure proper operation of the shut down system.

The extracted subsurface liquids will also be hot but not as hot as the injection steam. The extraction piping will also be insulated, primarily to keep the liquids flowing at the desired rate. The hazards that exist due to the temperature of extracted liquids are the same as the injected water.



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**TABLE 2-1**  
**GENERAL SITE HAZARD BACKGROUND DATA**

<b>OVERALL HAZARD IS:</b>			
HIGH:	LOW: X	MODERATE:	UNKNOWN:
<b>FACILITY DESCRIPTION:</b> Former Columbia Gas Company, which began operation in April 1853 to supply manufactured gas to Columbia. The site is located along Front Street in the borough of Columbia, Lancaster County, Pennsylvania.			
<b>STATUS:</b>			
<b>UNUSUAL FEATURES</b> (containers, dikes, buildings, power lines, terrain, etc.): RR tracks, Susquehanna River			
<b>SITE HISTORY</b> (worker injury, complaints, regulatory agency action): None			
<b>WASTE TYPES:</b>			
LIQUID: X	SOLID: X	SLUDGE:	GAS:
<b>CHARACTERISTICS:</b>			
CORROSIVE: NO	IGNITABLE: NO	VOLATILE: POSSIBLY	TOXIC: POSSIBLY
REACTIVE: NO	UNKNOWN: YES	RADIOACTIVE: NO	
<b>OTHER</b> (name):			
<b>HAZARDS POSED BY SITE ACTIVITIES:</b> Direct contact with coal tar for dermal, mucus membrane and eye contact. Inhalation of concentrated fumes can cause nausea and dizziness.			
<b>UNUSUAL HAZARDS:</b>			

Any person who performs work in close vicinity of the steam pipes or the boiler will wear protective clothing, gloves and eye protection. Appropriate protective clothing includes coveralls, a sweatshirt or a jacket. A tyvek suit over a tee shirt is not considered thermally protective clothing.

Any person burned due to hot water or steam will be required to contact the Crozer-Chester Medical Burn Center at (610) 447-2000. All injuries will be reported as described in this document.

## **2.2 Hazards Associated with Heavy Equipment**

A major hazard throughout the construction phase will be working around heavy equipment. Because of the noise level, the equipment operator will not always be aware of what is going on around him. A worker can not expect the operator to know where he or she is or what they are going to do. Any equipment moving parts above head level create a head injury hazard. Unknown buried pipelines and overhead power lines are always hazards when working with heavy equipment. These hazards will be mitigated by the following procedures:

- All equipment must have back-up alarms.
- Personnel must make eye contact with the operator before approaching the equipment. Hand signals will be used whenever possible.
- Operators must be aware of personnel in the area and use proper hand signals before maneuvering.
- Operators must wear hard hats when operating machines unless equipment has an enclosed cab or cage cover.
- Operators must wear hard hats when going to and from their equipment.
- All workers must wear eye protection and steel toe boots when working in the vicinity of heavy equipment.
- Operators must be cautious when maneuvering equipment near overhead power lines.

### 2.3 Hazards Associated with Working Around Electricity

Electricity will be supplied to the site from adjacent utility lines. The electrical lines will be run through a designated conduit separate from the work area. All electrical lines will be labeled with warning signs.

Power utilizers will be the injection, extraction, recycling and discharge pumps, the computer and associated components and any electrical piping insulation that is used.

### 2.4 Hazards Associated with Chemical Exposure

Previous sampling and analytical data, investigations, and site history have indicated that the chemical hazards, presented in Table 2-2, exist at the site. Detailed hazard information for these chemicals is available through MSDS sheets in Appendix E.

Table 2-2  
Potential Site Chemical Hazards

CONTAMINANT	SKIN HAZ.	P E L [1]	T L V [2]	R E L [3]	STEL <sup>4</sup>	IDLH <sup>5</sup>	ODOR THRES-HOLD	IP <sup>6</sup>
Coal Tar	No	0.2	0.2	0.1	n/a	700CA	n/a	n/a
Benzene	Yes	1	0.10	0.1	5	3000CA	34-119	9.24
Toluene	Yes	100	50	100	150	2000	0.16-37	8.82
Ethylbenzene	No	100	100	100	125	2000	0.092-060	8.76
Xylene	No	100	100	100	150	1000	20	8.5
Naphthalene	No	10	10	10	15	500	0.038	8.12
Activated Carbon	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cyanide	Yes	5 mg/m <sup>3</sup>	N/A	5 mg/m <sup>3</sup>	N/A	50 mg/m <sup>3</sup>	N/A	N/A

**NOTE:**

<sup>(1)</sup> OSHA Permissible Exposure Limit (PEL)

<sup>(2)</sup> ACGIH Threshold Limit Value (TLV)

<sup>(3)</sup> NIOSH Recommended Exposure Limit (REL)

**USE LOWEST FIGURE OF THE THREE LIMITS.**

<sup>(4)</sup> Short-Term Exposure Limit

<sup>(5)</sup> Immediately Dangerous to Life and Health

<sup>(6)</sup> Ionization Potential

<sup>(7)</sup> All Concentrations in mg/m<sup>3</sup> (ppm)

<sup>(8)</sup> CA = Carcinogenic

Primary chemical hazards will be volatile compounds. Benzene, although not expected in high concentrations, is a highly volatile compound that can be noted by its gasoline-like odor. Benzene is considered a carcinogen and therefore immediately dangerous to life and health at any detectable concentration. Respiratory protection should include the use of an air-purifying respirator with organic vapor cartridges when required according to the Health and Safety Plan. Naphthalene will be expected in higher concentrations than benzene. Naphthalene is also volatile but not considered carcinogenic and can be easily detected by its mothball-like odor. An air-purifying respirator with combination organic vapor/dust, mist cartridges should also be used in the presence of naphthalene. Although coal tar contains many carcinogenic compounds, most are only slightly volatile and pose hazards primarily through dermal or eye contact and ingestion.

Contact with coal tar constituents is not likely to be significant. However, there are certain phases of the project that are more likely to expose a worker to coal tar. If exposure is likely to occur, workers will be required to wear, at a minimum, full level D with eye protection, tyvek suit, nitrile outer gloves, and rubber boot covers.

## **2.5 General Site Hazards**

### **Lighting**

Work areas must have adequate lighting for employees to see to work and identify hazards (5-foot candles minimum, comparable to a single 75-100 watt bulb). Personnel should carry flashlights in all 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. Applicable OSHA standards for electric 29 CFR 1910 Subpart S shall apply.

### **Lockout/Tagout**

Operations where the unexpected energization or start-up of equipment or release of stored energy could cause injury to personnel, will be protected by the implementation of a

lockout/tagout program meeting the requirements of 29 CFR 1910.147. Lockout/Tagout is discussed in Section 9.0

### **Fall Protection**

Fall accidents can result in an injury or fatality. Requirements to help prevent falls will be implemented. Elevated work where a fall potential exists will be performed using appropriate ladders and/or fall protection (i.e., body harness or lifeline). Applicable OSHA standards for fall protection 29 CFR 1910.21 through 29 CFR 1910.32, and 29 CFR 1910.104 through 29 CFR 1910.107 shall apply.

### **Drum Handling**

The movement and opening of drums will be done in accordance with 29 CFR 1910.120(j). Drum Handling is discussed in Section 8.0.

### **Cold Stress**

When the temperature falls below 40°F, cold stress protocols shall be followed. Employees must be supplied with adequate clothing to maintain core temperature. Cold stress is discussed in detail in Appendix C.

### **Heat Stress**

When the temperature exceeds 70°F, and personnel are wearing personal protective clothing, a heat stress monitoring program shall be implemented. Employees shall have frequent break periods and access to drinking water. Heat stress is discussed in detail in Appendix D.

### **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). An emergency eye wash kit will be provided in the office trailer.



### 3.0 PERSONAL PROTECTIVE EQUIPMENT

The following is a brief description of the personal protective equipment which may be required during various phases of the project. The U.S. EPA terminology for protective equipment which will be used on site is Levels C and D.

Respiratory protective equipment shall be NIOSH approved and use shall conform to OSHA 29 CFR 1910.134.

#### 3.1 Level C

Level C protection shall be used when:

- Substance(s) require the same level of skin protection as Level B, but a lesser level of respiratory protection;
- The types of air contaminants have been identified, concentrations measured, and respirator decision logic indicates that APR's are sufficient to remove the contaminants; or
- The substance has adequate warning properties and all criteria for the selection of APR has been met.

#### 3.2 Level D

Level D protection will be used when:

- The atmosphere contains no known hazard;
- Work functions preclude splashes, immersions, or the potential for unexpected inhalation of, or contact with, hazardous concentrations of chemicals.
- Atmospheric concentrations of contaminants are less than the TLV.

PPE required for Level C and level D protection are presented in Table 3-1.

**TABLE 3-1  
PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS**

**LEVEL C PPE TO BE UTILIZED: (Check Appropriate PPE)**

X	Half-face APR (MSHA/NIOSH Approved) (REQUIRED) or
X	Full-face APR (MSHA/NIOSH Approved) (REQUIRED)
X	TYPE OF CARTRIDGES TO BE USED: Combination Organic Vapor/HEPA
	Dust Mist Filter (OPTIONAL)
X	HEPA Filter (OPTIONAL)
X	Chemical-resistant clothing (one-piece coverall; hooded, two-piece, chemical splash suit, chemical-resistant hood and apron, disposable chemical-resistant coveralls (i.e., Tyvek) (REQUIRED) FABRIC TYPE: Non-porous Tyvek
X	Disposable inner gloves (surgical) (REQUIRED)
X	Disposable chemical-resistant outer gloves (REQUIRED) MATERIAL TYPE: Neoprene or equivalent in resisting coal tar penetration
X	Chemical-resistant boots with steel tow and shank or disposable boot covers; booties (REQUIRED) MATERIAL TYPE: Neoprene or equivalent in resisting coal tar penetration
X	Sleeves to be duct-taped over gloves and pants to be duct-taped over boots (REQUIRED)
X	Safety goggles/glasses (When handling coal tar)
	Hard hat with face shield
X	Hearing Protectors (REQUIRED if site noise levels are greater than 85 dB based on an 8 hr. TWA.)
	Two-way radio communication (intrinsically safe) (OPTIONAL)
X	Hard hat (required)
X	Long cotton underwear (OPTIONAL)
	Modifications:



**LEVEL D PPE TO BE UTILIZED: (Check Appropriate PPE)**

X	Standard work uniform/coveralls (REQUIRED)
X	Work boots with steel tow and shank (REQUIRED)
X	Work gloves (REQUIRED)
X	Safety goggles/glasses (REQUIRED)
X	Hearing Protectors (REQUIRED if site noise levels are greater than 85 dB based on an 8 hr. TWA.)
	Hard hat with face shield
X	Hard hat (around heavy equipment)
	Two-way radio communication (intrinsically safe) (OPTIONAL)
	Long cotton underwear (OPTIONAL)
	Modifications: Modified Level D including a non-porous tyvek is to be worn for certain specified operations.

**3.3 Activity vs. Level of Protection**

Table 3-2 presents site activities and the initial level of PPE required for each. Upgrading of levels of protection for each activity will be performed in accordance with the provisions of Section 4.0.

**Table 3-2  
PPE Required for Site Activities**

ACTIVITY	LEVEL OF PPE	SPECIAL REQUIREMENTS
Tar Sampling	D	Upgrade to Modified Level D if contact with coal tar is possible, Upgrade to Level C if air monitoring dictates use of respirators
Well Installation	D	Upgrade to Modified Level D if contact with coal tar is possible, Upgrade to Level C if air monitoring dictates use of respirators
Excavation	D	Upgrade to Modified Level D if contact with coal tar is possible, Upgrade to Level C if air monitoring dictates use of respirators
Enhanced Recovery System Operation	D	Upgrade to Modified Level D if contact with coal tar is possible, Upgrade to Level C if air monitoring dictates use of respirators

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## 4.0 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 in order to determine the appropriate level of employee protection required for personnel working on-site.

### 4.1 Routine Air Monitoring Requirements

Two types of air monitoring will be performed; work zone monitoring and perimeter monitoring. Work zone air monitoring will be performed to ensure a safe work area. Perimeter monitoring will be performed to construct a record over time of Airborne Contaminant Levels. In order to construct this record, the site operator will place a wind sock on the site and place a PID at the downwind perimeter of the site. The PID will run continuously and record concentrations of airborne VOCs every 15 seconds. The high low and average VOC levels will be recorded in a field book at the end of each day. The site operator will move the PID every hour, as necessary, to capture downwind conditions.

Perimeter monitoring will also be performed for the first day of operation to characterize any effect the operation may have on air quality. Perimeter monitoring will be performed during boring and well installation activities and once weekly during operation. Work zone monitoring requirements are as follows:

- Upon initial entry of exclusion zone to rule out immediately dangerous to life and health (IDLH) conditions;
- When the possibility of an IDLH condition or flammable atmosphere has developed;
- As an on-going check of the levels of contaminants in the breathing zone;
- When work is initiated on a different portion of the site;
- When contaminants other than those previously identified are encountered;
- When a different operation is initiated; and

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- When handling drums of coal tar or working in areas of known coal tar contamination.

If elevated levels are detected during work zone monitoring, perimeter monitoring will be performed.

Air monitoring will consist at a minimum of the criteria listed below. All air monitoring data will be documented and submitted to the Corporate Health and Safety Officer on a regularly scheduled basis. The data will also be made available in the command post site files for review by all interested persons. Air monitoring instruments will be calibrated and maintained in accordance with the manufacturer's specifications.

Table 4-1 presents the air monitoring instruments to be used on site. The PID will be used whenever personnel may be exposed to chemicals of concern. Dräger Tubes will be used when PID readings exceed the limits specified. An Explosimeter will be used periodically to detect flammable or oxygen deficient atmospheric conditions.

**TABLE 4-1  
AIR MONITORING INSTRUMENTS**

<b>X</b>	<b>Hnu MODEL:</b> PID-101				
	<b>Bulb Size (Please Check):</b>				
	9.5 Ev	X	10.2 eV		11.7 eV
	<b>TIP MODEL:</b>				
	<b>OVA MODEL:</b>				
<p><b>USE:</b> Detection of Organic Gases and Vapors  <b>ACTION LEVEL:</b> &gt; 1 ppm sustained for five minutes, check for benzene with Sensidyne Tubes.</p> <p style="padding-left: 40px;">&gt; 5 ppm sustained for five minutes, upgrade to level C PPE w/min HF APR w/Combination Organic Vapor/Dust/HEPA Cartridges.</p> <p style="padding-left: 40px;">&gt; 50 ppm sustained for five minutes, upgrade to level C PPE w/min FF APR w/Combination Organic Vapor/HEPA Cartridges.</p> <p style="padding-left: 40px;">&gt; 250 ppm sustained for five minutes, evacuate site and notify Corporate HAS Officer.</p> <p style="padding-left: 40px;"><b>NOTE:</b> Wear APR with Organic Vapor/HEPA Cartridges when windy/dusty conditions exist.</p> <p><b>FREQUENCY:</b> Periodically during operations (at least hourly) or when a sense of smell indicates possible exposure.</p>					

<b>X</b>	<b>OTHER: Drager Tubes</b>				
<p><b>NAME:</b> Benzene 2/a Tube  <b>ACTION LEVEL:</b> &lt; 1ppm (and &lt;5 ppm PID) or Level D PPE</p> <p style="padding-left: 40px;">1-9 ppm Benzene, Upgrade to Level C PPE w/minimum HF APR with combination Organic Vapor/HEPA Cartridges.</p> <p style="padding-left: 40px;">10-50 ppm Benzene, Upgrade to Level C PPE w/minimum FF APR with combination Organic Vapor/HEPA Cartridges.</p> <p style="padding-left: 40px;">&gt; 50 ppm, Evacuate Site and notify corporate HAS Office.</p> <p style="padding-left: 40px;"><b>NOTE:</b> Add Dust/Mist Filters in windy/dusty conditions.</p> <p><b>FREQUENCY:</b> As required based on results of HNu readings.</p>					

	<b>OTHER: Explosimeter/O., LEL</b>				
<p><b>NAME:</b>  <b>ACTION LEVEL:</b>  <b>FREQUENCY:</b></p>					

**NOTE:** The designated site health and safety officer is to complete the "Record of Hazardous Waste Field Activity" Form (Appendix F) and return it to the Corporate Health and Safety Officer on a regularly scheduled basis, but in no case shall more than one month elapse between submittals.

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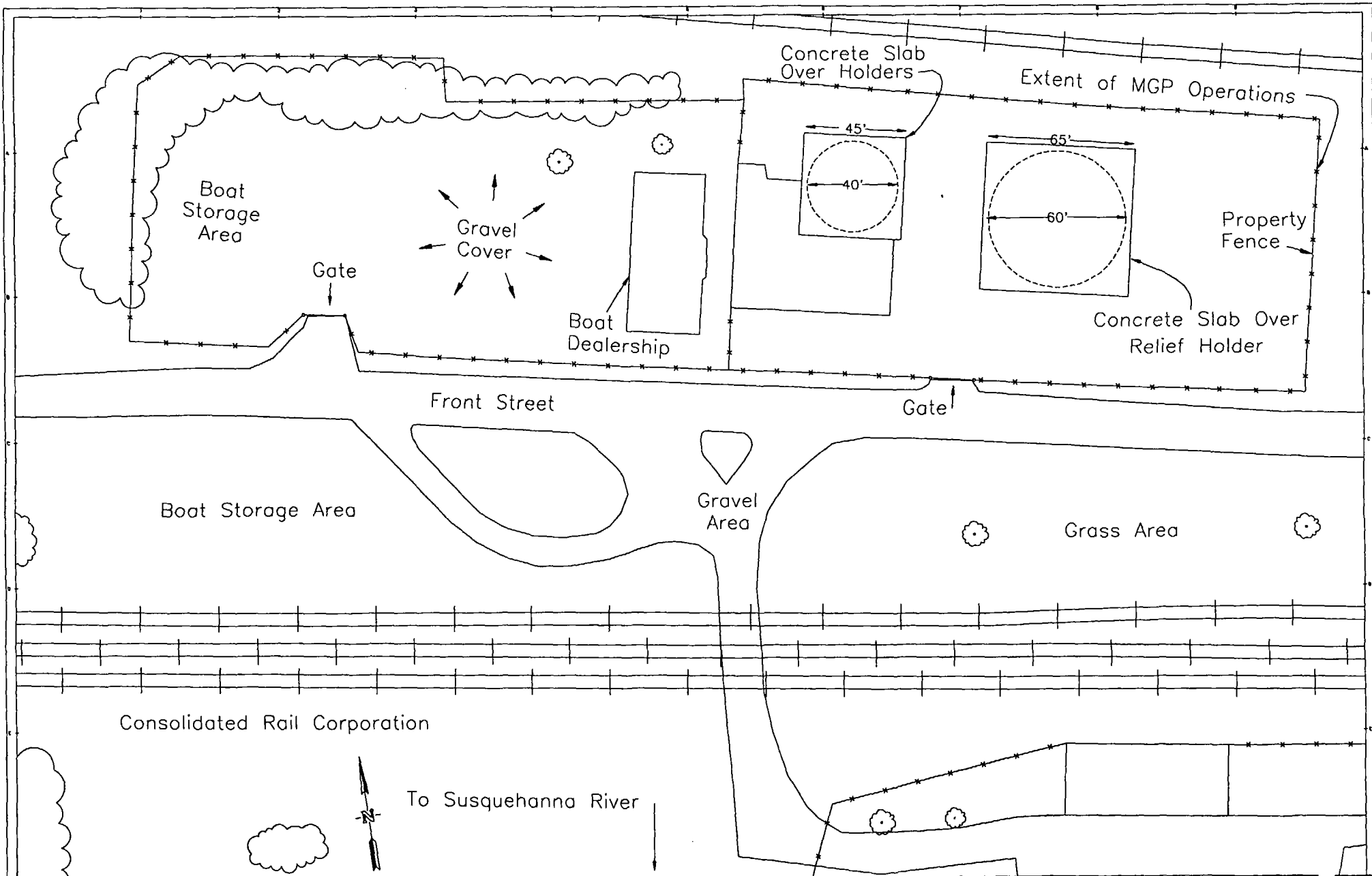
## 5.0 SITE CONTROL

### 5.1 Work Zones

The primary purpose for site controls is to establish the hazardous area perimeter, to reduce migration of contaminants into clean areas, and to prevent access or exposure to hazardous materials by unauthorized personnel. At the end of each workday, the site will be secured to prevent unauthorized entry. Site work zones will include:

- **Clean Zone/Support Zone.** This uncontaminated zone will be the area outside the exclusion and decontamination zone and within the geographic perimeters of the site. This area is used for staging of materials, parking of vehicles, office and laboratory facilities, sanitation facilities, and receipt of deliveries. Personnel entering this zone may include delivery personnel, visitors, security guards, etc., who may not be permitted in the exclusion zone. All personnel arriving in the support zone will report to the command post and sign a site entry/exit log. There will be only one controlled entry/exit point from the clean zone to the decontamination zone.
- **Decontamination Zone.** The decontamination zone will provide a location for removal of contaminated personal protective equipment and final decontamination of personnel and equipment. All personnel and equipment should exit via the decon area. A separate decontamination area will be established for heavy equipment.
- **Exclusion Zone/Hot Zone.** The exclusion zone will be the "hot zone" or contaminated area inside the site perimeter. Entry to and exit from this zone will be made through a designated point, and all personnel will be required to sign the hot zone entry/exit log located at the decon area. Appropriate warning signs to identify the exclusion zone will be posted (i.e., "DANGER-AUTHORIZED PERSONNEL ONLY", "PROTECTIVE EQUIPMENT BEYOND THIS POINT", etc.) Exit from the exclusion zone must be accompanied by personnel and equipment decontamination as described in Section 6.0.

A site map depicting the location of the site and the delineation of the various work zones is shown in Figure 5-1.



NO.	DATE	REVISION	CHG. DATE	APPRO. DATE
C	12/18/98	ISSUED TO AGENCY FOR REVIEW		
B	12/18/98	ISSUED TO CLIENT FOR REVIEW		
A	12/18/98	ISSUED TO CLIENT FOR REVIEW		
NO.	DATE	REVISION	CHG. DATE	APPRO. DATE

PENNSYLVANIA POWER & LIGHT COMPANY  
 UGI COLUMBIA SITE  
 3-1612

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CURRENT DATE: 12/18/98      CDD FILE: 18122801.dwg

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## 5.2 General Field Safety and Standard Operating Procedures

- The "Buddy System" will be used at all times by all field personnel in the exclusion zone. No one is to perform field work alone. Maintain visual, voice, or radio communication at all times.
- Whenever possible, avoid contact with contaminated (or potentially contaminated) surfaces. Walk around (not through) puddles and discolored surfaces. Do not kneel or set equipment on the ground. Stay away from waste drums unless it is necessary to sample or handle the drums. Protect equipment from contamination by bagging.
- Eating, drinking and/or smoking is only permitted in designated areas.
- Hands and face must be thoroughly washed upon leaving the decon area.
- Beards or other facial hair that interferes with respirator fit will preclude admission to the exclusion zone under a level C or stricter environment.
- All equipment must be decontaminated or properly discarded upon exit from the exclusion zone as determined by the project manager.
- All personnel exiting the exclusion zone must go through the decontamination procedures as described in this H&S Plan.
- PPE as described in this H&S Plan will be required for all field personnel working on-site.
- No contact lenses are permitted to be worn on-site.

## 6.0 DECONTAMINATION

In general, everything that enters the exclusion zone must either be decontaminated or properly discarded upon exit from the exclusion zone. All personnel, including any state or local officials, must enter and exit the exclusion zone through the decon area. Prior to demobilization, contaminated equipment will be decontaminated and inspected by the project manager/site engineer before it is moved into the clean zone. Any material that is generated by decontamination procedures will be stored in a designated area in the exclusion zone pending disposal approvals and disposition.

The type of decontamination solution to be used is dependent on the type of chemical hazards. The decontamination solution for this project is water. Decontamination solutions will be changed as required and collected and stored on-site until disposal approvals are secured and the arrangements for its final disposition are finalized.

### 6.1 Personnel Decontamination

Personnel may become contaminated in a number of ways including:

- contacting vapors, gases, mists, or particulates in the air;
- being splashed by materials while sampling open containers;
- walking through puddles of liquids or on contaminated soil; or
- using contaminated instruments or equipment.

Even with safeguards, contamination may occur. Harmful materials can be transferred into the clean area, exposing unprotected personnel. In removing contaminated clothing, personnel may contact contaminants on clothing or inhale them. To prevent such occurrences, decontamination procedures have been developed and established before anyone can enter the site and must continue throughout site operation.

Personnel decontamination procedures will be based on the contaminant associated with the remedial action at the Columbia, PA, Manufactured Gas Plant Site and the level of protection being worn by site personnel. Decontamination procedures are detailed in Section 6.7.



## **6.2 Sampling Equipment**

Sampling devices require special cleaning procedures when used on site. These procedures are delineated in the chart in Section 6.7.

## **6.3 Equipment Decontamination**

Heavy equipment will be decontaminated by moving the equipment to the designated decon area and brushing off the heavy contamination with a broom, etc. The equipment will then be steam cleaned with the decontamination waters collected for proper disposition. Following the decontamination and prior to exiting the decontamination zone, the project manager/site engineer will inspect the equipment, and if properly decontaminated make note of the date, time, method, and name of decon personnel in the field notebook. The equipment will then be tagged by the project manager/site engineer using a tag containing the same information as that entered into the field log.

## **6.4 Disposal of Contaminated Materials**

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be properly packaged and stored on-site until disposal arrangements are finalized. Clothing not completely decontaminated on-site should be secured in plastic bags before being removed from the site. The proper disposal methods for the site are outlined in the chart in Section 6.7.

## **6.5 Emergency Decontamination**

Personnel with medical problems or injuries may also require decontamination. There is the possibility that the decontamination may aggravate or cause more serious health effects. If prompt lifesaving, first aid, or medical treatment is required, decontamination procedures will be omitted. In either case, a member of the site management team will accompany contaminated personnel to the medical facility to advise on matters involving decontamination.

Emergency decontamination procedures for this site are discussed in the chart in Section 6.7.

## 6.6 Sanitizing of Personal Protective Equipment

Respirator, reusable protective clothing, and other personal articles not only must be decontaminated before being reused, but also sanitized. The inside of masks and clothing become soiled due to exhalation, body oils, and perspiration. Manufacturer's instructions should be used to sanitize the respirator masks. If practical, reusable protective clothing should be machine washed after a thorough decontamination.

## 6.7 Decontamination Procedures

The decontamination procedures for PPE and equipment are presented in Table 6-1.

**Table 6-1**  
**Decontamination Procedures**

X	<b>LEVEL C:</b> Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, boot cover removal, outer glove removal, suit/safety boot wash, suit/safety boot rinse, (canister or mask change), safety boot removal, splash suit removal, inner glove wash, face piece removal, inner glove removal, inner clothing removal, field wash, re-dress. Modifications:
X	<b>LEVEL D:</b> Segregated equipment drop, boot and glove wash, boot and glove rinse. Modifications:
X	<b>SAMPLING EQUIPMENT:</b> In following order: water rinse, soap scrub, water rinse, methanol or pesticide grade acetone wash, water rinse.
X	<b>HEAVY EQUIPMENT DECONTAMINATION:</b> Steam clean the heavy equipment, contain the runoff and discharge the runoff to recovered water treatment system.
X	<b>DISPOSAL PROCEDURES:</b> All contaminated equipment and materials will be stored in a drum in the exclusion zone or the decontamination area until they can be decontaminated or disposed of at an approved disposal facility.
X	<b>EMERGENCY DECONTAMINATION EQUIPMENT/PROCEDURES:</b> Remove gross contamination with a brush, carefully remove contaminated clothing, wash the skin where contaminants could have come into contact. If time permits, reclothe the victim with clean clothes or blankets.

## 7.0 EMERGENCY RESPONSE/CONTINGENCY PLAN

It is essential that site personnel be prepared in the event of an emergency. Emergencies can take many forms: illnesses or injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in weather. The following outlines the general procedures for emergencies.

### 7.1 Emergency Contacts/Telephone Numbers

In case of an emergency, Table 7-1 presents a list of emergency contacts and Table 7-2 lists the emergency equipment available on-site.

**Table 7-1  
Emergency Contacts**

<b>FIRE:</b>		911
<b>POLICE:</b>		911
<b>AMBULANCE:</b>		911
Capable of Transporting Contaminated Personnel?	YES: X	NO:
<b>HOSPITAL:</b> Columbia Hospital		(717) 684 - 2841
Address: 631 Poplar Road Columbia, PA 17512		
Chemical Trauma Capabilities?	YES: X	NO:
Decontamination Capabilities?	YES: X	NO:
Directions From Site to Hospital:	Exit site on Front St. at Locust St., take right to 3rd light, (about 4 blocks), this intersection is Locust & Fifth St.; take left. Go 3 blocks to watch tower, take a right. Go to stop sign, hospital on left.	
<b>NOTE:</b>	See attach map for route to hospital. The route to the hospital was verified by: Jason A. Gerrish Distance from the site to the hospital is: 1 (miles) The approximate driving time is: 5 minutes	
<b>POISON CONTROL CENTER:</b>		(215) 433 - 3211
<b>ELECTRIC COMPANY:</b> PP&L Metropolitan Edison		(800) 342 - 5775 (800) 545 - 7750
<b>PP &amp; L EMERGENCY HOTLINE</b>		(610) 774 - 5566
<b>GAS COMPANY:</b> Columbia Gas Transmission Corp.		(717) 529 - 2248
<b>WATER COMPANY:</b> Columbia Water Company		(717) 684 - 2188
<b>AIRPORT:</b> Lancaster Airport		(717) 569 - 1221
<b>NATIONAL EMERGENCY RESPONSE CENTER:</b>		(800) 424 - 8802
<b>CENTER FOR DISEASE CONTROL:</b>		(404) 488 - 4100 (24-hour)
<b>AT&amp;F (explosion information)</b>		(800) 424 - 9555
<b>CHEMTREC:</b>		(800) 424 - 9300
<b>STATE ENVIRONMENTAL AGENCY: PADEP - Anthony Martinelli</b>		(717) 657 - 4592
<b>STATE EMERGENCY RESPONSE NUMBER</b>		(800) 812 - 3782
<b>Pennsylvania Emergency Management Agency</b>		(717) 783 - 5082
<b>U.S. EPA REGION: III - Mr. Steven Donohue</b>		(215) 597 - 3166
<b>U.S. EPA REGION III PENNSYLVANIA SPILL REPORTING NUMBER</b>		(215) 597- 9898
<b>RETEC CORPORATE OFFICE:</b>	Ms. Dawn Dearborn	(508) 371 - 1422
<b>RETEC PERSONNEL OFFICE (local):</b>		
<b>RETEC CORPORATE HEALTH AND SAFETY OFFICER:</b>	Mr. William A. Odenthal	(412) 823 - 3340
<b>CROZER-CHESTER MEDICAL BURN CENTER</b>		(610) 447 - 2000
<b>RETEC MEDICAL CONSULTANT</b>	Shady Hospital (412) 623-1070	
<b>RETEC PERSONNEL MEDICAL CONSULTANT (local)</b>		
<b>RETEC PROJECT MANAGER:</b>	Alfred P. Leuschner	(617) 371 - 1422
<b>CLIENT CONTACT: (PP &amp; L)</b>	Brad Wise	(610) 774 - 6508
<b>CLEAN SITES CONTACT:</b>	Douglas McClure	(703) 739 - 1279
<b>SUPERVISING CONTRACTOR: To be determined</b>		

Table 7-2

EMERGENCY EQUIPMENT AVAILABLE ON-SITE

COMMUNICATION EQUIPMENT	
	PUBLIC TELEPHONES
X	PRIVATE TELEPHONES
	CELLULAR TELEPHONES
	TWO-WAY RADIO (WALKIE TALKIE)
X	EMERGENCY ALARMS/HORNS
MEDICAL EQUIPMENT	
X	FIRST AID KITS
	STRETCHER
X	EYE WASH STATION
	SAFETY SHOWER
X	BLANKETS
	OTHER:
FIRE FIGHTING EQUIPMENT	
X	FIRE EXTINGUISHER TYPES: Dry Chemical
	OTHER:
SPILL/LEAK EQUIPMENT	
X	ABSORBENT BOOM PADS
	DRY ABSORBENT
ADDITIONAL SAFETY EQUIPMENT:	

## 7.2 Personnel Responsibilities During Emergencies

The project manager/site engineer, as the site administrator for the project, has primary responsibility for responding to and correcting emergency situations. The on-site project manager/site engineer will:

- Take appropriate measures to protect personnel including withdrawal from the exclusion zone, total evacuation and securing of the site, or upgrading or downgrading the level of protective clothing and respiratory protection.
- Take appropriate measures to protect the public and the environment including isolating and securing the site, preventing run-off to surface waters and ending or controlling the emergency to the extent possible.
- Ensure that the appropriate Federal, State and Local agencies are informed, and emergency response plans are coordinated. In the event of a fire or explosion, the local fire department should be summoned immediately. In the event of an air release of toxic materials, the local authorities (police and fire department) should be informed in order to assess the need for evacuation. In the event of a spill, PADEP and EPA will be alerted.
- Ensure that appropriate decon procedures or testing for exposed or injured personnel is performed.
- Notify RETEC's Project Manager, Clean Sites and PP&L
- Determine the cause of the incident and make recommendations to prevent recurrence.
- Ensure that all required reports have been prepared.
- If an injury has occurred, depending on the type and severity, notify RETEC's medical consultant and/or occupational physician.
- Notify RETEC's Corporate Health and Safety Officer.
- Notify the injured person's regional office.

- Notify all necessary agencies.
- Prepare an *Injury/Exposure Report* (Appendix G) and submit the report to RETEC's Corporate Health and Safety Officer and RETEC's Corporate Personnel Office within 48 hours.

### **7.3 Medical Emergencies**

Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and, if possible, first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must be reported to the project manager/site engineer.

Any person transporting an injured/exposed person to a hospital for treatment should take directions to the hospital with them, and information on the chemicals involved. The hospital should be alerted ahead of time as to the nature of the contamination.

Any vehicle used to transport contaminated personnel will be cleaned or decontaminated as necessary.

### **7.4 Fire or Explosion**

In the event of a fire or explosion, the local fire department should be summoned immediately. Upon their arrival the project manager/site engineer will advise the fire commander of the location and nature of the fire, and the location and identification of all hazardous materials on-site.

If it is safe to do so, site personnel may use fire fighting equipment available on-site or remove or isolate flammable or other hazardous materials which may contribute to the fire.

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## 7.5 Spill or Leaks

In the event of a spill or leak, site personnel will locate the source of the spillage and stop the flow, if it can be done safely, and begin containment and recovery of the spilled material.

## 7.6 Evacuation Routes and Resources

Evacuation routes have been established for the site. Evacuation should be conducted immediately, without regard for equipment under conditions of extreme emergency.

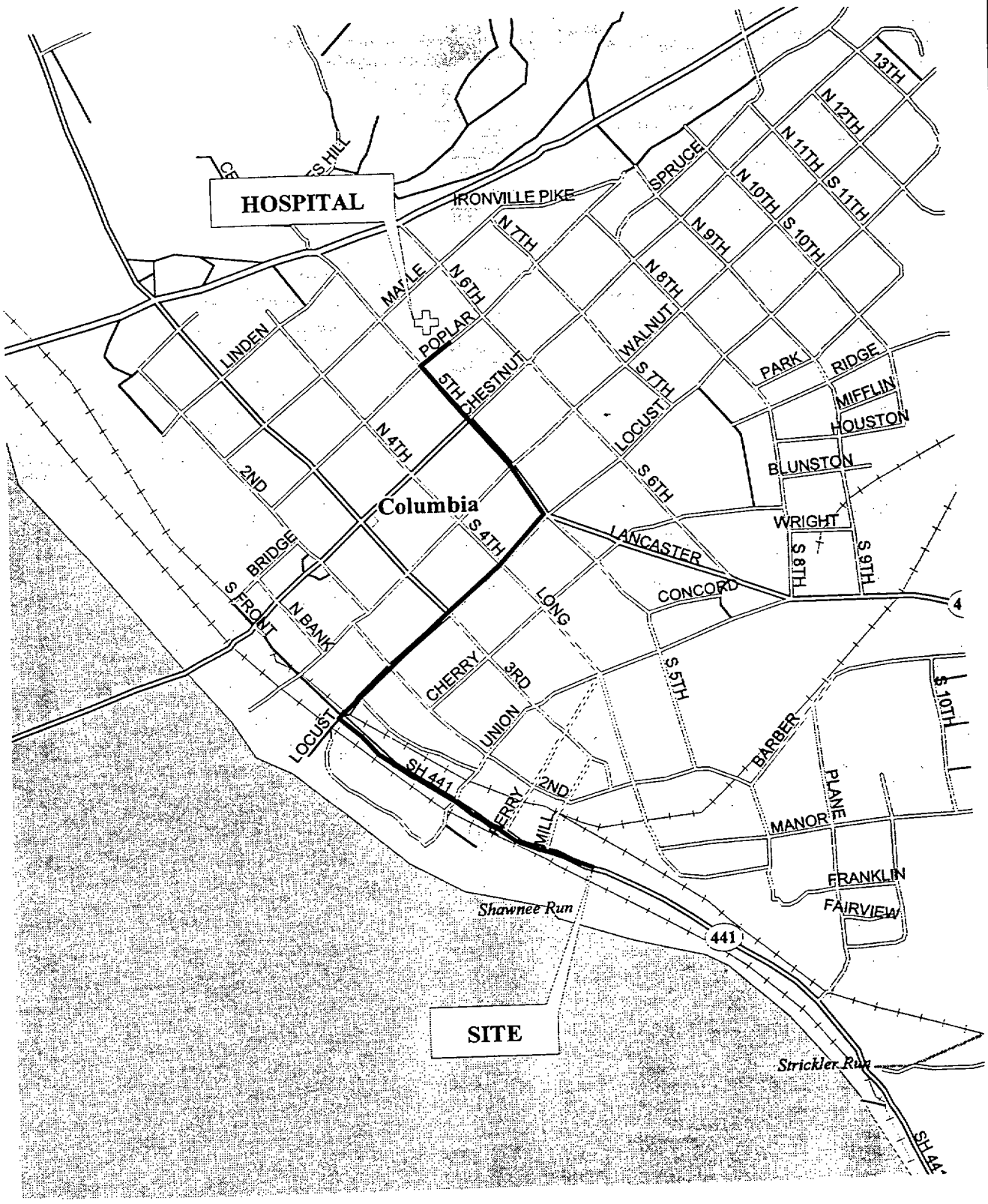
- Evacuation notification will be a continuous blast on an air horn, vehicle horn, or by verbal communication via radio.
- Keep upwind of smoke, vapors, or spill location.
- Exit through the decontamination corridor if possible.
- If evacuation is not via the decontamination corridor, site personnel should remove contaminated clothing once they are in a location of safety and leave the clothing near the exclusion zone or in a safe place.
- The project manager/site engineer will conduct a head count to insure all personnel have been evacuated safely.
- In the event that the a site evacuation is necessary, all personnel are to:
  - Escape the emergency situation;
  - Decontaminate to the maximum extent practical; and
  - Meet at RETEC's command post or some other pre-arranged location.

## 7.7 Directions to Hospital

Figure 7-1 presents the route from the site to the hospital. To get to the hospital:

- Exit site onto Front Street making a right turn.
- Follow Front Street to Locust Street.
- Take right onto Locust.
- Follow Locust until 3rd traffic light (about 4 blocks).
- This is the intersection of Locust Street and Fifth Street, take left.
- Go 3 blocks to watch tower, take right, onto Poplar Street.
- At stop sign take left into hospital.





Route From Site To Hospital

FIGURE  
7-1

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## 8.0 DRUM HANDLING/SAMPLING

This project will require the handling or sampling of drummed materials. Accidents may occur during handling of drums and other hazardous waste containers. Hazards include detonation, fires, explosions, vapor generation, and physical injury resulting from moving heavy containers by hand and working around stacked drums, and heavy equipment. OSHA regulations (29 CFR Parts 1910 and 1926) include general requirements and standards for storing, containing and handling chemicals and containers, and for maintaining equipment used for handling materials. EPA regulations (40 CFR Part 265) stipulates requirements for types of containers, maintenance of containers and containment structures, and design and maintenance of storage areas. DOT regulations (49 CFR Parts 171 through 178) also stipulate requirements for containers and procedures for shipment of hazardous waste. If drums are to be handled in any manner, personnel shall:

- Have a dry chemical fire extinguisher on hand to control small fires.
- Check for presence of required labels, markings, etc. and note conditions of containers. Are the drums bulging, deteriorated or leaking?
- Before moving any drum or container, determine the most appropriate sequence in which the various containers should be moved.
- Exercise extreme caution in handling drums that are not intact and tightly sealed.
- Use the following types of equipment to move drums and/or containers: (1) drum grappler attached to a hydraulic excavator, (2) a small front-end loader with a bucket sling, (3) rough terrain fork lift, or (4) a drum cart.
- Train personnel in proper lifting and moving techniques to prevent back injuries.
- Have overpacks ready before any attempt is made to move drums.
- Pressurized drums are extremely hazardous. If possible, do not move drums that may be under internal pressure as evidenced by bulging or swelling.

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- If a pressurized drum has to be moved, handle the drum with a grappler unit constructed for explosive containment, if possible. Either move the drum only as far as necessary to allow seating on firm ground, or carefully overpack the drum.
- If a drum containing liquid cannot be moved without rupture, immediately transfer its contents to a sound drum using a pump designed for transferring the liquid.
- Unless drum contents are known, exercise extreme caution when opening drums.
- If an explosive situation exists, use non-sparking tools such as a bronze wrench.
- If a drum shows signs of swelling or bulging, relieve excess pressure prior to opening, and if possible, open using such remote devices as pneumatically operated impact wrenches, hydraulically or pneumatically operated drum piercers, or a backhoe equipped with bronze spikes for penetrating drum tops.
- DO NOT use picks, chisels, or firearms to open drums.
- If pressure must be released manually, place a barrier such as explosion-resistant plastic sheeting between the worker and bung to deflect any gas, liquid, or solid that may be expelled as the bung is loosened.
- Reseal open bungs and drill holes with new bungs or plugs to avoid explosions and/or vapor generation. If an open drum cannot be resealed, place the drum into an overpack. Plug any opening in pressurizing drums with pressure venting caps set for 5 psi.
- When manually sampling a drum, keep sampling personnel at a safe distance while drums are being opened. Sample only after opening operations are complete.
- Do not lean over other drums to reach the drum being sampled.
- Cover drum tops with plastic sheeting or other suitable non-chlorinated material to avoid excessive contact with drum tops.
- Never stand on drum tops.
- Obtain samples with either hollow glass rods or vacuum pumps.

## 9.0 LOCKOUT/TAGOUT

This project will involve the operation of machines and/or equipment in which the unexpected energization or start up of the machinery or equipment (boiler pumps), or release of stored energy, could cause injury to personnel. OSHA regulations for Lockout/Tagout (29 CFR 1910.147 - Control of Hazardous Energy) must be implemented and personnel must comply with all Lockout/Tagout procedures.

To assure personnel are protected from equipment accidentally operating during maintenance and servicing, OSHA requires the utilization of lockout/tagout procedures. These procedures apply to maintenance and/or servicing of equipment and not to normal operations.

These procedures apply to operations when guards are removed or bypassed, or other safety devices are bypassed, or any part of the body is in a danger zone for the servicing and/or maintenance of the equipment. The procedures do not apply to cord and plug connected equipment which is under the control of the operator.

Some of the common energy sources which require lockout/tagout procedures include, but are not limited to:

- electrical;
- hydraulic;
- pneumatic;
- chemical; or
- thermal.

### **Tags**

Tags are only warning devices and do not provide physical restraint. Tags **MUST NOT** be removed without authorization of the person responsible for its attachment and never bypassed or ignored. Tags must be legible, understandable, and used as part of the overall lockout/tagout program. Tagout devices shall warn against hazardous conditions and shall include verbiage such as:

- DO NOT START
- DO NOT OPEN
- DO NOT CLOSE

- DO NOT ENERGIZE
- DO NOT OPERATE

## **Locks**

Locks are used as a positive means to hold energy isolating devices in the safe or off position. Locks prevent removal without excessive force or unusual techniques such as bolt cutters etc.

The lockout/tagout procedure requires the utilization of a lockout device on all energy isolating devices which can be locked out, unless it can be demonstrated that a tagout device provides the equivalent amount of protection. If tagouts are authorized, they must be placed in the same location where the lock would be placed. All lockout/tagout devices shall be singularly identified, used only for controlling energy, durable, standardized, and identifiable.

### **9.1 Procedures**

- **Prepare:** Notify affected personnel that work requiring lockout/tagout will be performed.
- **Shutdown:** Turn off or shutdown the equipment by following an orderly shutdown procedure.
- **Isolation:** Locate and isolate the equipment energy isolating devices.
- **Lockout/Tagout:** Lockout/tagout each energy isolating device in a "safe" or "off" position. If the tagout device is utilized, affix it at the same point where the lock would be used or as close as possible.
- **Stored Energy:** Assure all potentially hazardous or residual energy is relieved or otherwise made safe. Make sure the stored energy will not reaccumulate by locking a vent valve in the closed position.
- **Verify:** Verify proper isolation and/or de-energization by testing the start button to ensure that the equipment will not operate. Make sure you push the **STOP** button after activating the start button.

- Perform Work: After lockout/tagout procedures have been implemented, execute the maintenance and/or servicing work.
- Release: Ensure that all non-essential items (tools, etc.) have been removed and the equipment is operationally intact. Ensure that personnel are safely positioned and affected personnel have been notified.
- Removal: Lockout/tagout devices must be removed only by the authorized employee who applied the devices.
- Notification: Notify affected personnel that the maintenance and/or servicing is complete, the lockout/tagout devices have been removed, and the equipment is released for operation.

Testing or positioning may be required for some equipment. Before removing lockout/tagout devices, clear the machine, remove personnel, remove devices, energize, and proceed with testing. After testing, de-energize and reapply the lockout/tagout procedures.

Outside personnel, such as contractors, and RETEC personnel shall inform each other of their lockout/tagout procedures to assure all lockout/tagout procedures are complied with.

Some jobs may require lockout/tagout of numerous energy isolation devices. A group lockout/tagout is then used which provides equal protection. Group lockout/tagout must be under the primary responsibility of an authorized employee. Each group member must apply his/her own personal lockout/tagout device.

During shift changes, special procedures must be utilized to assure the continuity of lockout/tagout protection. There must be an orderly transfer between off-going and on-coming personnel.

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**APPENDIX A**

**SITE SAFETY PLAN AMENDMENTS**

**REMEDIAATION TECHNOLOGIES, INC.  
SITE SAFETY PLAN AMENDMENTS**

**AMENDMENT NO.: 1**

<b>CLIENT:</b> PP&L	<b>PROJ. NO.:</b> 3-1612-100
<b>LOCATION:</b> Columbia, PA	<b>DATE:</b> 11/17/94
<b>PROJ. MGR.:</b> Al Leuschner	<b>SITE ENG.:</b> Mark Moeller
<b>SITE HEALTH AND SAFETY OFFICER:</b> Jason Gerrish	
<b>AMENDMENT:</b> Added project description, additional hazards, name of RETEC's medical consultant, and added activated carbon to list of chemicals of concern.	
<b>REASON FOR AMENDMENT:</b> Implementations of removal actions.	
<b>ALTERNATE SAFEGUARD PROCEDURES:</b>	
<b>REQUIRED CHANGES IN PPE:</b>	

\_\_\_\_\_  
SITE HEALTH AND SAFETY OFFICER

\_\_\_\_\_  
DATE

\_\_\_\_\_  
CORPORATE HEALTH AND SAFETY OFFICER

\_\_\_\_\_  
EFFECTIVE DATE OF AMENDMENT



**APPENDIX B**

**SITE SAFETY PLAN ACKNOWLEDGEMENT FORM**



**APPENDIX C**  
**COLD STRESS**

## COLD STRESS

These Threshold Limit Values (TLVs) are intended to protect workers from the severe effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body core temperature from falling below 36°C and to prevent cold injury to body extremities. Deep body temperature is the core temperature of the body as determined by rectal temperature measurements. For a single, occasional exposure to a cold environment, a drop in core temperature to no lower than 35°C should be permitted. In addition to provisions for total body protection, TLV objective is to protect all parts of the body with emphasis on hands, feet and head from cold injury.

### Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 1 (taken from Dembert in *AFP*, January, 1982). Workmen should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken to as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air, or to immersion in cold water, in temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating clothing to maintain core temperatures above 36°C must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill factor<sup>1</sup> or the cooling power of the air is a critical factor. An equivalent chill temperature chart relating the

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<sup>1</sup>Wind chill factor is a unit of heat loss from a body defined in watts per meter squared per hour being a function of the air temperature and wind velocity upon the exposed body.

actual dry bulb air temperature and the wind velocity is presented in Table 2. The equivalent chill temperatures on exposed skin when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

2. Unless there are unusual or extenuating circumstances, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary action to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

### **Evaluation and Control**

For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of  $-32^{\circ}\text{C}$  ( $-25^{\circ}\text{F}$ ). Superficial or deep local tissue freezing will occur only at temperatures below  $-1^{\circ}\text{C}$  regardless of wind speed.

1. If fine work is to be performed with bare hands for more than 10-20 minutes in an environment below  $16^{\circ}\text{C}$  ( $60^{\circ}\text{F}$ ), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars shall be covered by thermal insulating material at temperatures below  $-1^{\circ}\text{C}$  ( $30^{\circ}\text{F}$ ).

At air temperatures of  $2^{\circ}\text{C}$  ( $35.6^{\circ}\text{F}$ ) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 3. Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

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TABLE 1

PROGRESS CLINICAL PRESENTATIONS OF HYPOTHERMIA <sup>2</sup>		
Core Temperature		Clinical Signs
°C	°F	
37.6	99.6	"Normal" rectal temperature
37	98.6	"Normal" oral temperature
36	96.8	Metabolic rate increases in an attempt to compensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with normal blood
33	91.4	Severe hypothermia below this temperature
32	89.6	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
31	87.8	
30	86.0	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases.
29	84.2	
28	82.4	Ventricular fibrillation possible with myocardial irritability
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent
26	78.8	Victim seldom conscious
25	77.0	Ventricular fibrillation may occur spontaneously
24	75.2	Pulmonary edema
22	71.6	Maximum risk of ventricular fibrillation
21	69.8	
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to recover
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patient to recover

<sup>2</sup> Presentations approximately related to core temperature. Reprinted from the January 1982 issue of *American Family Physician* published by the American Academy of Family Physicians.

**TABLE 2**

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE (under calm conditions) <sup>3</sup>												
Est. Wind Speed (mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-131
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-145
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	Little Danger - In < 1 hr. with dry skin. Maximum danger of false sense of security.				Increasing Danger - Danger from freezing of exposed flesh within one minute.				Greater Danger - Flesh may freeze within 30 seconds.			
	Trench foot and immersion foot may occur at any point on this chart.											

<sup>3</sup>Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

*Handwritten signature*

**TABLE 3**

Threshold Limit Values Work/Warm-up Schedule for Four Hour Shift <sup>4</sup>											
Air Temp. - Sunny Sky		Non Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C	°F	Max. Work Period (min.)	No. of Breaks	Max Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	'15° to -19°	Normal Breaks		Normal Breaks		75	2	55	3	40	4
-29° to -31°	-20° to -24°	Normal Breaks		75	2	55	3	40	4	30	5
-32° to -34°	-25° to -29°	75	2	55	3	40	4	30	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55	3	40	4	30	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40	4	30	5	Non-emergency work should cease		Non-emergency work should cease			
-40° to -42°	-40° to -44°	30	5	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease			
-43° & below	-45° & below	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease			

<sup>4</sup>Notes for Table 3:

- Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at 30° F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (5).
- The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
- If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill of about 1720 Wm<sup>2</sup>; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m<sub>2</sub>. In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.



To prevent contact frostbite, the workers should wear anti-contact gloves.

1. When cold surfaces below  $-7^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ) are within reach, a warning should be given to each worker by his supervisor to prevent inadvertent contact by skin.
2. If the air temperature is  $-17.5^{\circ}\text{C}$  ( $9^{\circ}\text{F}$ ) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below  $4^{\circ}\text{C}$  ( $40^{\circ}\text{F}$ ). The workers shall wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind shall be reduced by shielding the work area, or by wearing an easily removable outer windbreak layer garment. Wind chill cooling rates are illustrated in Table 4.
2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing is used may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments must include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, and the clothing is wet, the employee shall change into dry clothes before entering the cold area. The workers shall change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change shall be determined empirically and will vary individually and according to the type shoe worn and how much the individual's feet sweat.
3. If extremities, ears, toes, and nose, cannot be protected sufficiently to prevent sensation of excessive cold or frostbite by handwear, footwear, and face masks, these protective items shall be supplied in auxiliary heated versions.
4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.

<b>Table 4</b> <b>Wind Chill Cooling Rate Effects*</b>	
Wind Chill Rates (Watts/m <sup>2</sup> )	Comments/Effects
700	Conditions considered comfortable when dressed for skiing.
1200	Conditions no longer pleasant for outdoor activities on overcast days.
1400	Conditions no longer pleasant for outdoor activities on sunny days.
1600	Freezing of exposed skin begins for most people depending on the degree of activity and the amount of sunshine.
2300	Conditions for outdoor travel such as walking become dangerous. Exposed areas of the face freeze in less than 1 minute for the average person.
2700	Exposed flesh will freeze within half a minute for the average person.

\*Adapted from Canadian Department of the Environment, Atmospheric Environment Service.

- Workers handling evaporative liquid (gasoline, alcohol or cleaning fluids) at air temperature below 4°C (40°F) shall take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point only just above ambient temperatures.

### Work-Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (20°F), heated warming shelters (tents, cabins, rest rooms, etc.) shall be made available nearby and the workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for the immediate return to the shelter. When entering the heated shelter, the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of the diuretic and circulatory effects.

For work practices at or below -12°C (10°F) ECT, the following shall apply:

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1. The worker shall be under constant protective observation (buddy system or supervision).
  2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing shall be provided.
  3. New employees shall not be required to work full time in cold in the first days until they become accustomed to the working conditions and required protective clothing.
  4. The weight and bulkiness of clothing shall be included in estimating the required work performance and weights to be lifted by the worker.
  5. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used. The worker should be protected from drafts to the greatest extent possible.
  6. The workers shall be instructed in safety and health procedures. The training program shall include as a minimum instruction in:
    - a. Proper rewarming procedures and appropriate first aid treatment.
    - b. Proper clothing practices.
    - c. Proper eating and drinking habits.
    - d. Recognition of impending frostbite.
    - e. Recognition of signs and symptoms of impending hypothermia or excessive cooling of body even when shivering does not occur.
    - f. Safe work practices.

### **Special Workplace Recommendations**

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.
2. Special wind protective clothing shall be provided based upon existing air velocities to which workers are exposed.

Special caution shall be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain shall be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals are required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below  $16^{\circ}\text{C}$  ( $60^{\circ}\text{F}$ ) to enable overall compliance with the requirements of the TLV to be maintained.
2. Whenever the air temperature at a workplace falls below  $-1^{\circ}\text{C}$  ( $30^{\circ}\text{F}$ ), the dry bulb temperature should be measured and recorded at least every 4 hours.
3. In indoor workplace, the wind speed should also be recorded at least every 2 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).
4. In outdoor work situation, the windspeed should be measured and recorded together with the air temperature whenever the air temperature is below  $-1^{\circ}\text{C}$  ( $30^{\circ}\text{F}$ ).
5. The equivalent chill temperature shall be recorded with the other data whenever the equivalent chill temperature is below  $-7^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ).

Employees shall be excluded from work in cold at  $-1^{\circ}\text{C}$  ( $30^{\circ}\text{F}$ ) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below  $-24^{\circ}\text{C}$  ( $-10^{\circ}\text{F}$ ) with wind speeds less than five miles per hour, or air temperatures should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to provided for first aid treatment.

**APPENDIX D**  
**HEAT STRESS**

## HEAT STRESS AND OTHER PHYSIOLOGICAL FACTORS

Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat, fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of most common (and potentially serious) illness at hazardous wastes sites, regular monitoring and other preventative precautions are vital.

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include:

- Lack of physical fitness,
- Lack of acclimatization,
- Age,
- Dehydration,
- Obesity,
- Alcohol and drug use,
- Infection,
- Sunburn,
- Diarrhea, and
- Chronic disease.

Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount and type of PPE worn. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the following:

- Anticipated work rate;
- Ambient temperature and other environmental factors;
- Type of protective ensemble; and
- Individual worker characteristics and fitness.

### **Monitoring**

Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

- For workers wearing permeable clothing (eg., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress [4]. If the actual work clothing differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly [5].
- For workers wearing semipermeable or impermeable<sup>1</sup> encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C) [2].

To monitor the worker, measure the following:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

If the heart rate still excess 110 beats per minute at the next rest period, shorten the following work cycle by one-third [5].

- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking)/

If oral temperature excess 99.6°F (37.7°C) at the beginning of the next rest period, shorten the following work cycle by one-third [5].

Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C) [5].

- Body water loss, if possible. Measure weight on a scale accurate to  $\pm 0.25$  lb at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing. The body water loss should not exceed 1.5 percent total body weight loss in a work day [12].

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<sup>1</sup>Although no protective ensembles is "completely" impermeable, for practical purposes an outfit may be considered impermeable when calculating heat stress risk.



Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 1). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Table 1 Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers <sup>2</sup>		
Adjusted Temp. <sup>3</sup>	Normal Work Ensemble <sup>4</sup>	Impermeable Ensemble
90°C (32.2°F) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° -87.5°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
87.5°-87.5°F (28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

## Prevention

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

- Adjust work schedules:
  - Modify work/rest schedules according to monitoring requirements.
  - Mandate work slowdowns as needed.
  - Rotate personnel: alternate job functions to minimize overstress or overexertion at one task.
    - Add additional personnel to work teams.
  - Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.

<sup>2</sup>For work levels of 250 Kilocalories/hour.

<sup>3</sup>Calculate the adjusted air temperature ( $t_{a \text{ adj}}$ ) using this equation:  $t_{a \text{ adj}} = t_a^\circ = (13 \times \% \text{ sunshine})$ . Measure air temp. ( $t_a$ ) with a standard thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distant shadow, 0 percent sunshine = no shadows).

<sup>4</sup>A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain workers' body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost water [7]. When heavy sweating occurs, encourage the work to drink more. The following strategies may be useful:
  - Maintain water temperature at 50° to 60°F (10° to 15.6°C).
  - Provide small disposable cups that hold about 4 ounces (0.1 liter).
  - Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.
  - Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
  - Weigh workers before and after work to determine if fluid replacement is adequate.
- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:
  - Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.
  - Cooling jackets, vests, or suits.
- Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress.

## Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This section discusses the demonstrated physiological responses to PPE, the individual human traits that play a factor in these responses, and some of the precautionary and training measures that need to be taken to avoid PPE-induced injury.

The physiological factors may affect worker ability to function using PPE include:

- Physical condition,
- Level of acclimatization,
- Age,
- Gender, and
- Weight.

**Physical Condition.** Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work, a fit person, relative to an unfit person, will have [1,3,8,9]:

- Less physiological strain.
- A lower heart rate.
- A lower body temperature, which indicates less retained body heat (a rise in internal temperature precipitates heat injury.)
- A more efficient sweating mechanism.
- Slightly lower oxygen consumption.
- Slightly lower carbon dioxide production.

**Level of Acclimatization.** The degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions affects his or her ability to do work. Acclimatized individuals generally have lower heart rates and body temperatures than unacclimatized individuals [10], and sweat sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work loads than unacclimatized workers [11]. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss [3].

*Acclimatization can occur after just a few days of exposure to a hot environment [8,9]. NIOSH recommends a progressive 6-day acclimatization period for the unacclimatized worker before allowing him/her to do full work on a hot job. Under this regimen, the first day of work on site is begun using*

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only 50 percent of the anticipated workload and exposure time, and 10 period may be shortened 2 or 3 days. However, workers can lose acclimatization in a matter of days, and work regimens should be adjusted to account for this.

When enclosed in an impermeable suit, fit acclimatized individuals sweat more profusely than unfit or unacclimatized individuals and may therefore actually face a greater danger of heat exhaustion due to rapid dehydration. This can be prevented by consuming adequate quantities of water. See previous section on *Prevention* for additional information.

**Age.** Generally, maximum work capacity declines with increasing age, but this is not always the case. Active, well conditioned seniors often have performance capabilities equal to or greater than young sedentary individuals. However, there is some evidence, indicated by lower sweat rate and higher body core temperatures, that older individuals are less effective in compensating for a given level of environmental heat and work loads [12]. At moderate thermal loads, however, the physiological responses of "young" and "old" are similar and performance is not affected [12].

Age should not be the sole criterion for judging whether or not an individual should be subjected to moderate heat stress. Fitness level is a more important factor.

**Gender.** The literature indicates that females tolerate heat stress at least as well as their male counterparts [13]. Generally, a female's work capacity averages 10 to 30 percent less than that of a male [3]. The primary reasons for this are the greater oxygen-carrying capacity and the stronger heart in the male [8]. However, a similar situation exists as with aging: not all males have greater work capacities than all females.

**Weight.** The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). Heat loss (dissipation) is a function of surface area and heat production is dependent on mass. Therefore, heat balance is described by the ratio of the two.

Since overweight individuals (those with a low ratio) produce more heat per units of surface area than thin individuals (those with a high ratio), overweight individuals should be given special consideration in heat stress situations. However, when wearing impermeable clothing, the weight of an individual is not a critical factor in determining the ability to dissipate excess heat.

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## Signs and Symptoms of Heat Stress

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms
  - pain in the 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 fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical health must be obtained. Signs and symptoms are:
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - dizziness and confusion
  - strong, rapid pulse
  - coma

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**APPENDIX E**

**MSDS's**

ORIGINAL  
(Rec'd)

# Occupational Health Guideline for Phosphoric Acid

## INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

## SUBSTANCE IDENTIFICATION

- Formula:  $H_3PO_4$
- Synonyms: White phosphoric acid; ortho-phosphoric acid; 85% phosphoric acid; meta-phosphoric acid
- Appearance and odor: Viscous, colorless, odorless liquid which can solidify at temperatures below 21 C (70 F).

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for phosphoric acid is 1 milligram of phosphoric acid per cubic meter of air ( $mg/m^3$ ) averaged over an eight-hour work shift.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Phosphoric acid can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

### • Effects of overexposure

1. *Short-term Exposure:* Solid phosphoric acid or its solutions may cause skin burns. Contact with the eyes may produce irritation and eye burns. Exposure to phosphoric acid vapor or mist may cause irritation of the eyes, nose, and throat.

2. *Long-term Exposure:* Repeated or prolonged exposure may cause irritation of the skin.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to phosphoric acid.

### • Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to phosphoric acid at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from phosphoric acid exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of phosphoric acid dust or mist might cause exacerbation of symptoms due to its irritant properties.

—Skin disease: Phosphoric acid dust, mist, or solutions may cause dermatitis. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

### • Summary of toxicology

Phosphoric acid mist is an irritant to the eyes, upper respiratory tract, and skin. The solid is especially irritating to skin in the presence of moisture. Unacclimated workers could not endure exposure to fumes of phosphorus pentoxide (the anhydride of phosphoric acid) at a concentration of  $100 mg/m^3$ ; exposure to concentrations between  $3.6$  and  $11.3 mg/m^3$  produced coughing. Concentrations of  $0.8$  to  $5.4 mg/m^3$  were noticeable but not uncomfortable. There is no evidence that phosphorus poisoning can result from contact with phosphoric acid. The risk of pulmonary edema resulting from the inhalation of mist or spray is remote. A dilute solution buffered to pH 2.5 caused a moderate brief stinging sensation but no injury when dropped in the human eye. A 75% solution will cause severe skin burns.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 98

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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2. Boiling point (760 mm Hg): 260 C (500 F)
3. Specific gravity (water = 1): 1.7
4. Vapor density (air = 1 at boiling point of phosphoric acid): 3.4
5. Melting point: 21 C (70 F)
6. Vapor pressure at 20 C (68 F): 0.0285 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Reactivity**

1. **Conditions contributing to instability:** None
2. **Incompatibilities:** Contact with strong caustics can cause liberation of much heat and violent spattering. Contact with most metals causes formation of flammable and explosive hydrogen gas.
3. **Hazardous decomposition products:** Toxic gases and vapors (such as phosphoric acid fume) may be released when phosphoric acid decomposes.
4. **Special precautions:** Liquid phosphoric acid will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Not combustible

- **Warning properties**

Phosphoric acid mist can cause irritation of the eyes and respiratory tract, according to the *Hygienic Guide*. No quantitative information is given, however. Deichmann and Gerarde note that since phosphoric acid "has a low vapor pressure at room temperature, it is not irritating to the eyes or respiratory tract, unless introduced into the atmosphere as a spray or mist."

## MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Sampling and analyses may be performed by collection of phosphoric acid on a cellulose membrane filter, followed by leaching with hot water, chemical reaction, and spectrophotometric analysis. An analytical method for phosphoric acid is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

## RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental

concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

## PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with solid or liquid phosphoric acid or solutions containing greater than 1.6% ortho-phosphoric acid by weight or any concentration of meta-phosphoric acid.

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with solutions containing 1.6% or less ortho-phosphoric acid by weight.

- If employees' clothing may have become contaminated with solid phosphoric acid, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing contaminated with phosphoric acid should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of phosphoric acid from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the phosphoric acid, the person performing the operation should be informed of phosphoric acid's hazardous properties.

- Where there is any possibility of exposure of an employee's body to solid or liquid phosphoric acid or solutions containing phosphoric acid, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Non-impervious clothing which becomes contaminated with phosphoric acid should be removed immediately and not reworn until the phosphoric acid is removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of solid or liquid phosphoric acid or solutions containing phosphoric acid contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to solid or liquid phosphoric acid or solutions containing more than 1.6% ortho-phosphoric acid by weight, or any concentration of meta-phosphoric acid, an eye-wash fountain should be provided within the immediate work area for emergency use.

## SANITATION

- Skin that becomes contaminated with phosphoric acid should be immediately washed or showered to remove any phosphoric acid.

## COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to phosphoric acid may occur and control methods which may be effective in each case:

Operation	Controls	Operation	Controls
Use in manufacture of aluminum products in bright dipping operations; use in cleaning, electropolishing, and pickling in manufacture of steel, brass, bronze, and copper during surface treatment and rust-proofing operations	Process enclosure; local exhaust ventilation; personal protective equipment	Use in manufacture of food products, intermediates, and food additives; use as an antioxidant and preservative; use in wood, textile, polyurethane foam flame-retardant processing and production of flame-retardant agents	Process enclosure; personal protective equipment
Use in synthesis of intermediates in manufacture of soil fertilizers; use in manufacture of livestock and poultry feed	Process enclosure; local exhaust ventilation; personal protective equipment	Use in manufacture of cleaning preparations and disinfectants	Process enclosure; personal protective equipment
Use during synthesis of detergent and soap builders and water-treatment chemicals; use as an acidulant and flavor agent in manufacture of carbonated beverages and jellies and preserves	Process enclosure; personal protective equipment	Use as a bonding agent in manufacture of refractory bricks; use during lithography and photoengraving operations	Process enclosure; personal protective equipment
		Use as a catalyst in synthesis of other chemicals; use in synthesis of textile and leather processing chemicals, clays, ceramics, cements, and clay-thinning agents for drilling mud formulations	Process enclosure; personal protective equipment
		Use in synthesis of pharmaceuticals and pharmaceutical intermediates and in the extraction of penicillin; use as a laboratory reagent	Process enclosure; personal protective equipment
		Use during manufacture of opal glass; during manufacture of dental cements and dentrifice adhesives, adhesive gums, and synthetic rubber; and in the manufacture of electric lights	Process enclosure; personal protective equipment

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If phosphoric acid gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

- **Skin Exposure**

If phosphoric acid gets on the skin, immediately flush the contaminated skin with water. If phosphoric acid soaks through the clothing, remove the clothing immediately and flush the skin with water.

- **Breathing**

If a person breathes in large amounts of phosphoric acid, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Swallowing**

When phosphoric acid has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

## **SPILL, LEAK, AND DISPOSAL PROCEDURES**

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If phosphoric acid is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. If in the solid form, collect spilled material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill.
3. If in the liquid form, collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

- Waste disposal method:

Liquid phosphoric acid may be disposed of by absorbing in vermiculite, dry sand, earth, or a similar material and disposing in a secured sanitary landfill.

## **REFERENCES**

- American Conference of Governmental Industrial Hygienists: "Phosphoric Acid," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
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## RESPIRATORY PROTECTION FOR PHOSPHORIC ACID

Condition	Minimum Respiratory Protection* Required Above 1 mg/m <sup>3</sup>
Particulate or Vapor Concentration	
50 mg/m <sup>3</sup> or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
2000 mg/m <sup>3</sup> or less	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.
Greater than 2000 mg/m <sup>3</sup> or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.  A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

\*Only NIOSH-approved or MSHA-approved equipment should be used.

# Occupational Health Guideline for Sulfuric Acid

## INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

## SUBSTANCE IDENTIFICATION

- Formula:  $H_2SO_4$
- Synonyms: Oil of vitriol
- Appearance and odor: Colorless to dark brown, oily, odorless liquid.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for sulfuric acid is 1 milligram of sulfuric acid per cubic meter of air ( $mg/m^3$ ) averaged over an eight-hour work shift. NIOSH has recommended a permissible exposure limit of 1  $mg/m^3$  averaged over a work shift of up to 10 hours per day, 40 hours per week. The NIOSH Criteria Document for Sulfuric Acid should be consulted for more detailed information.

## HEALTH HAZARD INFORMATION

- Routes of exposure  
Sulfuric acid can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- Effects of overexposure
  1. *Short-term Exposure:* Sulfuric acid may cause irritation of the eyes, nose, and throat. Breathing in the mist or vapor may cause teeth erosion or the mouth to become sore and also difficulty in breathing. Splashes in the eyes or on the skin will cause severe skin burns.
  2. *Long-term Exposure:* Repeated or prolonged exposure to dilute solutions of sulfuric acid may cause irritation of the skin. Repeated or prolonged exposure

to mists or vapors of sulfuric acid may cause erosion of the teeth, chronic irritation of the eyes, or chronic inflammation of the nose, throat, and bronchial tubes.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to sulfuric acid.

- Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to sulfuric acid at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory system, eyes, and teeth should be stressed. The skin should be examined for evidence of chronic disorders.

—14" x 17" chest roentgenogram: Sulfuric acid may cause acute lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Sulfuric acid is reported to cause pulmonary function impairment. Periodic surveillance is indicated.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis, except that an x-ray is considered necessary only when indicated by the results of pulmonary function testing.

- Summary of toxicology

Sulfuric acid mist severely irritates the eyes, respiratory tract, and skin. Concentrated sulfuric acid destroys tissue due to its severe dehydrating action, whereas the dilute form acts as a milder irritant due to acid properties. The LC50 of mist of 1-micron particle size for an 8 hour exposure was 50  $mg/m^3$  for adult guinea pigs and 18  $mg/m^3$  for young animals. Continuous exposure of guinea pigs to 2  $mg/m^3$  for 5 days caused pulmonary edema and thickening of the alveolar walls; exposure of guinea pigs to 2  $mg/m^3$  for 1 hour caused an increase in

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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pulmonary airway resistance from reflex bronchoconstriction. A worker sprayed in the face with liquid fuming sulfuric acid suffered skin burns of the face and body, as well as pulmonary edema from inhalation. Sequelae were pulmonary fibrosis, residual bronchitis, and pulmonary emphysema; in addition, necrosis of the skin resulted in marked scarring. In human subjects, concentrations of about 5 mg/m<sup>3</sup> were objectionable, usually causing cough, an increase in respiratory rate, and impairment of ventilatory capacity. Workers exposed to concentrations of 12.6 to 35 mg/m<sup>3</sup> had a markedly higher incidence of erosion and discoloration of teeth than was noted in unexposed individuals. Splashed in the eye, the concentrated acid causes extremely severe damage, often leading to blindness, whereas dilute acid produces more transient effects from which recovery may be complete. Repeated exposure of workers to the mist causes chronic conjunctivitis, tracheobronchitis, stomatitis, and dermatitis, as well as dental erosion. While ingestion of the liquid is unlikely in ordinary industrial use, the highly corrosive nature of the substance may be expected to produce serious mucous membrane burns of the mouth and esophagus.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 98
2. Boiling point (760 mm Hg): 270 C (518 F)
3. Specific gravity (water = 1): 1.84
4. Vapor density (air = 1 at boiling point of sulfuric acid): 3.4
5. Melting point: 3 C (37 F)
6. Vapor pressure at 20 C (68 F): Less than 0.001 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions
8. Evaporation rate (butyl acetate = 1): Data not available

### • Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Contact of acid with organic materials (such as chlorates, carbides, fulminates, and picrates) may cause fires and explosions. Contact of acid with metals may form toxic sulfur dioxide fumes and flammable hydrogen gas.
3. Hazardous decomposition products: Toxic gases and vapors (such as sulfuric acid fume, sulfur dioxide, and carbon monoxide) may be released when sulfuric acid decomposes.

4. Special precautions: Liquid sulfuric acid will attack some forms of plastics, rubber, and coatings.

### • Flammability

1. Sulfuric acid is not combustible by itself, but is highly reactive and capable of igniting finely divided combustible materials on contact. Fires involving small amounts of combustibles may be smothered with dry chemical. Water applied directly to sulfuric acid causes

evolution of heat and splattering.

### • Warning properties

The International Labour Office (ILO) reports that sulfuric acid, in liquid or vapor form, can cause eye irritation, but no quantitative information is given. The NIOSH criteria document for sulfuric acid states that Bushtueva exposed 10 human subjects to different concentrations of sulfuric acid aerosol. At a concentration of 1.1 to 2.4 mg/m<sup>3</sup>, 40% of the subjects experienced eye irritation.

## MONITORING AND MEASUREMENT PROCEDURES

### • General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

### • Method

Sampling and analyses may be performed by collection of sulfuric acid on a cellulose membrane filter, followed by extraction with distilled water and isopropyl alcohol, treatment with perchloric acid, and titration with barium perchlorate. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure sulfuric acid may be used. An analytical method for sulfuric acid is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 5, 1979, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00349-1).

## RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

## PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid sulfuric acid or solutions containing more than 1% sulfuric acid by weight.
- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with solutions containing 1% or less sulfuric acid by weight.
- Where there is any possibility of exposure of an employee's body to liquid sulfuric acid or solutions containing more than 1% sulfuric acid by weight, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with sulfuric acid should be removed immediately and not reworn until the sulfuric acid is removed from the clothing.
- Clothing contaminated with sulfuric acid should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of sulfuric acid from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the sulfuric acid, the person performing the operation should be informed of sulfuric acid's hazardous properties.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid sulfuric acid or solutions containing sulfuric acid contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid sulfuric acid or solutions containing more than 1% sulfuric acid by weight, an eye-wash fountain should be provided within the immediate work area for emergency use.

## SANITATION

- Skin that becomes contaminated with sulfuric acid should be immediately washed or showered to remove any sulfuric acid.

## COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to sulfuric acid may occur and control methods which may be effective in each case:

Operation	Controls
Use in manufacture of phosphoric acid and fertilizers	Process enclosure; local exhaust ventilation; personal protective equipment
Use in petroleum refining as an alkylation catalyst for production of high-octane gasoline, production of jet fuels, kerosene, lube and white oils, oil additives, and preparation of cracking catalysts	Process enclosure; local exhaust ventilation; personal protective equipment
Use during manufacture of pigments and dyes, and dyestuff intermediates	Process enclosure; local exhaust ventilation; personal protective equipment
Use in manufacture of industrial and military explosives	Process enclosure; local exhaust ventilation; personal protective equipment
Use in production of alcohols, phenols, and inorganic sulfates	Process enclosure; local exhaust ventilation; personal protective equipment
Use in ore leaching and processing; use in metal cleaning and plating; manufacture of electrogalvanized wire; anodizing of metal; electroplating	Process enclosure; local exhaust ventilation; personal protective equipment
Use in manufacture of detergents	Process enclosure; local exhaust ventilation; personal protective equipment
Use in coke-oven gas refining; use in plastics industry for manufacture of rayon, cellophane, cellulose, acetate, caprolactam, and others; use in lead storage batteries as electrolyte	Process enclosure; local exhaust ventilation; personal protective equipment
Use in food processing in manufacture of brewing sugars for beer, manufacture of glucose, refining of mineral and vegetable oils	Process enclosure; local exhaust ventilation; personal protective equipment

## Operation

Use for preparation of insecticides; use in manufacture of natural and synthetic rubber

Use for gas drying to dry acid and corrosive gases; use in treatment of industrial water for pH control

Use in manufacture of textiles and leather for treatment of wool, pickling leather, as a dye assist, as a solvent for vat dyes, and in fabric finishing

Use as a laboratory reagent as a solvent and for chemical analysis; use in chemical synthesis in preparation of acids, intermediates for medicinals, gas, esters, and fatty acids

## Controls

Process enclosure; local exhaust ventilation; personal protective equipment

Process enclosure; local exhaust ventilation; personal protective equipment

Process enclosure; local exhaust ventilation; personal protective equipment

Process enclosure; local exhaust ventilation; personal protective equipment

## • Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

## SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If sulfuric acid is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect spilled or leaked material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill. Sulfuric acid should be absorbed in vermiculite, dry sand, earth, or a similar material. It may also be diluted and neutralized.

• Waste disposal method:

Sulfuric acid may be placed in sealed containers or absorbed in vermiculite, dry sand, earth, or a similar material and disposed of in a secured sanitary landfill. It may also be diluted and neutralized.

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

### • Eye Exposure

If liquid sulfuric acid or solutions containing sulfuric acid get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

### • Skin Exposure

If liquid sulfuric acid or solutions containing sulfuric acid get on the skin, immediately flush the contaminated skin with water. If liquid sulfuric acid or solutions containing sulfuric acid penetrate through the clothing, remove the clothing immediately and flush the skin with water. Get medical attention immediately.

### • Breathing

If a person breathes in large amounts of sulfuric acid, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

### • Swallowing

If liquid sulfuric acid or solutions containing sulfuric acid have been swallowed and the person is conscious, give him large quantities of water immediately to dilute the sulfuric acid. Do not attempt to make the exposed person vomit. Get medical attention immediately.

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## RESPIRATORY PROTECTION FOR SULFURIC ACID

Condition	Minimum Respiratory Protection* Required Above 1 mg/m <sup>3</sup>
<b>Particulate Concentration</b>  50 mg/m <sup>3</sup> or less	A gas mask with a chin-style or a front- or back-mounted acid gas canister with a high efficiency particulate filter.  A high efficiency particulate filter respirator with a full facepiece.  Any supplied-air respirator with a full facepiece, helmet, or hood.  Any self-contained breathing apparatus with a full facepiece.
100 mg/m <sup>3</sup> or less	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.
Greater than 100 mg/m <sup>3</sup> or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.  A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
<b>Fire Fighting</b>	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
<b>Escape</b>	A gas mask with a chin-style or a front- or back-mounted acid gas canister with a high efficiency particulate filter.  Any escape self-contained breathing apparatus.

\*Only NIOSH-approved or MSHA-approved equipment should be used.

# Occupational Health Guideline for Hydrogen Peroxide

## INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

## SUBSTANCE IDENTIFICATION

- Formula:  $H_2O_2$
- Synonyms: High-strength hydrogen peroxide; peroxide; hydrogen dioxide
- Appearance and odor: Colorless liquid with a slightly sharp odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for hydrogen peroxide is 1 part of hydrogen peroxide per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 1.4 milligrams of hydrogen peroxide per cubic meter of air ( $mg/m^3$ ).

## HEALTH HAZARD INFORMATION

- **Routes of exposure**  
Hydrogen peroxide can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- **Effects of overexposure**  
Exposure to vapor from hydrogen peroxide may cause extreme irritation of the eyes, nose, and throat. Splashes of hydrogen peroxide in the eyes may cause severe damage and possible blindness. Eye damage may appear a week or more after exposure. If the liquid is splashed on the skin, it may cause tingling and temporary whitening. If the skin is washed promptly, the skin will return to normal in 2 or 3 hours. If the hydrogen peroxide is not removed, redness and blister formation may result. If swallowed, hydrogen peroxide may cause injury to

the mouth and throat with possible bleeding from the esophagus and stomach. The swallowed hydrogen peroxide may produce large quantities of oxygen gas which may distend the esophagus and stomach and cause severe damage.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to hydrogen peroxide.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to hydrogen peroxide at potentially hazardous levels:

**1. Initial Medical Screening:** Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from hydrogen peroxide exposure.

—Eye disease: Hydrogen peroxide, 90 percent, is an eye irritant. Persons with pre-existing eye disorders may be more susceptible to the effects of this agent.

—Chronic respiratory disease: Hydrogen peroxide, 90 percent, causes respiratory irritation in animals. In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of hydrogen peroxide, 90 percent, might cause exacerbation of symptoms due to its irritant properties.

—Skin disease: Hydrogen peroxide, 90 percent, is a primary skin irritant. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

**2. Periodic Medical Examination:** Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Ninety percent hydrogen peroxide vapor, mist, or liquid irritates the eyes, mucous membranes, and skin. Repeated exposure of dogs to 7 ppm for 6 months caused sneezing, lacrimation, and bleaching of hair; at autopsy there was local atelectasis. In humans, inhalation of high concentrations of vapor or mist may cause extreme irritation and inflammation of the nose and

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service    Centers for Disease Control  
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR  
Occupational Safety and Health Administration

throat. Exposure for a short period to mist or diffused spray may cause stinging of the eyes and lacrimation. Splashes of the liquid in the eyes may cause severe damage, including ulceration of the cornea; there may be a delayed appearance of damage to the eyes, and corneal ulceration has, on rare occasions, appeared even a week or more after exposure. Skin contact with the liquid for a short time will cause a temporary whitening or bleaching of the skin; if splashes on the skin are not removed, erythema and formation of vesicles may occur. Ingestion may cause irritation of the upper gastrointestinal tract; decomposition of the hydrogen peroxide will result in the rapid liberation of oxygen, which may distend and damage the esophagus or stomach.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 34
2. Boiling point (760 mm Hg): 141 C (286 F) (calculated)
3. Specific gravity (water = 1): 1.38
4. Vapor density (air = 1 at boiling point of hydrogen peroxide): Not applicable (decomposes)
5. Melting point: -11 C (12 F)
6. Vapor pressure at 30 C (86 F): 5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions
8. Evaporation rate (butyl acetate = 1): Data not available

### • Reactivity

1. Conditions contributing to instability: Hydrogen peroxide decomposes slowly at ordinary temperatures and builds up pressure if the container is closed. The rate of decomposition doubles for each 10 C rise (1.5 times 10 C rise) in temperature and becomes self-sustaining at 141 C (285 F). Contaminated hydrogen peroxide can decompose at a rate that will exceed the capacity of the vent in the container. Hydrogen peroxide in concentrations up to about 90% does not readily detonate. Higher concentrations or elevated temperatures may facilitate detonation.

2. Incompatibilities: Contact with most organic or readily oxidizable materials and combustibles causes fires and explosions. Contact with iron, copper, brass, bronze, chromium, zinc, lead, manganese, silver, and other catalytic metals (or their salts) causes rapid decomposition with evolution of oxygen gas and heat which may increase container pressure.

3. Hazardous decomposition products: None

4. Special precautions: Liquid hydrogen peroxide will attack some forms of plastics, rubber, and coatings; many will ignite. The adiabatic decomposition temperature is 740 C (1364 F), so that most combustible materials in contact with the decomposition products will readily burst into flames.

### • Flammability

1. Not combustible, but a powerful oxidizing agent

### • Warning properties

1. Odor Threshold: No quantitative information is available concerning the odor threshold of hydrogen peroxide.

2. Eye Irritation Level: The AIHA *Hygienic Guide* states that "the eyes do not appear to be damaged from exposure to the vapor." Grant reports, "Injuries of human eyes have been rare. Workers exposed to vapors from 90% hydrogen peroxide have noted primarily respiratory irritation, but a splash of such high concentration is generally feared as a potential cause of severe corneal damage . . . ."

"Experimental exposure of dogs to 7 ppm hydrogen peroxide in air 6 hours a day caused no adverse effect during 23 weeks but then began to cause sneezing and lacrimation. Rabbits similarly exposed for 10 weeks suffered no corneal damage."

Deichmann and Gerarde, however, note that "vapors are irritating to the eyes, nose and throat."

According to the *Hygienic Guide*, hydrogen peroxide can be "recognized only by irritant effects, especially in nasal passages." They give an irritation threshold of approximately 100 ppm.

3. Evaluation of Warning Properties: Hydrogen peroxide has poor warning properties.

## MONITORING AND MEASUREMENT PROCEDURES

### • General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

### • Method

At the time of publication of this guideline, no measurement method for hydrogen peroxide had been published by NIOSH.

## RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforce-

ment and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

## PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch *minimum*), and other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid hydrogen peroxide.
- Clothing contaminated with hydrogen peroxide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of hydrogen peroxide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the hydrogen peroxide, the person performing the operation should be informed of hydrogen peroxide's hazardous properties.
- Where there is any possibility of exposure of an employee's body to liquid hydrogen peroxide, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with hydrogen peroxide should be removed immediately and not reworn until the hydrogen peroxide is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid hydrogen peroxide contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid hydrogen peroxide, an eye-wash fountain should be provided within the immediate work area for emergency use.

## SANITATION

- Skin that becomes contaminated with hydrogen peroxide should be promptly washed or showered to remove any hydrogen peroxide.
- Employees who handle liquid hydrogen peroxide should wash their hands thoroughly before eating, smoking, or using toilet facilities.

## COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to hydrogen peroxide may occur and control methods which may be effective in each case:

### Operation

Use in manufacture of propellants for military and space programs; use as a component of explosives

Use in chemical synthesis as an oxidant in organic and inorganic synthesis

Use as a polymerization promoter; use as a bleaching agent for oils, waxes, fats, and discolored concentrated acids

### Controls

Process enclosure; general dilution ventilation; personal protective equipment; vented containers; ample available water supply

Process enclosure; general dilution ventilation; personal protective equipment; vented containers; ample available water supply

Process enclosure; general dilution ventilation; personal protective equipment; vented containers; ample available water supply

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

### • Eye Exposure

If liquid hydrogen peroxide gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

### • Skin Exposure

If liquid hydrogen peroxide gets on the skin, immediately flush the contaminated skin with water. If liquid hydrogen peroxide soaks through the clothing, remove the clothing immediately and flush the skin with water. Get medical attention promptly.

### • Breathing

If a person breathes in large amounts of hydrogen peroxide, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

### • Swallowing

When hydrogen peroxide has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

### • Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency

rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

## SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If hydrogen peroxide is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Dilute with copious quantities of water.

- Waste disposal method:

After dilution with copious quantities of water, hydrogen peroxide may be flushed into a sewer.

## REFERENCES

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## RESPIRATORY PROTECTION FOR HYDROGEN PEROXIDE (90%)

Condition	Minimum Respiratory Protection* Required Above 1 ppm
Vapor Concentration	
10 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
50 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
75 ppm or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 75 ppm** or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.  A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask containing non-oxidizable sorbents and providing protection against hydrogen peroxide.  Any escape self-contained breathing apparatus.

\*Only NIOSH-approved or MSHA-approved equipment should be used.

\*\*Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of hydrogen peroxide; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 75 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

# SODIUM HYDROXIDE

SHD

<p><b>Common Synonyms</b> Caustic soda Lye</p>	<p>Solid flakes or pellets    White                      Odorless</p> <p>Sinks and mixes with water.</p>
<p>Avoid contact with solid and dust. Keep people away. Wear rubber overclothing (including gloves). Stop discharge if possible. Isolate and remove discharged material Notify local health and pollution control agencies.</p>	
<p style="text-align: center;"><b>Fire</b></p>	<p>Not flammable. May cause fire on contact with combustibles. Flammable gas may be produced on contact with metals. Wear rubber overclothing (including gloves). Flood discharge area with water. Cool exposed containers with water.</p>
<p style="text-align: center;"><b>Exposure</b></p>	<p>CALL FOR MEDICAL AID.</p> <p><b>DUST</b> Irritating to eyes, nose and throat. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. IF IN EYES, hold eyelids open and flush with plenty of water.</p> <p><b>SOLID</b> Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>
<p style="text-align: center;"><b>Water Pollution</b></p>	<p>Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials Notify operators of nearby water intakes</p>
<p><b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook) Issue warning-corrosive Restrict access Disperse and flush</p>	<p><b>2. LABEL</b> 2.1 Category: Corrosive 2.2 Class: 8</p>
<p><b>3. CHEMICAL DESIGNATIONS</b> 3.1 CG Compatibility Class: Not listed 3.2 Formula: NaOH 3.3 IMO/UN Designation: 8.0/1823 3.4 DOT ID No.: 1823 3.5 CAS Registry No.: 1310-73-2</p>	<p><b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 Physical State (as shipped): Solid 4.2 Color: White 4.3 Odor: Odorless</p>
<p style="text-align: center;"><b>5. HEALTH HAZARDS</b></p> <p>5.1 <b>Personal Protective Equipment:</b> Chemical safety goggles; face shield; filter or dust-type respirator; rubber boots; rubber gloves.</p> <p>5.2 <b>Symptoms Following Exposure:</b> Strong corrosive action on contacted tissues. INHALATION: dust may cause damage to upper respiratory tract and lung itself, producing from mild nose irritation to pneumonitis. INGESTION: severe damage to mucous membranes; severe scar formation or perforation may occur. EYE CONTACT: produces severe damage.</p> <p>5.3 <b>Treatment of Exposure:</b> INHALATION: remove from exposure; support respiration; call physician. INGESTION: give water or milk followed by dilute vinegar or fruit juice; do NOT induce vomiting. SKIN: wash immediately with large quantities of water under emergency safety shower while removing clothing; continue washing until medical help arrives; call physician. EYES: irrigate immediately with copious amounts of water for at least 15 min.; call physician.</p> <p>5.4 <b>Threshold Limit Value:</b> 2 mg/m<sup>3</sup></p> <p>5.5 <b>Short Term Inhalation Limits:</b> Not pertinent</p> <p>5.6 <b>Toxicity by Ingestion:</b> (10% solution) oral rabbit LD<sub>50</sub> = 500 mg/kg</p> <p>5.7 <b>Late Toxicity:</b> None</p> <p>5.8 <b>Vapor (Gas) Irritant Characteristics:</b> Non-volatile</p> <p>5.9 <b>Liquid or Solid Irritant Characteristics:</b> Severe skin irritant. Causes second-and third-degree burns on short contact and is very injurious to the eyes.</p> <p>5.10 <b>Odor Threshold:</b> Not pertinent</p> <p>5.11 <b>IDLH Value:</b> 200 mg/m<sup>3</sup></p>	

<p style="text-align: center;"><b>6. FIRE HAZARDS</b></p> <p>6.1 <b>Flash Point:</b> Not flammable 6.2 <b>Flammable Limits in Air:</b> Not flammable 6.3 <b>Fire Extinguishing Agents:</b> Not pertinent 6.4 <b>Fire Extinguishing Agents Not to be Used:</b> Not pertinent 6.5 <b>Special Hazards of Combustion Products:</b> Not pertinent 6.6 <b>Behavior in Fire:</b> Not pertinent 6.7 <b>Ignition Temperature:</b> Not flammable 6.8 <b>Electrical Hazard:</b> Not pertinent 6.9 <b>Burning Rate:</b> Not flammable 6.10 <b>Adiabatic Flame Temperature:</b> Data not available 6.11 <b>Stoichiometric Air to Fuel Ratio:</b> Data not available 6.12 <b>Flame Temperature:</b> Data not available</p>	<p style="text-align: center;"><b>10. HAZARD ASSESSMENT CODE</b> (See Hazard Assessment Handbook) <b>SS</b></p>								
<p style="text-align: center;"><b>7. CHEMICAL REACTIVITY</b></p> <p>7.1 <b>Reactivity With Water:</b> Dissolves with liberation of much heat; may steam and splatter</p> <p>7.2 <b>Reactivity with Common Materials:</b> When wet, attacks metals such as aluminum, tin, lead, and zinc to produce flammable hydrogen gas.</p> <p>7.3 <b>Stability During Transport:</b> Stable</p> <p>7.4 <b>Neutralizing Agents for Acids and Caustics:</b> Flush with water, rinse with dilute acetic acid</p> <p>7.5 <b>Polymerization:</b> Not pertinent 7.6 <b>Inhibitor of Polymerization:</b> Not pertinent 7.7 <b>Molar Ratio (Reactant to Product):</b> Data not available 7.8 <b>Reactivity Group:</b> Data not available</p>	<p style="text-align: center;"><b>11. HAZARD CLASSIFICATIONS</b></p> <p>11.1 <b>Code of Federal Regulations:</b> Corrosive material</p> <p>11.2 <b>NAS Hazard Rating for Bulk Water Transportation:</b> Not listed</p> <p>11.3 <b>NFPA Hazard Classification:</b></p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: right;">Category</td> <td style="text-align: right;">Classification</td> </tr> <tr> <td style="text-align: right;">Health Hazard (Blue).....</td> <td style="text-align: right;">3</td> </tr> <tr> <td style="text-align: right;">Flammability (Red).....</td> <td style="text-align: right;">0</td> </tr> <tr> <td style="text-align: right;">Reactivity (Yellow).....</td> <td style="text-align: right;">1</td> </tr> </table>	Category	Classification	Health Hazard (Blue).....	3	Flammability (Red).....	0	Reactivity (Yellow).....	1
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Flammability (Red).....	0								
Reactivity (Yellow).....	1								
<p style="text-align: center;"><b>8. WATER POLLUTION</b></p> <p>8.1 <b>Aquatic Toxicity:</b> 125 ppm/96 hr/mosquito fish/TL<sub>50</sub>/fresh 180 ppm/23 hr/oysters/lethal/salt water</p> <p>8.2 <b>Waterfowl Toxicity:</b> Data not available 8.3 <b>Biological Oxygen Demand (BOD):</b> None 8.4 <b>Food Chain Concentration Potential:</b> None</p>	<p style="text-align: center;"><b>12. PHYSICAL AND CHEMICAL PROPERTIES</b></p> <p>12.1 <b>Physical State at 15°C and 1 atm:</b> Solid</p> <p>12.2 <b>Molecular Weight:</b> 40.00</p> <p>12.3 <b>Boiling Point at 1 atm:</b> Very high</p> <p>12.4 <b>Freezing Point:</b> 604°F = 318°C = 591°K</p> <p>12.5 <b>Critical Temperature:</b> Not pertinent 12.6 <b>Critical Pressure:</b> Not pertinent 12.7 <b>Specific Gravity:</b> 2.13 at 20°C (solid)</p> <p>12.8 <b>Liquid Surface Tension:</b> Not pertinent 12.9 <b>Liquid Water Interfacial Tension:</b> Not pertinent 12.10 <b>Vapor (Gas) Specific Gravity:</b> Not pertinent 12.11 <b>Ratio of Specific Heats of Vapor (Gas):</b> Not pertinent 12.12 <b>Latent Heat of Vaporization:</b> Not pertinent 12.13 <b>Heat of Combustion:</b> Not pertinent 12.14 <b>Heat of Decomposition:</b> Not pertinent 12.15 <b>Heat of Solution:</b> Not pertinent 12.16 <b>Heat of Polymerization:</b> Not pertinent 12.25 <b>Heat of Fusion:</b> 50.0 cal/g 12.26 <b>Limiting Value:</b> Data not available 12.27 <b>Reid Vapor Pressure:</b> Data not available</p>								
<p style="text-align: center;"><b>9. SHIPPING INFORMATION</b></p> <p>9.1 <b>Grade of Purity:</b> Technical flakes; USP pellets 9.2 <b>Storage Temperature:</b> Ambient 9.3 <b>Inert Atmosphere:</b> No requirement 9.4 <b>Venting:</b> Open</p>									
<p style="text-align: center;"><b>NOTES</b></p>									

SHD

## SODIUM HYDROXIDE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
	N O T  P E R T I N E N T		N O T  P E R T I N E N T		N O T  P E R T I N E N T		N O T  P E R T I N E N T

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
34	44.810		N O T		N O T		N O T
36	47.660						
38	50.500						
40	53.350						
42	56.190		P E R T I N E N T		P E R T I N E N T		P E R T I N E N T
44	59.040						
46	61.880						
48	64.719						
50	67.570						
52	70.410						
54	73.259						
56	76.099						
58	78.950						
60	81.790						
62	84.639						
64	87.480						
66	90.320						
68	93.169						
70	96.009						
72	98.860						
74	101.700						
76	104.500						
78	107.400						
80	110.200						
82	113.099						
84	115.900						



# Occupational Health Guideline for Coal Tar Pitch Volatiles

## INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

## SUBSTANCE IDENTIFICATION

### Anthracene

- Formula:  $C_{14}H_{10}$
- Synonyms: None
- Appearance and odor: Pale green solid with a faint aromatic odor.

### Phenanthrene

- Formula:  $C_{14}H_{10}$
- Synonyms: None
- Appearance and odor: Colorless solid with a faint aromatic odor.

### Pyrene

- Formula:  $C_{16}H_{10}$
- Synonyms: None
- Appearance: Bright yellow solid

### Carbazole

- Formula:  $C_{12}H_9N$
- Synonyms: None
- Appearance and odor: Colorless solid with a faint aromatic odor.

### Benzo(a)pyrene

- Formula:  $C_{20}H_{12}$
- Synonyms: BaP, 3,4-benzopyrene

- Appearance and odor: Colorless solid with a faint aromatic odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for coal tar pitch volatiles is 0.2 milligram of coal tar pitch volatiles per cubic meter of air ( $mg/m^3$ ) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit for coal tar products be reduced to 0.1  $mg/m^3$  (cyclohexane-extractable fraction) averaged over a work shift of up to 10 hours per day, 40 hours per week, and that coal tar products be regulated as occupational carcinogens. The NIOSH Criteria Document for Coal Tar Products and NIOSH Criteria Document for Coke Oven Emissions should be consulted for more detailed information.

## HEALTH HAZARD INFORMATION

- Routes of exposure  
Coal tar pitch volatiles can affect the body if they are inhaled or if they come in contact with the eyes or skin.
- Effects of overexposure  
Repeated exposure to coal tar pitch volatiles has been associated with an increased risk of developing bronchitis and cancer of the lungs, skin, bladder, and kidneys. Pregnant women may be especially susceptible to exposure effects associated with coal tar pitch volatiles. Repeated exposure to these materials may also cause sunlight to have a more severe effect on a person's skin. In addition, this type of exposure may cause an allergic skin rash.
- Reporting signs and symptoms  
A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to coal tar pitch volatiles.
- Recommended medical surveillance  
The following medical procedures should be made available to each employee who is exposed to coal tar pitch volatiles at potentially hazardous levels:

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

### 1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the oral cavity, respiratory tract, bladder, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders, for premalignant and malignant lesions, and evidence of hyperpigmentation or photosensitivity.

—Urinalysis: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. A urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and microscopic on centrifuged sediment, as well as a test for red blood cells.

—Urinary cytology: Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer. Employees having 5 or more years of exposure or who are 45 years of age or older should have a urinary cytology examination.

—Sputum cytology: Coal tar pitch volatiles are associated with an excess of lung cancer. Employees having 10 or more years of exposure or who are 45 years of age or older should have a sputum cytology examination.

—14" x 17" chest roentgenogram: Coal tar pitch volatiles are associated with an excess of lung cancer. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Coal tar pitch volatiles are reported to cause an excess of bronchitis. Periodic surveillance is indicated.

—A complete blood count: Due to the possibility of benzene exposure associated with coal tar pitch volatiles, a complete blood count is considered necessary to search for leukemia and aplastic anemia.

—Skin disease: Coal tar pitch volatiles are defatting agents and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of these agents.

**Periodic Medical Examination:** The aforementioned medical examinations should be repeated on an annual basis, and semi-annually for employees 45 years of age or older or with 10 or more years' exposure to coal tar pitch volatiles.

#### Summary of toxicology

Coal tar pitch volatiles (CTPV) are products of the destructive distillation of bituminous coal and contain polynuclear aromatic hydrocarbons (PNA's). These hydrocarbons sublime readily, thereby increasing the amounts of carcinogenic compounds in working areas. Epidemiologic evidence suggests that workers intimately exposed to the products of combustion or distillation of bituminous coal are at increased risk of cancer at many sites. These include cancer of the respiratory tract, kidney, bladder, and skin. In a study of coke oven workers, the level of exposure to CTPV and the length of time exposed were related to the development of cancer. Coke oven workers with the highest risk of cancer were those employed exclusively at topside jobs for 5 or more years, for whom the increased risk of

dying from lung cancer was 10-fold; all coke oven workers had a 7-1/2-fold increase in risk of dying from kidney cancer. Although the causative agent or agents of the cancer in coke oven workers is unidentified, it is suspected that several PNA's in the CTPV generated during the coking process are involved. Certain industrial populations exposed to coal tar products have a demonstrated risk of skin cancer. Substances containing PNA's which may produce skin cancer also produce contact dermatitis; examples are coal tar, pitch, and cutting oils. Although allergic dermatitis is readily induced by PNA's in guinea pigs, it is only rarely reported in humans from occupational contact with PNA's; these have resulted largely from the therapeutic use of coal tar preparations. Components of pitch and coal tar produce cutaneous photosensitization; skin eruptions are usually limited to areas exposed to the sun or ultraviolet light. Most of the phototoxic agents will induce hypermelanosis of the skin; if chronic photodermatitis is severe and prolonged, leukoderma may occur. Some oils containing PNA's have been associated with changes of follicular and sebaceous glands which commonly take the form of acne. There is evidence that exposures to emissions at coke ovens and gas retorts may be associated with an increased occurrence of chronic bronchitis. Coal tar pitch volatiles may be associated with benzene, an agent suspected of causing leukemia and known to cause aplastic anemia.

### CHEMICAL AND PHYSICAL PROPERTIES

#### • Physical data—Anthracene

1. Molecular weight: 178.2
2. Boiling point (760 mm Hg): 340 C (644 F)
3. Specific gravity (water = 1): 1.24
4. Vapor density (air = 1 at boiling point of anthracene): 6.15
5. Melting point: 217 C (423 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

#### • Physical data—Phenanthrene

1. Molecular weight: 178.2
2. Boiling point (760 mm Hg): 340 C (644 F)
3. Specific gravity (water = 1): 1.18
4. Vapor density (air = 1 at boiling point of phenanthrene): 6.15
5. Melting point: 100.5 C (213 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

#### • Physical data—Pyrene

1. Molecular weight: 202.3
2. Boiling point (760 mm Hg): Greater than 360 C (greater than 680 F)

3. Specific gravity (water = 1): 1.28
4. Vapor density (air = 1 at boiling point of pyrene): 6.9
5. Melting point: 150.4 C (303 F)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

• Physical data—Carbazole

1. Molecular weight: 167.2
2. Boiling point (760 mm Hg): 355 C (671 F)
3. Specific gravity (water = 1): Greater than 1
4. Vapor density (air = 1 at boiling point of carbazole): 5.8

5. Melting point: 246 C (475 F)

6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg

7. Solubility in water, g/100 g water at 20 C (68 F):

Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

• Physical data—Benzo(a)pyrene

1. Molecular weight: 252.3
2. Boiling point (760 mm Hg): Greater than 360 C (greater than 680 F)

3. Specific gravity (water = 1): Greater than 1

4. Vapor density (air = 1 at boiling point of benzo(a)pyrene): 8.7

5. Melting point: 179 C (354 F)

6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg

7. Solubility in water, g/100 g water at 20 C (68 F):

Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: None hazardous

2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.

3. Hazardous decomposition products: None

4. Special precautions: None

• Flammability

1. Flash point: Anthracene: 121 C (250 F) (closed cup); Others: Data not available

2. Autoignition temperature: Anthracene: 540 C (1004 F); Others: Data not available

3. Flammable limits in air, % by volume: Anthracene: Lower: 0.6; Others: Data not available

4. Extinguishant: Foam, dry chemical, and carbon dioxide

• Warning properties

Grant states that "coal tar and its various crude fractions appear principally to cause reddening and squamous eczema of the lid margins, with only small erosions of the corneal epithelium and superficial changes in the stroma, which disappear in a month following exposure. Chronic exposure of workmen to tar fumes and dust has been reported to cause conjunctivitis and discoloration of the cornea in the palpebral fissure,

either near the limbus or, in extreme cases, across the whole cornea. Occasionally, epithelioma of the lid margin has been attributed to contact with coal tar."

## MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Coal tar products may be sampled by collection on a glass fiber filter with subsequent ultrasonic extraction and weighing. An analytical method for coal tar pitch volatiles is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 1, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00267-3).

## RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

## PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with condensed coal tar pitch volatiles, where skin contact may occur.

• If employees' clothing may have become contaminated with coal tar pitch volatiles, employees should change into uncontaminated clothing before leaving the work premises.

• Clothing contaminated with coal tar pitch volatiles

ould be placed in closed containers for storage until it can be discarded or until provision is made for the removal of coal tar pitch volatiles from the clothing. If clothing is to be laundered or otherwise cleaned to remove the coal tar pitch volatiles, the person performing the operation should be informed of coal tar pitch volatiles's hazardous properties.

Employees should be provided with and required to use splash-proof safety goggles where condensed coal pitch volatiles may contact the eyes.

## SANITATION

- Workers subject to skin contact with coal tar pitch volatiles should wash with soap or mild detergent and water any areas of the body which may have contacted coal tar pitch volatiles at the end of each work day.
- Employees who handle coal tar pitch volatiles should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.
- Areas in which exposure to coal tar pitch volatiles may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

## COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to coal tar pitch volatiles may occur and control methods which may be effective in each case:

Operation	Controls
Operation from traction and packaging from coal tar fraction of coking	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a binding agent in manufacture of coal briquettes used for fuel; use as a dielectric in the manufacture of battery electrodes, electric-arc furnace electrodes, and electrodes for alumina production	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture of roofing felts and papers and roofing	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

## Operation

Use for protective coatings for pipes for underground conduits and drainage; use as a coating on concrete as waterproofing and corrosion-resistant material; use in road paving and sealing

## Controls

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in manufacture and repair of refractory brick; use in production of foundry cores; use in manufacture of carbon ceramic items

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

### • Eye Exposure

If condensed coal tar pitch volatiles get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with these chemicals.

### • Skin Exposure

If condensed coal tar pitch volatiles get on the skin, wash the contaminated skin using soap or mild detergent and water. Be sure to wash the hands before eating or smoking and to wash thoroughly at the close of work.

### • Breathing

If a person breathes in large amounts of coal tar pitch volatiles, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

### • Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

## SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed.

- If coal tar pitch volatiles are released in hazardous concentrations, the following steps should be taken:

1. Ventilate area of spill.

2. Collect released material in the most convenient and safe manner for reclamation or for disposal in sealed containers in a secured sanitary landfill.

• Waste disposal method:

Coal tar pitch volatiles may be disposed of in sealed containers in a secured sanitary landfill.

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## RESPIRATORY PROTECTION FOR COAL TAR PITCH VOLATILES

Condition	Minimum Respiratory Protection* Required Above 0.2 mg/m <sup>3</sup>
Particulate and Vapor concentration	
2 mg/m <sup>3</sup> or less	<p>A chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high-efficiency filter.</p> <p>Any supplied-air respirator.</p> <p>Any self-contained breathing apparatus.</p>
10 mg/m <sup>3</sup> or less	<p>A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high-efficiency filter.</p> <p>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.</p> <p>Any supplied-air respirator with a full facepiece, helmet, or hood.</p> <p>Any self-contained breathing apparatus with a full facepiece.</p>
200 mg/m <sup>3</sup> or less	<p>A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.</p> <p>A powered air-purifying respirator with an organic vapor cartridge and a high-efficiency particulate filter.</p>
400 mg/m <sup>3</sup> or less	<p>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.</p>
Greater than 400 mg/m <sup>3</sup> or entry and escape from unknown concentrations	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p> <p>A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.</p>
Fire Fighting	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p>
Escape	<p>Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class.</p> <p>Any escape self-contained breathing apparatus.</p>

\*Only NIOSH-approved or MSHA-approved equipment should be used.

DATE: 02/07/90  
INDEX: 44892820053

ACCT: G95032-01  
CAT NO: B24520

PO NBR: N/A

BENZENE\*\*  
BENZENE\*\*  
BENZENE\*\*

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MATERIAL SAFETY DATA SHEET  
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SCIENTIFIC  
LABORATORY DIVISION  
AGENT LANE  
LAWN NJ 07410  
796-7100

EMERGENCY CONTACTS:  
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SUBSTANCE IDENTIFICATION  
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CAS-NUMBER 71-43-2

SUBSTANCE: \*\*BENZENE\*\*

OTHER NAMES/SYNONYMS:

BENZOL; CYCLOHEXATRIENE; BENZOLE; PHENE; PYROBENZOL; PYROBENZOLE;  
CARBON OIL; COAL TAR NAPHTHA; PHENYL HYDRIDE; BENZOLENE;  
CARBURET OF HYDROGEN; COAL NAPHTHA; MOTOR BENZOL; ANNULENE; (6)ANNULENE;  
C A U019; STCC 4308110; UN 1114;

REGISTRY NO: 13065; B-2+3; B-2+5-S; B-2+5; B-411; C6H6; ACC02610

CHEMICAL FAMILY:

1. CARBON, AROMATIC

MOLECULAR FORMULA: C6-H6

MOLECULAR WEIGHT: 78.11

HAZARD RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=0 PERSISTENCE=1  
ENVIRONMENTAL RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

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COMPONENTS AND CONTAMINANTS  
-----

IDENTIFICATION: BENZENE  
CAS= 71-43-2

PERCENT: >99

OTHER CONTAMINANTS: 0.15% NON-AROMATICS; 1 PPM THIOPHENE

EXPOSURE LIMITS:

PERmissible EXPOSURE LIMIT (PEL):  
100 PPM OSHA TWA, 5 PPM OSHA 15 MINUTE STEL;  
100 PPM OSHA ACTION LEVEL  
10 PPM (30 MG/M3) ACGIH TWA;  
ACGIH A2-SUSPECTED HUMAN CARCINOGEN  
10 PPM (0.32 MG/M3) NIOSH RECOMMENDED 8 HOUR TWA;  
100 PPM (3.2 MG/M3) NIOSH RECOMMENDED 15 MINUTE CEILING

10 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY  
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING  
SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY  
WARNING AND RELEASE REQUIREMENTS--(FEBRUARY 27, 1987)

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PHYSICAL DATA  
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DESCRIPTION: COLORLESS TO LIGHT YELLOW LIQUID WITH AN AROMATIC ODOR.

BOILING POINT: 176 F (80 C) MELTING POINT: 42 F (6 C)

SPECIFIC GRAVITY: 0.8765 @ 20 C VISCOSITY: 0.6468 CP @ 20 C

SOLUBILITY: 100% VAPOR PRESSURE: 75 MMHG @ 20 C

EVAPORATION RATE: (BUTYL ACETATE = 1) 5.1 SOLUBILITY IN WATER: 0.18% @ 25 C

FLAMMABILITY THRESHOLD: 4.63 PPM VAPOR DENSITY: 2.8

PERCENT SOLUBILITY: ACETONE, ALCOHOL, CARBON DISULFIDE, ACETIC ACID,  
CARBON TETRACHLORIDE, CHLOROFORM, ETHER, OILS

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FIRE AND EXPLOSION DATA  
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FLAMMABLE AND EXPLOSION HAZARD:

1. SERIOUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

2. MODERATE EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

DATE: 06/07/90 ACCT: 69S038-01  
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AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

DUE TO LOW ELECTROCONDUCTIVITY OF THE SUBSTANCE, FLOW OR AGITATION MAY CAUSE STATISTICAL ELECTROSTATIC CHARGES RESULTING IN SPARKS WITH POSSIBLE IGNITION.

FLASH POINT: 12 F (-11 C) (CC) UPPER EXPLOSIVE LIMIT: 7.8%

LOWER EXPLOSIVE LIMIT: 1.2% AUTOIGNITION TEMP.: 928 F (+498 C)

FLAMMABILITY CLASS(OSHA): IB

EXTINGUISHING MEDIA:

DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM  
EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM  
EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

EXTINGUISHING:

REMOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK SPILLS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN EVENT OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED. USE WATER IN FLOODING QUANTITIES TO CONTROL A FOG; SOLID STREAMS MAY SPREAD FIRE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER; APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING HAZARDOUS MATERIALS; KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS FLAMMABLE.

WATER MAY BE INEFFECTIVE (NFPA 325M, FIRE HAZARD PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND VOLATILE SOLIDS, 1984)

EXTINGUISHING PHASES: DRY CHEMICAL, ALCOHOL FOAM OR CARBON DIOXIDE. WATER MAY BE INEFFECTIVE. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL. IF A LEAK OR SPILL HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE THE VAPORS AND TO PROVIDE PROTECTION FOR THE MEN ATTEMPTING TO STOP THE LEAK. WATER SPRAY MAY BE USED TO FLUSH SPILLS AWAY FROM EXPOSURES (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

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TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:  
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND 172.102:  
PART E:  
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.119  
PACKAGING OPTIONS: 49 CFR 173.118

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TOXICITY

ACETONE:

TOXICITY DATA: 20 MG/24 HOURS SKIN-RABBIT MODERATE; 15 MG/24 HOURS OPEN SKIN-RABBIT MILD; 88 MG EYE-RABBIT MODERATE; 2 MG/24 HOURS EYE-RABBIT SEVERE.

TOXICITY DATA: 2000 PPM/5 MINUTES INHALATION-HUMAN LCLO; 2 PPH/5 MINUTES INHALATION-HUMAN LCLO; 65 MG/M3/5 YEARS INHALATION-HUMAN LCLO; 100 PPM INHALATION-HUMAN LCLO; 150 PPM/1 YEAR INTERMITTENT INHALATION-MAN LCLO; 20,000 PPM/5 MINUTES INHALATION-MAMMAL LCLO; 10,000 PPM/7 HOURS INHALATION-RAT LC50; 9980 PPM INHALATION-MOUSE LC50; 146,000 MG/M3 INHALATION-DOG LCLO; 170,000 MG/M3 INHALATION-CAT LCLO;

5000 PPM/30 MINUTES INHALATION-RABBIT LCLO; 50 MG/KG ORAL-MAN LDLO; 100 MG/KG ORAL-RAT LD50; 4700 MG/KG ORAL-MOUSE LD50;

1000 MG/KG ORAL-DOG LDLO; 88 MG/KG INTRAPERITONEAL-RABBIT LDLO; 2890 UG/KG INTRAPERITONEAL-RAT LD50; 340 MG/KG INTRAPERITONEAL-MOUSE LD50; 527 MG/KG INTRAPERITONEAL-GUINEA PIG LDLO; 194 MG/KG UNREPORTED-MAN LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS).

GENOTOXIC STATUS: OSHA CARCINOGEN; KNOWN HUMAN CARCINOGEN (NTP); HUMAN SUFFICIENT EVIDENCE, ANIMAL SUFFICIENT EVIDENCE (IARC GROUP-1). THE RELATIONSHIP BETWEEN EXPOSURE TO BENZENE AND THE DEVELOPMENT OF ACUTE MYELOGENOUS LEUKEMIA HAS BEEN ESTABLISHED IN EPIDEMIOLOGICAL STUDIES.

LOCAL EFFECTS: IRRITANT- SKIN, EYE.

ACUTE TOXICITY LEVEL: MODERATELY TOXIC BY INHALATION AND INGESTION.

ADDITIONAL EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT; BONE MARROW DEPRESSANT. DISORIENTATION MAY ALSO AFFECT THE IMMUNE, HEMATOPOIETIC AND NERVOUS SYSTEMS.

INCREASED RISK FROM EXPOSURE: PERSONS WITH CERTAIN IMMUNOLOGICAL TENDENCIES.

ADDITIONAL DATA: USE OF ALCOHOLIC BEVERAGES MAY ENHANCE THE TOXIC EFFECTS. USE OF STIMULANTS SUCH AS EPINEPHRINE MAY CAUSE CARDIAC ARRHYTHMIAS.



HEALTH EFFECTS AND FIRST AID

LATION:  
ENE:

NT/NARCOTIC/BONE MARROW DEPRESSANT/CARCINOGEN.  
E EXPOSURE- CONCENTRATIONS OF 3000 PPM MAY CAUSE RESPIRATORY TRACT  
RITATION; MORE SEVERE EXPOSURES MAY RESULT IN PULMONARY EDEMA. SYSTEMIC  
EFFECTS ARE MAINLY ON THE CENTRAL NERVOUS SYSTEM AND DEPEND ON EXPOSURE  
TIME AND CONCENTRATION. NO EFFECTS WERE NOTED AT 25 PPM FOR 8 HOURS;  
SIGNS OF INTOXICATION BEGAN AT 50-150 PPM WITHIN 5 HOURS; AT 500-1500 PPM,  
WITHIN 1 HOUR; WERE SEVERE AT 7500 PPM, WITHIN 30-60 MINUTES; AND  
1,000 PPM WAS FATAL WITHIN 5-10 MINUTES. EFFECTS MAY INCLUDE NAUSEA,  
VOMITING, HEADACHE, DIZZINESS, DROWSINESS, WEAKNESS, SOMETIMES PRECEDED  
BY A BRIEF PERIOD OF EXHILARATION OR EUPHORIA, IRRITABILITY, MALAISE,  
CONFUSION, ATAXIA, STAGGERING, WEAK, RAPID PULSE, CHEST PAIN AND  
LIGHTNESS WITH BREATHLESSNESS, PALLOR, CYANOSIS OF THE LIPS AND  
FINGERTIPS, AND TINNITUS. IN SEVERE EXPOSURES THERE MAY BE BLURRED  
VISION, SHALLOW, RAPID BREATHING, DELIRIUM, CARDIAC ARRHYTHMIAS,  
UNCONSCIOUSNESS, DEEP ANESTHESIA, PARALYSIS, AND COMA CHARACTERIZED  
BY MOTOR RESTLESSNESS, TREMORS AND HYPERREFLEXIA, SOMETIMES PRECEDED  
BY CONVULSIONS. RECOVERY DEPENDS ON THE SEVERITY OF EXPOSURE.  
POLYNEURITIS MAY OCCUR AND THERE MAY BE PERSISTENT NAUSEA, ANOREXIA,  
MUSCULAR WEAKNESS, HEADACHE, DROWSINESS, INSOMNIA, AND AGITATION. NERVOUS  
IRRITABILITY, BREATHLESSNESS, AND UNSTEADY GAIT MAY PERSIST FOR 2-3 WEEKS;  
A PECULIAR SKIN COLOR AND CARDIAC DISTRESS MAY PERSIST FOR 4 WEEKS. LIVER  
AND KIDNEY EFFECTS MAY OCCUR, BUT ARE USUALLY MILD, TEMPORARY IMPAIRMENTS.  
CHROMOSOMAL DAMAGE HAS BEEN FOUND AFTER EXPOSURE TO TOXIC LEVELS. ALTHOUGH  
GENERALLY HEMATOXICITY IS NOT A SIGNIFICANT CONCERN IN ACUTE EXPOSURE.  
DELAYED HEMATOLOGICAL EFFECTS, INCLUDING ANEMIA AND THROMBOCYTOPENIA,  
HAVE BEEN REPORTED, AS HAVE HEMORRHAGES. SPONTANEOUS BLEEDING  
AND SECONDARY INFECTIONS. IN FATAL EXPOSURES, DEATH MAY BE DUE TO  
ASPHYXIA, CENTRAL NERVOUS SYSTEM DEPRESSION, CARDIAC OR RESPIRATORY  
FAILURE AND CIRCULATORY COLLAPSE, OR OCCASIONALLY, SUDDEN VENTRICULAR  
FIBRILLATION. IT MAY OCCUR WITHIN A FEW MINUTES TO SEVERAL HOURS, OR  
CARDIAC ARRHYTHMIA MAY OCCUR AT ANYTIME WITHIN 24 HOURS. ALSO, DEATH FROM  
CENTRAL NERVOUS SYSTEM, RESPIRATORY OR HEMORRHAGIC COMPLICATIONS MAY OCCUR  
UP TO 5 DAYS AFTER EXPOSURE. PATHOLOGIC FINDINGS HAVE INCLUDED  
RESPIRATORY INFLAMMATION WITH EDEMA AND HEMORRHAGE OF THE LUNGS, RENAL  
CONGESTION, CEREBRAL EDEMA, AND EXTENSIVE PETECHIAL HEMORRHAGES IN THE  
BRAIN, PLEURAE, PERICARDIUM, URINARY TRACT, MUCOUS MEMBRANES, AND SKIN.  
CHRONIC EXPOSURE- LONGTERM EXPOSURE MAY CAUSE SYMPTOMS REFERABLE TO THE  
CENTRAL NERVOUS, HEMATOPOIETIC AND IMMUNE SYSTEMS. EARLY EFFECTS ARE VAGUE  
AND VARIED AND MAY INCLUDE HEADACHE, LIGHT-HEADEDNESS, DIZZINESS, NAUSEA,  
ANOREXIA, ABDOMINAL DISCOMFORT, AND FATIGUE, SORE, DRY THROAT, WEAKNESS,  
LETHARGY, MALAISE, DROWSINESS, NERVOUSNESS, AND IRRITABILITY HAVE  
ALSO BEEN REPORTED. LATER THERE MAY BE DYSPNEA, PALLOR, SLIGHTLY INCREASED  
TEMPERATURE, DECREASED BLOOD PRESSURE, RAPID PULSE, PALPITATIONS, AND  
VISUAL DISTURBANCES. DIZZINESS WHEN COLD WATER IS PLACED IN THE EAR AND  
HEARING IMPAIRMENT HAVE BEEN REPORTED, AS HAVE DIFFUSE CEREBRAL ATROPHY  
ASSOCIATED WITH ATAXIA, TREMORS AND EMOTIONAL LABILITY. WORKERS EXPOSED TO  
BENZENE IN COMBINATION WITH OTHER SOLVENTS HAVE EXHIBITED POLYNEURITIS.  
SEVERAL CASE REPORTS, ONE OF THEM AN ACUTE EXPOSURE, SUGGEST THE  
POSSIBILITY THAT SYSTEMIC EXPOSURE MAY BE ASSOCIATED WITH RETROBULAR  
OR OPTIC NEURITIS. OCCASIONALLY HEMORRHAGES IN RETINA AND CONJUNCTIVA  
OCCUR AND RARELY NEURORETINAL EDEMA AND PAPILLEDAMA HAVE ACCOMPANIED  
THE RETINAL HEMORRHAGES. HEMATOLOGICAL EFFECTS VARY WIDELY AND MAY  
APPEAR AFTER A FEW WEEKS OR MANY YEARS OF EXPOSURE OR EVEN MANY YEARS  
AFTER EXPOSURE HAS CEASED. THE DEGREE OF EXPOSURE BELOW WHICH NO  
BLOOD EFFECTS WILL OCCUR CANNOT BE ESTABLISHED WITH CERTAINTY. IN THE  
EARLY STAGES, THERE MAY BE BLOOD CLOTTING DEFECTS DUE TO FUNCTIONAL,  
MORPHOLOGICAL AND QUANTITATIVE PLATELET ALTERATION WITH RESULTANT  
BLEEDING FROM THE NOSE AND GUMS, EASY BRUISING AND PETECHIAE; LEUKOPENIA  
WITH PREDOMINANT LYMPHOCYTOPENIA OR NEUTROPENIA; AND ANEMIA WHICH MAY BE  
NORMOCHROMIC OR MACROCYTIC AND HYPOCHROMIC. LEUKOCYTOSIS AND  
CIRCULATING IMMATURE MARROW CELLS HAVE ALSO BEEN REPORTED. BONE MARROW  
MAY BE HYPER-, HYPO- OR NORMOPLASTIC AND DOES NOT ALWAYS CORRELATE  
WITH THE PERIPHERAL BLOOD PICTURE. ALSO, THE SYMPTOMS DO NOT ALWAYS  
PARALLEL THE LABORATORY FINDINGS. IF TREATED AT THIS STAGE, THE EFFECTS  
APPEAR REVERSIBLE, ALTHOUGH RECOVERY MAY BE PROTRACTED AND THERE MAY BE  
RELAPSES. DECREASED ERYTHROCYTE SURVIVAL, HEMOLYSIS, CAPILLARY  
FRAGILITY, INTERNAL HEMORRHAGES, IRON METABOLISM DISTURBANCES, AND  
HYPERBILIRUBINEMIA HAVE ALSO BEEN REPORTED. EXPOSURE TO HIGH LEVELS FOR  
LONGER PERIODS MAY RESULT IN APLASIA AND FATTY DEGENERATION OF THE  
BONE MARROW WITH PANCYTOPENIA. THE MOST SERIOUS CASES OF APLASTIC ANEMIA  
MAY BE FATAL DUE TO HEMORRHAGE AND INFECTION; DEATH MAY OCCUR WITHIN 3  
MONTH OF DIAGNOSIS. ENORMOUS VARIABILITY IN INDIVIDUAL RESPONSE, INCLUDING  
NON-DOSE DEPENDENT APLASIA, AND THE FINDING OF EOSINOPHILIA SUGGESTS  
THAT, IN SOME CASES, THE BLOOD DYSCRASIA MAY PARTIALLY BE AN ALLERGIC  
REACTION. NUMEROUS CASE REPORTS AND SERIES HAVE SUGGESTED A  
RELATIONSHIP BETWEEN EXPOSURE TO BENZENE AND THE OCCURRENCE OF  
VARIOUS TYPES OF LEUKEMIA. SEVERAL CASE-CONTROL STUDIES HAVE ALSO  
SHOWN INCREASED ODDS RATIOS FOR EXPOSURE TO BENZENE, BUT MIXED EXPOSURE  
PATTERNS AND POORLY DEFINED EXPOSURES RENDER THEIR INTERPRETATION  
DIFFICULT. THREE INDEPENDENT COHORT STUDIES HAVE DEMONSTRATED AN INCREASED  
INCIDENCE OF ACUTE NONLYMPHOCYTIC LEUKEMIA IN WORKERS EXPOSED TO BENZENE.  
ALTHOUGH APLASTIC ANEMIA IS PROBABLY THE MORE LIKELY CONSEQUENCE OF  
LONGTERM EXPOSURE, IT IS NOT UNCOMMON FOR AN INDIVIDUAL SURVIVING THIS  
TO GO THROUGH A PRELEUKEMIC PHASE INTO FRANK LEUKEMIA, CONVERSELY.

LEUKEMIA WITHOUT PRECEDENT APLASTIC ANEMIA CAN OCCUR. IN ONE STUDY THE RANGE OF TIME FROM THE START OF THE EXPOSURE TO THE DIAGNOSIS OF LEUKEMIA WAS 3-24 YEARS. IT HAS BEEN SUGGESTED THAT THE CHROMOSOMAL ALTERATIONS WHICH CAN ARISE IN PERIPHERAL BLOOD AND BONE MARROW CELLS AND PERSIST FOR A LONG TIME AFTER EXPOSURE CEASES, MAY BE ASSOCIATED WITH THE INCREASED INCIDENCE OF LEUKEMIA. THE IMMUNOSUPPRESSIVE EFFECT HAS ALSO BEEN SUGGESTED AS BEING ASSOCIATED WITH THE LEUKEMOGENESIS. ADVERSE EFFECTS ON THE IMMUNOLOGICAL SYSTEM HAVE BEEN SHOWN TO MAKE RABBITS MORE SUSCEPTIBLE TO TUBERCULOSIS AND PNEUMONIA AND MAY EXPLAIN WHY THE TERMINAL EVENT IN SOME CASES OF BENZENE INTOXICATION MAY BE OVERWHELMING INFECTION. EXPOSED MICE EXHIBITED A TENDENCY TOWARD INDUCTION OF LYMPHOID NEOPLASMS. RATS EXHIBITED AN INCREASED INCIDENCE OF NEOPLASMS, MAINLY CARCINOMAS, AT VARIOUS SITES. MENSTRUAL DISTURBANCES HAVE BEEN REPORTED MORE FREQUENTLY IN EXPOSED WOMEN. TESTICULAR DAMAGE HAS BEEN REPORTED IN RATS, RABBITS AND GUINEA PIGS. SOME ANIMAL STUDIES HAVE DEMONSTRATED EMBRYO/FETOTOXICITY, SOMETIMES AT LEVELS AS LOW AS 10 PPM AND THE POTENTIAL FOR TERATOGENIC EFFECTS SUCH AS DECREASED BODY WEIGHT AND SKELETAL VARIANTS, HAVE ALSO BEEN SHOWN. OTHER STUDIES HAVE NOT PRODUCED EVIDENCE OF ABNORMALITIES OR EMBRYOLETHALITY.

IF EXPOSED- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING IS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

IF CONTACT:

LEUKEMIA:  
SYMPTOMS:  
SYMPTOMS:

ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE IRRITATION. EFFECTS MAY INCLUDE ERYTHEMA, A BURNING SENSATION, AND WITH PROLONGED CONTACT, BLISTERING AND EDEMA. UNDER NORMAL CONDITIONS, SIGNIFICANT SIGNS OF SYSTEMIC TOXICITY ARE UNLIKELY FROM SKIN CONTACT ALONE DUE TO THE SLOW RATE OF ABSORPTION; IT MAY HOWEVER, CONTRIBUTE TO THE TOXICITY FROM INHALATION. APPLICATION TO GUINEA PIGS RESULTED IN INCREASED DERMAL PERMEABILITY.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT DEFATS THE SKIN AND MAY RESULT IN DERMATITIS WITH ERYTHEMA, SCALING, DRYNESS, VESICULATION, AND CRACKING, POSSIBLY ACCOMPANIED BY PARESTHESIAS OF THE FINGERS WHICH MAY PERSIST SEVERAL WEEKS AFTER THE DERMATITIS SUBSIDES. PERIPHERAL NEURITIS AS ALSO BEEN REPORTED. SECONDARY INFECTIONS MAY OCCUR. TESTS ON GUINEA PIGS INDICATE SENSITIZATION IS POSSIBLE. ALTHOUGH ANIMAL STUDIES HAVE FAILED TO ESTABLISH A RELATIONSHIP BETWEEN SKIN CONTACT AND A CARCINOGENIC EFFECT, MOST OF THE STUDIES WERE INADEQUATE; SOME PAPILLOMAS AND HEMATOPOIETIC EFFECTS HAVE BEEN REPORTED.

IF EXPOSED- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

IF CONTACT:

LEUKEMIA:  
SYMPTOMS:  
SYMPTOMS:

ACUTE EXPOSURE- VAPOR CONCENTRATIONS OF 3000 PPM ARE VERY IRRITATING, EVEN ON BRIEF EXPOSURE. DROPLETS CAUSE MODERATE BURNING SENSATION, BUT ONLY SLIGHT, TRANSIENT CORNEAL EPITHELIAL INJURY WITH RAPID RECOVERY. CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS. 50% OF RATS EXPOSED TO 50 PPM FOR MORE THAN 600 HOURS DEVELOPED CATARACTS.

IF EXPOSED- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE. OCCASIONALLY LIFTING UPPER AND LOWER LIDS. UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

SECTION:

BENZENE:

ACUTE/CARCINOGEN.

ACUTE EXPOSURE- MAY CAUSE LOCAL IRRITATION AND BURNING SENSATION IN THE MOUTH, THROAT, AND STOMACH. SIGNS AND SYMPTOMS OF SYSTEMIC INTOXICATION MAY INCLUDE NAUSEA, VOMITING, HEADACHE, DIZZINESS, WEAKNESS, STAGGERING, CHEST PAIN AND TIGHTNESS, SHALLOW, RAPID PULSE, BREATHLESSNESS, PALLOR FOLLOWED BY FLUSHING, AND A FEAR OF IMPENDING DEATH. THERE MAY BE VISUAL DISTURBANCES AND CONVULSIONS, VIOLENT EXCITEMENT, EUPHORIA OR DELIRIUM MAY PRECEDE WEARINESS, FATIGUE AND SLEEPINESS FOLLOWED BY UNCONSCIOUSNESS, COMA AND DEATH. THOSE WHO SURVIVE THE CENTRAL NERVOUS SYSTEM EFFECTS MAY DEVELOP BRONCHITIS, PNEUMONIA, PULMONARY EDEMA, AND INTRAPULMONARY HEMORRHAGE. ASPIRATION MAY CAUSE IMMEDIATE PULMONARY EDEMA AND HEMORRHAGE. THE USUAL LETHAL DOSE IN HUMANS IS 10-15 MILLILITERS, BUT SMALLER AMOUNTS HAVE BEEN REPORTED TO CAUSE DEATH. A SINGLE EXPOSURE MAY PRODUCE LONGTERM EFFECTS WITH PANCYTOPENIA PERSISTING UP TO A YEAR.

CHRONIC EXPOSURE- DAILY ADMINISTRATION TO HUMANS OF 2-5 GRAMS IN OLIVE OIL HAS CAUSED HEADACHE, VERTIGO, BLADDER IRRITABILITY, IMPOTENCE, GASTRIC DISTURBANCES, AND RENAL DYSFUNCTION. IN FEMALE RATS TREATED WITH 132 SINGLE DAILY DOSES OVER 187 DAYS, NO EFFECTS WERE OBSERVED AT 1 MG/KG, SLIGHT LEUKOPENIA AT 10 MG/KG, AND BOTH LEUKOPENIA AND ANEMIA AT 50 AND 100 MG/KG. IN A 2 YEAR GAVAGE STUDY WITH RATS AND MICE, THERE WAS AN INCREASED INCIDENCE OF LYMPHOMAS AND TUMORS OF THE ORAL CAVITY, SKIN, LUNGS, OVARIES, AND MAMMARY, HARDERIAN, AND PREPUITAL GLANDS. IN A ONE YEAR GAVAGE STUDY, RATS GIVEN 50 OR 250 MG/KG, 7-5 DAYS/WEEK FOR 52 WEEKS

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DID NOT EXHIBIT ACUTE OR SUBACUTE TOXIC EFFECTS. BUT A DOSE CORRELATED INCREASE OF LEUKEMIAS AND MAMMARY CARCINOMAS WAS OBSERVED. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

IN AID- EXTREME CARE MUST BE USED TO PREVENT ASPIRATION. GASTRIC LAVAGE WITH A CUFFED ENDOTRACHEAL TUBE IN PLACE TO PREVENT FURTHER ASPIRATION SHOULD BE DONE WITHIN 15 MINUTES. IN THE ABSENCE OF DEPRESSION OR CONVULSIONS OR IMPAIRED GAG REFLEX, EMESIS CAN ALSO BE INDUCED USING SYRUP OF IPECAC WITHOUT INCREASING THE HAZARD OF ASPIRATION (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GASTRIC LAVAGE SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

NOTE:  
SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

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REACTIVITY

STABILITY:  
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

## COMPATIBILITIES:

OXIDIZERS:

OXYGEN (STRONG); INCOMPATIBLE.

METHYL CHLORIDE WITH DICHLOROETHYL ALUMINUM OR ETHYLALUMINUM SESQUICHLORIDE; POSSIBLE EXPLOSION.

ARSENIC PENTAFLUORIDE + POTASSIUM METHOXIDE: EXPLOSIVE INTERACTION.

OXYGEN (STRONG); INCOMPATIBLE.

AMMONIA + IRON: INCOMPATIBLE.

BORON TRIFLUORIDE: FIRE AND EXPLOSION HAZARD.

BORON TRIFLUORIDE: POSSIBLE EXPLOSION OR IGNITION.

CHLORINE: EXPLOSION IN THE PRESENCE OF LIGHT.

CHLORINE TRIFLUORIDE: VIOLENT REACTION WITH POSSIBLE EXPLOSION.

CHLORINE ANHYDRIDE (POWDERED): IGNITION.

CHLORINE: SPONTANEOUSLY EXPLOSIVE REACTION IN AIR.

OXYGEN DIFLUORIDE: IGNITION, EVEN AT REDUCED TEMPERATURES.

PERCHLORATE: IGNITION REACTION.

INTERHALOGEN COMPOUNDS: IGNITION OR EXPLOSION.

BORON HEPTAFLUORIDE: IGNITION ON CONTACT.

BORON PENTAFLUORIDE: VIOLENT INTERACTION ABOVE 50 C.

SULFURIC ACID: VIOLENT OR EXPLOSIVE UNLESS PROPERLY AGITATED AND COOLED.

METHYL PERCHLORATE: EXPLOSIVE INTERACTION.

OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.

OXYGEN (LIQUID): EXPLOSIVE MIXTURE.

OZONE: FORMATION OF EXPLOSIVE GELATINOUS OZONIDE.

PERCHLORATES (METAL): FORMATION OF EXPLOSIVE COMPLEX.

PERCHLORYL FLUORIDE + ALUMINUM CHLORIDE: FORMATION OF SHOCK SENSITIVE COMPOUND.

PERMANGANATES + SULFURIC ACID: POSSIBLE EXPLOSION.

PERMANGANIC ACID: EXPLOSION HAZARD.

DIOXODISULFURIC ACID: EXPLOSION HAZARD.

DIOXOMONOSULFURIC ACID: EXPLOSIVE INTERACTION.

POTASSIUM PEROXIDE: IGNITION.

SILVER PERCHLORATE: FORMATION OF EXPLOSIVE COMPLEX.

SODIUM PEROXIDE + WATER: IGNITION.

TANTALUM HEXAFLUORIDE: VIOLENT REACTION.

## COMPOSITION:

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

## POLYMERIZATION:

RADICAL POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

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STORAGE AND DISPOSAL

RESERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

## \*\*STORAGE\*\*

STORAGE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH CAN BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983. FOLLOW RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

PROTECT AGAINST PHYSICAL DAMAGE. OUTSIDE OR DETACHED STORAGE IS PREFERABLE. STORAGE SHOULD BE IN A STANDARD FLAMMABLE LIQUIDS STORAGE ROOM OR CABINET, SEPARATE FROM OXIDIZING MATERIALS (NFPA 49, HAZARDOUS CHEMICALS HANDBOOK, 1975).

KEEP AWAY FROM INCOMPATIBLE SUBSTANCES.



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ORGANIC VAPOR CANISTER.

HAN OR  
L TO 1000 PPM- SUPPLIED AIR RESPIRATOR WITH FULL FACEPIECE IN  
POSITIVE-PRESSURE MODE.

FOR THAN  
PM OR  
IN  
ENTRANTION-

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE  
IN POSITIVE-PRESSURE MODE.  
FULL FACEPIECE POSITIVE-PRESSURE SUPPLIED-AIR RESPIRATOR  
WITH AUXILIARY SELF-CONTAINED AIR SUPPLY.

ANY ORGANIC VAPOR GAS MASK.  
ANY SELF-CONTAINED BREATHING APPARATUS WITH FULL  
FACEPIECE.

IGHTING- FULL FACEPIECE SELF-CONTAINED BREATHING APPARATUS IN  
POSITIVE-PRESSURE MODE.

FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS  
THE U. S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO  
SPECIAL HAZARDS OR NIOSH CRITERIA DOCUMENTS.  
SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND  
THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF  
OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

ANY DETECTABLE CONCENTRATION:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.  
SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION  
WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED  
IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

APPE- AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE  
OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.  
ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

REFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND  
OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY  
SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER  
POSITIVE PRESSURE MODE.

ING:  
LOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT  
EVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

IZENE:  
PROTECTIVE CLOTHING SHOULD MEET THE REQUIREMENTS FOR PERSONAL PROTECTIVE  
EQUIPMENT IN 29 CFR 1910.1023(H).

IVES:  
LOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS  
SUBSTANCE.

IZENE:  
PROTECTIVE GLOVES SHOULD MEET THE REQUIREMENTS FOR PERSONAL PROTECTIVE  
EQUIPMENT IN 29 CFR 1910.1023(H).

PROTECTION:  
LOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT  
CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY  
BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH  
STATION WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

IZENE:  
PROTECTIVE EYE EQUIPMENT SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE CLOTHING  
AND EQUIPMENT IN 29 CFR 1910.1023(H).

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.  
CREATION DATE: 10/11/84 REVISION DATE: 07/13/90

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DATE: 02/07/90  
INDEX: 44892820053

ACCT: G9S033-01  
CAT NO: B2T520

PO NBR: N/A

FORMATION FOR THEIR PARTICULAR PURPOSES.

# ETHYL BENZENE

ETB

<p><b>Common Synonyms</b> Phenylmethane E9</p>	<p><b>Liquid</b> Colorless Sweet, gasoline-like odor</p> <p>Floats on water. Flammable, irritating vapor is produced.</p>
<p>Avoid contact with liquid and vapor. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Shut off ignition sources and call fire department. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
<p><b>Fire</b></p>	<p><b>FLAMMABLE.</b> Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>
<p><b>Exposure</b></p>	<p><b>CALL FOR MEDICAL AID</b></p> <p><b>VAPOR</b> Irritating to eyes, nose and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p><b>LIQUID</b> Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If IN EYES, hold eyelids open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>
<p><b>Water Pollution</b></p>	<p><b>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.</b> Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and water officials. Notify operators of nearby water intakes.</p>
<p><b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook) Mechanical containment. Should be removed. Chemical and physical treatment.</p>	<p><b>2. LABEL</b> 2.1 Category: Flammable liquid 2.2 Class: 3</p>
<p><b>3. CHEMICAL DESIGNATIONS</b> 3.1 CG Compatibility Class: Aromatic hydrocarbon 3.2 Formula: C<sub>8</sub>H<sub>10</sub> 3.3 IMO/IUM Designation: 3/1175 3.4 DOT ID No.: 1175 3.5 CAS Registry No.: 100-41-4</p>	<p><b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 Physical State (see shipping label) 4.2 Color: Colorless 4.3 Odor: Aromatic</p>
<p><b>5. HEALTH HAZARDS</b></p> <p>5.1 Personal Protective Equipment: Self-contained breathing apparatus, safety goggles. 5.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Irritation of eye with corneal injury possible. Irritates skin and may cause blister. 5.3 Treatment of Exposure: <b>INHALATION:</b> If effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly. If breathing stops, give artificial respiration. <b>INGESTION:</b> induce vomiting only upon physician's approval. Material in lung may cause chemical pneumonia. <b>SKIN AND EYES:</b> promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limit: 200 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD<sub>50</sub> = 0.5 to 5 g/kg (rat) 5.7 Lethal Toxicity: Data not available. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel wear and high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure, may cause secondary burns on long exposure. 5.10 Odor Threshold: 140 ppm 5.11 TLVH Value: 2,000 ppm</p>	

<p><b>6. FIRE HAZARDS</b></p> <p>6.1 Flash Point: 20°F O.C.; 59°F C.C. 6.2 Flammable Limits in Air: 1.0% - 6.7% 6.3 Fire Extinguishing Agents: Foam (most effective), water fog, carbon dioxide or dry chemical. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent. 6.5 Special Hazards of Combustion: Products: Irritating vapors are generated when heated. 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back. 6.7 Ignition Temperature: 860°F 6.8 Electrical Hazard: Not pertinent. 6.9 Burning Rate: 5.8 mm/min 6.10 Adiabatic Flame Temperature: Data Not Available</p> <p style="text-align: right;">(Continued)</p>	<p><b>10. HAZARD ASSESSMENT CODE</b> (See Hazard Assessment Handbook) A-T-U</p> <p><b>11. HAZARD CLASSIFICATIONS</b></p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 HAS Hazard Rating for Bulk Water Transportation: Category: 3 Rating: 3 Health: Vapor Irritant: 2 Liquid or Solid Irritant: 2 Poisons: 2 Water Pollution: Human Toxicity: 1 Aquatic Toxicity: 3 Aesthetic Effect: 2 Reactivity: Other Chemicals: 1 Water: 0 Self Reaction: 0 11.3 NFPA Hazard Classification: Category: 2 Classification: Health Hazard (Blue): 2 Flammability (Red): 3 Reactivity (Yellow): 0</p>
<p><b>7. CHEMICAL REACTIVITY</b></p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data Not Available 7.8 Reactivity Group: 3</p>	<p><b>12. PHYSICAL AND CHEMICAL PROPERTIES</b></p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 106.17 12.3 Boiling Point at 1 atm: 136.2°C = 277.2°F 12.4 Freezing Point: -120°F = -85°C = 178°K 12.5 Critical Temperature: 551.0°F = 343.9°C = 617.1°K 12.6 Critical Pressure: 523 mm = 35.6 atm = 3.61 MPa 12.7 Specific Gravity: 0.863 at 25°C (liquid) 12.8 Liquid Surface Tension: 25.7 dyn/cm = 0.0292 N/m at 25°C 12.9 Liquid Vapor Interfacial Tension: 35.48 dyn/cm = 0.03548 N/m at 25°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.071 12.12 Latent Heat of Vaporization: 144 Btu/lb = 80.1 cal/g = 3.35 x 10<sup>3</sup> J/kg 12.13 Heat of Combustion: -17,780 Btu/lb = -8227 cal/g = -4135 x 10<sup>3</sup> J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: Data Not Available 12.18 Limiting Value: Data Not Available 12.19 Reid Vapor Pressure: 0.4 psi</p>
<p><b>8. WATER POLLUTION</b></p> <p>8.1 Aquatic Toxicity: 25 ppm LC50 (fish) / 100 ppm (fish water) 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 2.8% (20°C) / 5 days 8.4 Food Chain Concentration Potential: None</p>	<p><b>9. SHIPPING INFORMATION</b></p> <p>9.1 Grades of Purity: Research grade 99.9%, pure grade 99.5%, technical grade 99.0% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrestor) or pressure/vacuum</p>
<p><b>6. FIRE HAZARDS (Continued)</b></p> <p>6.11 Stoichiometric Air to Fuel Ratio: Data Not Available 6.12 Flame Temperature: Data Not Available</p>	

TB

## ETHYLBENZENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
40	54.990	40	.402	-90	1.065	40	.835
50	54.690	50	.404	-80	1.056	50	.774
60	54.370	60	.407	-70	1.047	60	.719
70	54.060	70	.409	-60	1.037	70	.670
80	53.750	80	.412	-50	1.028	80	.626
90	53.430	90	.414	-40	1.018	90	.586
100	53.120	100	.417	-30	1.009	100	.550
110	52.810	110	.419	-20	1.000	110	.518
120	52.500	120	.421	-10	.990	120	.488
130	52.190	130	.424	0	.981	130	.461
140	51.870	140	.426	10	.971	140	.436
150	51.560	150	.429	20	.962	150	.414
160	51.250	160	.431	30	.953	160	.393
170	50.940	170	.434	40	.943	170	.374
180	50.620	180	.436	50	.934	180	.356
190	50.310	190	.439	60	.924	190	.340
200	50.000	200	.441	70	.915	200	.325
210	49.690	210	.443	80	.906	210	.311
				90	.896		
				100	.887		
				110	.877		
				120	.868		
				130	.859		
				140	.849		
				150	.840		
				160	.830		

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.020	80	.202	80	.00370	-400	-.007
		100	.370	100	.00654	-350	.026
		120	.644	120	.01099	-300	.060
		140	1.071	140	.01767	-250	.093
		160	1.713	160	.02734	-200	.125
		180	2.643	180	.04087	-150	.157
		200	3.953	200	.05926	-100	.187
		220	5.747	220	.08363	-50	.217
		240	8.147	240	.11520	0	.246
		260	11.250	260	.15510	50	.274
		280	15.320	280	.20490	100	.301
		300	20.410	300	.26570	150	.327
		320	26.730	320	.33910	200	.353
		340	34.460	340	.42620	250	.377
		360	43.800	360	.52850	300	.401
		380	54.950	380	.64720	350	.424
						400	.446
						450	.467
						500	.487
						550	.507
						600	.525



# TOLUENE

TOL

<p><b>Common Synonyms</b> Toluol Methylbenzene Methylbenzol</p>		<p><b>Wettable liquid</b> Colorless Pleasant odor</p>
<p>Floats on water. Flammable, irritating vapor is produced.</p>		
<p>Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>		
<p><b>Fire</b></p>	<p><b>FLAMMABLE.</b> Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>	
<p><b>Exposure</b></p>	<p><b>CALL FOR MEDICAL AID.</b> <b>VAPOR</b> Irritating to eyes, nose and throat. If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing difficult, give oxygen. <b>LIQUID</b> Irritating to skin and eyes. If swallowed, will cause nausea, vomiting or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If IN EYES, hold eyelids open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. <b>DO NOT INDUCE VOMITING.</b></p>	
<p><b>Water Pollution</b></p>	<p>Dangerous to aquatic life in high concentrations. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and waste officials. Notify operators of nearby water intakes.</p>	
<p><b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook) Issue warning-high flammability. Evacuate area.</p>		<p><b>2. LABEL</b> 2.1 Category: Flammable liquid 2.2 Class: 3</p>
<p><b>3. CHEMICAL DESIGNATIONS</b> 3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: C<sub>7</sub>H<sub>8</sub> 3.3 IMO/IUN Designation: 3.2/1294 3.4 DOT ID No.: 1294 3.5 CAS Registry No.: 108-88-3</p>		<p><b>4. OBSERVABLE CHARACTERISTICS</b> 4.1 Physical State (see shipping): Liquid 4.2 Color, Opacity: Colorless 4.3 Odor: Pungent, aromatic, benzene-like, distinct, pleasant</p>
<p><b>5. HEALTH HAZARDS</b> 5.1 Personal Protective Equipment: Air-supplied mask, goggles or face shield, plastic gloves. 5.2 Symptoms Following Exposure: Vapors irritate eyes and upper respiratory tract, cause dizziness, headache, ataxia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If inhaled, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed reflexes. 5.3 Treatment of Exposure: <b>INHALATION:</b> remove to fresh air, give artificial respiration and oxygen if needed, call a doctor. <b>INGESTION:</b> do NOT induce vomiting; call a doctor. <b>EYES:</b> flush with water for at least 15 min. <b>SKIN:</b> wipe off, wash with soap and water. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limit: 600 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD<sub>50</sub> = 0.5 to 3 g/kg 5.7 Lethal Toxicity: Kidney and liver damage may follow ingestion. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin. 5.10 Odor Threshold: 0.17 ppm 5.11 TLVH Value: 2,000 ppm</p>		

**6. FIRE HAZARDS**

- Flash Point: 40°F C.C.; 55°F O.C.
- Flammable Limits in Air: 1.27%-7%
- Fire Extinguishing Agents: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires.
- Fire Extinguishing Agents: Water may be ineffective. Used: Water may be ineffective.
- Special Hazards of Combustion Products: Not pertinent.
- Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
- Ignition Temperature: 907°F
- Electrical Hazard: Class I, Group D
- Burning Rate: 5.7 mm/min.
- Adiabatic Flame Temperature: Data not available.

**7. CHEMICAL REACTIVITY**

- Reactivity With Water: No reaction
- Reactivity With Common Inorganic No reaction
- Stability During Transport: Stable
- Neutralizing Agents for Acids and Corrosives: Not pertinent
- Polymerization: Not pertinent
- Inhibitor of Polymerization: Not pertinent
- Molar Ratio (Reactant to Product): Data not available
- Reactivity Group: 3

**8. WATER POLLUTION**

- Aquatic Toxicity: 1180 mg/l/96 hr/LC50/TL<sub>50</sub> fresh water
- Waterfowl Toxicity: Data not available
- Biological Oxygen Demand (BOD): 0% 5 days, 38% (BOD<sub>5</sub>), 8 days
- Foam Chain Concentration Potential: None

**9. SHIPPING INFORMATION**

- Grade of Purity, Research, reagent, industrial: 99.8 - % industrial, 99.5 - 94 - %, with 5% xylene and small amounts of benzene and nonaromatic hydrocarbons; 90/100 less pure than industrial.
- Storage Temperature: Ambient
- Inert Atmosphere: No requirement
- Venting: Open (flame arrester) or pressure-vacuum

**6. FIRE HAZARDS (Continued)**

- Stoichiometric Air to Fuel Ratio: Data not available
- Flame Temperature: Data not available

**10. HAZARD ASSESSMENT CODE**  
(See Hazard Assessment Handbook)  
A-T-U

**11. HAZARD CLASSIFICATIONS**

- Code of Federal Regulations: Flammable liquid
- NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid Irritant	1
Poison	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
- HAZOP Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

**12. PHYSICAL AND CHEMICAL PROPERTIES**

- Physical State at 15°C and 1 atm: Liquid
- Molecular Weight: 92.14
- Boiling Point at 1 atm: 110.6°C = 232.1°F
- Freezing Point: -95.0°C = 173.2°F
- Critical Temperature: 355.6°C = 670.1°F
- Critical Pressure: 5.58 MPa = 80.9 atm
- Specific Gravity: 0.867 at 20°C (liquid)
- Liquid Surface Tension: 25.0 dynes/cm = 0.025 N/m at 20°C
- Liquid Water Interfacial Tension: 26.1 dynes/cm = 0.0261 N/m at 25°C
- Vapor (Gas) Specific Gravity: Not pertinent
- Ratio of Specific Heats of Vapor (Gas): 1.059
- Latent Heat of Vaporization: 155 Btu/lb = 86.1 cal/g = 3.61 x 10<sup>4</sup> J/kg
- Heat of Combustion: -17,430 Btu/lb = -9565 cal/g = -405.5 x 10<sup>3</sup> J/kg
- Heat of Decomposition: Not pertinent
- Heat of Solution: Not pertinent
- Heat of Polymerization: Not pertinent
- Heat of Fusion: 12.17 cal/g
- Limiting Value: Data not available
- Field Vapor Pressure: 1.1 atm

TOL	TOLUENE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
-30	57.180	0	.396	0	1.026	0	1.024
-20	56.870	5	.397	10	1.015	5	.978
-10	56.550	10	.399	20	1.005	10	.935
0	56.240	15	.400	30	.994	15	.894
10	55.930	20	.402	40	.983	20	.857
20	55.620	25	.403	50	.972	25	.821
30	55.310	30	.404	60	.962	30	.788
40	54.990	35	.406	70	.951	35	.757
50	54.660	40	.407	80	.940	40	.727
60	54.370	45	.409	90	.929	45	.700
70	54.060	50	.410	100	.919	50	.673
80	53.750	55	.411	110	.908	55	.649
90	53.430	60	.413	120	.897	60	.625
100	53.120	65	.414	130	.886	65	.603
110	52.810	70	.415	140	.876	70	.582
120	52.500	75	.417	150	.865	75	.562
		80	.418	160	.854	80	.544
		85	.420	170	.843	85	.526
		90	.421	180	.833	90	.509
		95	.422	190	.822	95	.493
		100	.424	200	.811	100	.477
		105	.425	210	.800		
		110	.427				
		115	.428				
		120	.429				
		125	.431				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.050	0	.038	0	.00070	0	.228
		10	.057	10	.00103	25	.241
		20	.084	20	.00150	50	.255
		30	.121	30	.00212	75	.268
		40	.172	40	.00295	100	.281
		50	.241	50	.00405	125	.294
		60	.331	60	.00547	150	.306
		70	.449	70	.00727	175	.319
		80	.600	80	.00954	200	.331
		90	.792	90	.01237	225	.343
		100	1.033	100	.01584	250	.355
		110	1.332	110	.02007	275	.367
		120	1.700	120	.02518	300	.378
		130	2.148	130	.03127	325	.389
		140	2.690	140	.03850	350	.400
		150	3.338	150	.04700	375	.411
		160	4.109	160	.05691	400	.422
		170	5.018	170	.06840	425	.432
		180	6.083	180	.08162	450	.443
		190	7.323	190	.09675	475	.453
		200	8.758	200	.11400	500	.462
		210	10.410	210	.13340	525	.472
						550	.482
						575	.491
						600	.500

# m-XYLENE

XML

<p><b>Common Synonyms</b> 1,3-Dimethylbenzene Xylol</p>		<p>Watery liquid</p> <p>Colorless</p> <p>Sweet odor</p> <p>Floats on water. Flammable, irritating vapor is produced.</p>
<p>Stop discharge if possible. Keep people away. Call fire department. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>		
<p><b>Fire</b></p>	<p><b>FLAMMABLE</b> Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>	
<p><b>Exposure</b></p>	<p><b>CALL FOR MEDICAL AID.</b></p> <p><b>VAPOR</b> Irritating to eyes, nose, and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p><b>LIQUID</b> Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If IN EYES, hold eyelids open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. <b>DO NOT INDUCE VOMITING.</b></p>	
<p><b>Water Pollution</b></p>	<p><b>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.</b> Floating to the surface. May be dangerous if it enters water intakes. Notify local health and waste officials. Notify operators of nearby water intakes.</p>	
<p><b>1. RESPONSE TO DISCHARGE</b> (See Response Methods Handbook) Issue warning-high flammability. Evacuate area. Should be removed. Chemical and physical treatment.</p>	<p><b>2. LABEL</b></p> <p>2.1 Category: Flammable liquid 2.2 Class: 3</p>	
<p><b>3. CHEMICAL DESIGNATIONS</b></p> <p>3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: m-C<sub>8</sub>H<sub>10</sub>(OH)<sub>2</sub> 3.3 HMGT/UN Designation: 3271307 3.4 DOT ID No.: 1307 3.5 CAS Registry No.: 108-36-3</p>	<p><b>4. OBSERVABLE CHARACTERISTICS</b></p> <p>4.1 Physical State (see indexes): Liquid 4.2 Color: Colorless 4.3 Odor: Like benzene, characteristic aromatic</p>	
<p><b>5. HEALTH HAZARDS</b></p> <p>5.1 Personal Protective Equipment: Approved canister or air-sucked mask, goggles or face shield, plastic gloves and boots.</p> <p>5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma; can be fatal. Kidney and liver damage can occur.</p> <p>5.3 Treatment of Exposure: <b>INHALATION:</b> remove to fresh air, administer artificial respiration and oxygen if required, call a doctor. <b>INGESTION:</b> do NOT induce vomiting, call a doctor. <b>EYES:</b> flush with water for at least 15 min. <b>SKIN:</b> wipe off, wash with soap and water.</p> <p>5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limit: 300 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 3; LD<sub>50</sub> = 50 to 500 g/kg 5.7 Late Toxicity: Kidney and liver damage. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If soiled on clothing and allowed to remain, may cause stinging and reddening of the skin. 5.10 Odor Threshold: 0.05 ppm 5.11 IDLH Value: 10,000 ppm</p>		

<p><b>6. FIRE HAZARDS</b></p> <p>6.1 Flash Point: 84°F C.C. 6.2 Flammable Limits in Air: 1.1% - 6.4% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide. 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion Products: Not pertinent. 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 986°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 5.8 mm/min. 6.10 Adiabatic Flame Temperature: Data not available. 6.11 Stoichiometric Air to Fuel Ratio: Data not available. 6.12 Flame Temperature: Data not available.</p>	<p><b>7. CHEMICAL REACTIVITY</b></p> <p>7.1 Reactivity With Water: No reaction. 7.2 Reactivity with Common Materials: No reaction. 7.3 Stability During Transport: Stable. 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent. 7.5 Polymerization: Not pertinent. 7.6 Inhibitor of Polymerization: Not pertinent. 7.7 Molar Ratio (Reactant to Product): Data not available. 7.8 Reactivity Group: 02</p>
<p><b>8. WATER POLLUTION</b></p> <p>8.1 Aquatic Toxicity: 22 ppm/96 hr (Dunlop/TL) (fresh water) 8.2 Waterborne Toxicity: Data not available. 8.3 Biological Oxygen Demand (BOD): 0.01%, 5 days, 0% (fresh), 0 days. 8.4 Food Chain Concentration Potential: Data not available.</p>	<p><b>9. SHIPPING INFORMATION</b></p> <p>9.1 Grades of Purity: Research 99.99%, Pure 99.9%, Technical 99.2% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrestor) or pressure-vacuum</p>
<p><b>NOTES</b></p>	

<p><b>10. HAZARD ASSESSMENT CODE</b> (See Hazard Assessment Handbook) F A-T-U</p>																																				
<p><b>11. HAZARD CLASSIFICATIONS</b></p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td>1</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>1</td> </tr> <tr> <td>Poison</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>3</td> </tr> <tr> <td>Acute Effect</td> <td>2</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemical</td> <td>1</td> </tr> <tr> <td>Water</td> <td>0</td> </tr> <tr> <td>Self-Reaction</td> <td>0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>2</td> </tr> <tr> <td>Flammability (Red)</td> <td>3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>	Category	Rating	Fire	3	Health		Vapor Irritant	1	Liquid or Solid Irritant	1	Poison	2	Water Pollution		Human Toxicity	1	Aquatic Toxicity	3	Acute Effect	2	Reactivity		Other Chemical	1	Water	0	Self-Reaction	0	Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	3	Reactivity (Yellow)	0
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<p><b>12. PHYSICAL AND CHEMICAL PROPERTIES</b></p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 106.16 12.3 Boiling Point at 1 atm: 104.4°F = 40.2°C = 435.1°R 12.4 Freezing Point: -54.2°F = -47.9°C = 225.2°R 12.5 Critical Temperature: 620.2°F = 343.0°C = 617.0°R 12.6 Critical Pressure: 513.2 atm = 34.95 MPa = 3,540 bar/psi 12.7 Specific Gravity: 0.864 at 20°C (liquid) 12.8 Liquid Surface Tension: 27.6 dyn/cm = 0.0286 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 36.4 dyn/cm = 0.0364 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Heat of Specific Heats of Vapor (Gas): 1071 12.12 Latent Heat of Vaporization: 147 Btu/lb = 81.9 cal/g = 3.43 x 10<sup>5</sup> J/kg 12.13 Heat of Combustion: -17,554 Btu/lb = -8752.4 cal/g = -408.31 x 10<sup>3</sup> J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 26.01 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.34 psia</p>																																				

LM

## m-XYLENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
15	55.400	40	.387	35	.962	15	.938
20	55.260	50	.393	40	.953	20	.898
25	55.130	60	.398	45	.944	25	.862
30	54.990	70	.404	50	.935	30	.827
35	54.850	80	.410	55	.926	35	.794
40	54.710	90	.415	60	.917	40	.764
45	54.570	100	.421	65	.908	45	.735
50	54.430	110	.426	70	.899	50	.708
55	54.290	120	.432	75	.890	55	.682
60	54.160	130	.437	80	.881	60	.658
65	54.020	140	.443	85	.873	65	.635
70	53.880	150	.448	90	.864	70	.613
75	53.740	160	.454	95	.855	75	.592
80	53.600	170	.460	100	.846	80	.572
85	53.460	180	.465			85	.554
90	53.320	190	.471				
95	53.180	200	.476				
100	53.050	210	.482				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	60	.090	60	.00172	0	.247
	N	70	.127	70	.00238	25	.260
	S	80	.177	80	.00324	50	.273
	O	90	.242	90	.00435	75	.286
	L	100	.326	100	.00577	100	.299
	U	110	.434	110	.00754	125	.311
	B	120	.571	120	.00975	150	.324
	L	130	.743	130	.01247	175	.336
	E	140	.956	140	.01577	200	.348
		150	1.219	150	.01977	225	.360
		160	1.538	160	.02455	250	.371
		170	1.924	170	.03023	275	.383
		180	2.388	180	.03691	300	.394
		190	2.939	190	.04473	325	.405
		200	3.590	200	.05382	350	.417
		210	4.355	210	.06431	375	.427
		220	5.247	220	.07635	400	.438
		230	6.282	230	.09009	425	.449
		240	7.476	240	.10570	450	.459
		250	8.846	250	.12330	475	.469
		260	10.410	260	.14310	500	.479
						525	.489
						550	.499
						575	.508
						600	.517



MELTING POINT: 176 F (80 C)      SPECIFIC GRAVITY: 1.1

VAPOR PRESSURE: 0.05 MMHG @ 20 C      EVAPORATION RATE: (DU ACETATE=1) >1.0

SOLUBILITY IN WATER: .033      VAPOR DENSITY: 4.4

SOLVENT SOLUBILITY: ALCOHOL, BENZENE, CCL4, FIXED & VOLATILE OILS.

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#### FIRE AND EXPLOSION DATA

##### FIRE AND EXPLOSION HAZARD:

MODERATE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME, AND A MODERATE EXPLOSION HAZARD IN THE FORM OF DUST AT 176 F. REACTIONS WITH INCOMPATIBLE SUBSTANCES MAY CAUSE FIRES AND EXPLOSIONS. VAPOR FORMS EXPLOSIVE MIXTURES WITH AIR.

FLASH POINT: 174 F (79 C)      UPPER EXPLOSIVE LIMIT: 5.9%

LOWER EXPLOSIVE LIMIT: 0.9%      AUTOIGNITION TEMP.: 979 F (526 C)

##### FIREFIGHTING MEDIA:

DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM  
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5000.3).

##### FIREFIGHTING:

WEAR PERSONAL PROTECTIVE EQUIPMENT (RESPIRATORY AND EYE). MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAME WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT.

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#### TOXICITY

100 MG/KG ORAL-CHILD LDLO; 1250 MG/KG ORAL-RAT LD50; 400 MG/KG ORAL-DUG LDLO;  
533 MG/KG ORAL-MOUSE LD50; 150 MG/KG INTRAPERITONEAL-MOUSE LD50; 100 MG/KG  
INTRAVENOUS-MOUSE LD50; MUTATION DATA (RTECS); REPRODUCTIVE EFFECTS DATA  
(RTECS); CARCINOGEN STATUS: NONE.

HAPHTHALENE IS A SKIN SENSITIZER AND A DEFICIENCY OF GLUCOSE-6-PHOSPHATE  
DEHYDROGENASE ARE MORE SUSCEPTIBLE TO THE HEMOLYTIC EFFECTS.

---

#### HEALTH EFFECTS AND FIRST AID

##### INHALATION:

HEMOLYTIC AGENT.

500 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

--- ACUTE EXPOSURE- CAUSES CENTRAL NERVOUS SYSTEM DEPRESSION, WITH HEADACHE,  
CONFUSION, EXCITEMENT, NAUSEA, VOMITING, SWEATING, DYSURIA, HEMATURIA,  
HEMOLYSIS AND CONVULSIONS. OPTIC NEURITIS IS RARE. PAROTID GLAND ENLARGE-  
MENT IS POSSIBLE. HEPATIC NECROSIS MAY OCCUR. SEE ALSO INGESTION.

CHRONIC EXPOSURE- HEMOLYTIC EFFECTS IN SUSCEPTIBLE POPULATIONS (GLUCOSE-6-  
PHOSPHATE DEHYDROGENASE DEFICIENCY). SEE MUTAGENIC DATA, ANIMAL REPRODUC-  
TIVE DATA AND ANIMAL TUMORIGENIC DATA REFERENCES IN TOXICITY SECTION.

--- FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING  
HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST.

GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:

IRRITANT/SENSITIZER.

ACUTE EXPOSURE- MAY CAUSE IRRITATION AND, IN SENSITIZED INDIVIDUALS, SEVERE DERMATITIS. POISONING MAY OCCUR BY SKIN ABSORPTION.

CHRONIC EXPOSURE- ITCHING, REDNESS, SCALING, WEEPING, AND CRUSTING OF THE SKIN. MAY PRODUCE SENSITIZATION DERMATITIS FOLLOWING REPEATED CONTACT. SEE MUTAGENIC DATA, ANIMAL REPRODUCTIVE EFFECTS DATA AND ANIMAL TUMORIGENIC DATA REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:

IRRITANT.

ACUTE EXPOSURE- 15 PPM OF VAPOR IS IRRITATING. VAPOR OR MIST MAY CAUSE SUPERFICIAL INJURY, CONJUNCTIVITIS, AND VISUAL DISTURBANCES.

CHRONIC EXPOSURE- WORKERS EXPOSED TO HIGH CONCENTRATIONS HAVE DEVELOPED CATARACTS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS; UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES) GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:

HEMOLYTIC AGENT.

ACUTE EXPOSURE- INGESTION MAY CAUSE INTRAVASCULAR HEMOLYSIS. INITIAL SYMPTOMS MAY INCLUDE HEADACHE, CONFUSION, EXCITEMENT, MALAISE, PROFUSE SWEATING, NAUSEA, VOMITING, ABDOMINAL PAIN, AND IRRITATION OF THE BLADDER. THERE MAY BE PROGRESSIVE JAUNDICE, HEMATURIA, HEMOGLOBINURIA, RENAL TUBULAR BLOCKAGE, AND ACUTE RENAL SHUTDOWN.

FIRST AID- IF VICTIM IS CONSCIOUS AND NOT CONVULSIVE, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER. INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

-----  
REACTIVITY

REACTIVITY:

STABLE AT ORDINARY PRESSURES UP TO THE BOILING POINT, 218 C.

INCOMPATIBILITIES:

OXIDIZERS AND OTHER MATERIALS, EXAMPLES FOLLOW:

NAPHTHALENE:

CHROMIC ANHYDRIDE: VIOLENT REACTION.

ALUMINUM TRICHLORIDE + BENZOYL CHLORIDE MIXTURE: VIOLENT REACTION.

STRONG OXIDIZERS: VIOLENT REACTION.

DINITROGEN PENTAOXIDE: POSSIBLE EXPLOSION.

PLASTICS: MELTED FORM WILL ATTACK.

RUBBER: MELTED FORM WILL ATTACK.

COATINGS: MELTED FORM WILL ATTACK.

DECOMPOSITION:  
COMBUSTION PREDICTED TO CAUSE EMISSION OF CARBON MONOXIDE AND CARBON DIOXIDE  
AND POSSIBLY OTHER HAZARDOUS ORGANICS AS WELL AS SMOKE.

POLYMERIZATION:  
WILL NOT OCCUR.

XX  
CONDITIONS TO AVOID

AVOID HEATING TO THE FLASH POINT, 79 C, UNLESS UNDER CAREFULLY ENGINEERED  
CONDITIONS. AVOID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS,  
INCLUDING THOSE LISTED IN THE REACTIVITY SECTION.

XX  
SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:  
SHUT OFF IGNITION SOURCES. FOR SMALL SPILLS, WITH CLEAN SHOVEL, PLACE MATERIAL  
INTO CLEAN, DRY CONTAINER AND COVER; MOVE CONTAINERS FROM SPILL AREA. NO  
SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY.  
ISOLATE HAZARD AREA AND DENY ENTRY. KEEP OUT OF SEWERS, WATERWAYS AND OTHER  
WATER SOURCES.

WHEN MATERIAL NOT INVOLVED IN FIRE:  
KEEP OPEN FLAMES, SPARKS AND OTHER IGNITION SOURCES AWAY.  
DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS AND WATER SOURCES.  
BUILD DIXES FOR CONTAINMENT OF SPILL FLOW.

-----  
PROTECTIVE EQUIPMENT

VENTILATION:  
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:  
EXPOSURE LIMIT TO 100 PPM-  
CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE WITH A FULL  
FACEPIECE AND A DUST FILTER.  
TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN A PRESSURE-  
DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET  
OR HOOD OPERATED IN CONTINUOUS FLOW MODE.  
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE, OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

250 PPM-  
GAS MASK WITH AN ORGANIC VAPOR CARTRIDGE (CHIN-STYLE, FRONT- OR BACK-MOUNTED  
CARTRIDGE) WITH A FULL FACEPIECE.  
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

>250 PPM, INCLUDING THE IDLH LEVEL, 500 PPM  
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE, OR USE EQUIVALENT  
RESPIRATOR.



CLOTHING:  
PROTECTIVE CLOTHING NOT REQUIRED. AVOID REPEATED OR PROLONGED CONTACT WITH THIS SUBSTANCE.

GLOVES:  
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT REPEATED OR PROLONGED CONTACT WITH THIS SUBSTANCE. PREFERRED MATERIALS: PVA AND VITON PLASTICS.

EYE PROTECTION:  
EMPLOYEE MUST WEAR SPLASH-PROOF SAFETY GOGGLES WHENEVER THERE IS REASONABLE PROBABILITY OF EYE CONTACT WITH THIS SOLUTION. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

WHEN THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.  
CREATION DATE: 01/11/85 REVISION DATE: 10/15/86

-ADDITIONAL INFORMATION-

THE INFORMATION BELOW IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. HOWEVER, WE MAKE NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT TO SUCH INFORMATION, AND WE ASSUME NO LIABILITY RESULTING FROM ITS USE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION FOR THEIR PARTICULAR PURPOSES.

MILPORT CHEMICAL COMPANY  
2829 South 5th Court  
Milwaukee, Wisconsin 53207

MATERIAL SAFETY DATA SHEET

Phone 414-769-7550  
Emergency Phone: CHEMTREC 1-800-424-9300

SECTION 1 - IDENTITY

COMMON NAME: BIO TREATMENT NUTRIENTS #36      DATE: 3/26/92  
CHEMICAL NAME: Mixture      CAS NO: None assigned  
CHEMICAL FAMILY: Mixture      FORMULA: Proprietary

SECTION 2 - HAZARDOUS COMPONENTS

- |                         |         |                 |
|-------------------------|---------|-----------------|
| 1. Urea                 |         | CAS#: 57-13-6   |
| PEL: NE                 | TLV: NE | WGTX: 67.7%     |
| 2. Diammonium Phosphate |         | CAS#: 7783-28-8 |
| PEL: NE                 | TLV: NE | WGTX: 33.3%     |

NE = NONE ESTABLISHED

These items may require reporting under Title III, Section 313(40CFR 372).

SECTION 3 - PHYSICAL DATA

BOILING POINT: Not applicable      SPECIFIC GRAVITY: Not established  
VAPOR PRESSURE: Not applicable  
EVAPORATION RATE: Not applicable  
SOLUBILITY IN WATER: Complete  
APPEARANCE AND ODOR: white or off-white solids with slight odor

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: Not applicable      FLAMMABLE LIMITS: Not applicable  
EXTINGUISHING MEDIA: Water spray, CO2, dry chemical or foam  
SPECIAL FIRE FIGHTING PROCEDURES: Wear self contained

breathing apparatus and full personal protective clothing to prevent any skin or eye contact with this material.  
UNUSUAL FIRE AND EXPLOSION HAZARDS: Under fire conditions this material may give off oxides of carbon and nitrogen. If any aqueous solution exposed to extreme heat could potentially give off extremely toxic hydrogen cyanide gas.

### SECTION 5 - REACTIVITY DATA

STABILITY: Stable                      CONDITIONS TO AVOID: Extreme heat  
INCOMPATIBILITY (Materials to Avoid): Acids, nitrates, chlorine, hypochlorites, oxidizers and heat.  
HAZARDOUS DECOMPOSITION PRODUCTS: Ammonia  
HAZARDOUS POLYMERIZATION: Will not occur  
CONDITIONS TO AVOID: Extreme heat

### SECTION 6 - HEALTH HAZARDS

#### EFFECTS OF OVEREXPOSURE

(1) ACUTE: Irritant, slightly toxic may cause nausea, vomiting or diarrhea if ingested.

(2) CHRONIC: None known

CARCINOGENICITY: None known

OSHA PEL: None established

ACGIH TLV: None established

### SECTION 7 - EMERGENCY AND FIRST AID PROCEDURES

#### EXPOSURE

INHALATION: Remove victim to fresh air, if unconscious give artificial respiration. Consult a physician.

INJECTION: If conscious, give victim water. Immediately consult a physician.

EYES: Flush eyes with water for at least fifteen minutes. Consult a physician

SKIN: Flush effected area with water, remove contaminated clothing. If redness persists consult a physician.

SPILLS: If necessary, contain spill with diking agent. Transfer contained and spilled material to a chemically compatible container for reuse or disposal.

WASTE DISPOSAL METHODS: Dispose of according to all local state and federal regulations.

### SECTION 8 - SAFE USAGE DATA

RESPIRATORY PROTECTION: NIOSH or MSHA approved respirator when dust, mists or vapors present.

VENTILATION: General

PROTECTIVE GLOVES: Impervious EYE PROTECTION: Goggles or face shield

OTHER PROTECTIVE EQUIPMENT: Rubber apron and boots. Eyewash available in area

STORAGE AND HANDLING: Store in a cool dry place away from incompatible materials.

OTHER PRECAUTIONS: None known

The information contained herein is offered only as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Milport Chemical will not be liable for any damages, losses, injuries or consequential damages which may result from the use or reliance on any information contained herein.

# MATERIAL SAFETY DATA SHEET

DATE January, 1992



PRODUCT NAME **MRX-P  
ACTIVATED CARBON**

<b>SECTION I</b>		
MANUFACTURER'S NAME <b>Calgon Carbon Corporation</b>	EMERGENCY TELEPHONE NO. <b>412-787-6700</b>	
ADDRESS <b>P.O. Box 717 Pittsburgh, PA 15230-0717</b>		
CHEMICAL NAME AND SYNONYMS <b>Carbon</b>	FORMULA <b>C</b>	

<b>SECTION II HAZARDOUS INGREDIENTS</b>							
PRINCIPAL HAZARDOUS COMPONENT (S)	CAS #	% BY WEIGHT	ORAL LD. <sub>50</sub>	DERMAL LD. <sub>50</sub>	TLV (Unit)		
					ACGIH	OSHA	OTHER
Chemical Name <b>Carbon</b>	<b>7440-44-0</b>	<b>100%</b>	<b>&gt;10g/Kg* (rat)</b>	<b>--</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>
Common Name <b>Activated Carbon</b>							
Chemical Name							
Common Name							
Chemical Name							
Common Name							
Chemical Name							
Common Name							
Chemical Name							
Common Name							

\*No animal mortalities during course of 14-day study.

**CAUTION!!** Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state, and federal regulations.

This product is non-hazardous according to the definitions for "health hazard" and "physical hazard" provided in the OSHA Hazard Communication Law (29 CFR part 1910).

<b>SECTION III PHYSICAL DATA</b>			
BOILING POINT (°F)	N/A	SPECIFIC GRAVITY (H <sub>2</sub> O=1)	2.3g/cc real dens:
VAPOR PRESSURE (mmHg.)	N/A	PERCENT VOLATILE BY VOLUME (%)	N/A
VAPOR DENSITY (AIR=1)	N/A	pH	N/A
SOLUBILITY IN WATER	insoluble	OTHER packing density	0.4 to 0.7g/cc

APPEARANCE AND ODOR **black particulate solid**

While this information and recommendations set forth herein are believed to be accurate as of the date hereof, CALGON CARBON CORPORATION MAKES NO WARRANTY AS TO THE ACCURACY OF THE INFORMATION SET FORTH THEREON.

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## SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method Used)	N/A
EXTINGUISHING MEDIA	If involved in fire, flood with plenty of water.
SPECIAL FIRE FIGHTING PROCEDURES	None
UNUSUAL FIRE AND EXPLOSION HAZARDS	Contact with strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc. may result in fire.

## SECTION V HEALTH HAZARD DATA

### EFFECT OF OVEREXPOSURE

#### A. ACUTE

##### 1. INGESTION

The product is non-toxic through ingestion. The acute oral LD<sub>50</sub> (rat) is >10g/Kg.

##### 2. INHALATION

The acute inhalation LC<sub>50</sub> (rat) is >64.4 mg/l (nominal concentration) for activated carbon.

##### 3. DERMAL EXPOSURE

#### a. TOXIC

Non-toxic

#### b. IRRITATION

The product is not a primary skin irritant. The primary skin irritation index (rabbit) is 0.

#### c. SENSITIZATION

None

4. EYE IRRITATION

The physical nature of the product may produce eye irritation.

B. SUBCHRONIC, CHRONIC, OTHER

The effects of long-term, low-level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the avoidance of all effects from repetitive acute exposures.

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FIRST AID

A. EYE

Flush with plenty of water for at least 15 minutes.

B. SKIN

Wash with soap and water.

C. INGESTION

D. INHALATION

**SECTION VI REACTIVITY DATA**

STABILITY	STABLE	X	CONDITIONS TO AVOID
	UNSTABLE		

Stability (to Avoid) Strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc.

Hazardous Decomposition Products  
Carbon monoxide may be generated in the event of fire.

**SECTION VII SPILL OR LEAK PROCEDURES**

LIMITABLE QUANTITIES (RQ) OF EPA HAZARDOUS SUBSTANCES IN PRODUCT	1. _____	NOTIFY EPA OF PRODUCT SPILLS EQUAL TO OR EXCEEDING _____ LBS.
	2. _____	
	3. _____	

First Aid Measures TO BE TAKEN IN CASE MATERIAL IS RELEASED  
Sweep up unused carbon and discard in refuse container or repackage.

Recommended Disposal Method  
Dispose of unused carbon in refuse container. Dispose of in accordance with local, state, and federal regulations.

**SECTION VIII HANDLING & STORAGE**

PROTECTIVE GLOVES Rubber gloves recommended	EYE PROTECTION Safety glasses or goggles recommended
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Additional Protective Clothing  
Not required

Respiratory Protection  
A NIOSH approved particulate filter respirator is recommended if excessive dust is generated.

VENTILATION	LOCAL EXHAUST Recommended	OTHER
	MECHANICAL (General) Recommended	

**STORAGE & HANDLING**

**CAUTION!!** Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state, and federal regulations.

**ADDITIONAL PRECAUTIONS**

Wash thoroughly after handling. Exercise caution in the storage and handling of all chemical substances.





CALGON CARBON CORPORATION  
P.O. BOX 717 • PITTSBURGH, PA 15230-0717

## TYPE MRX-P 10 X 30 GRANULAR ACTIVATED CARBON

### SPECIFICATIONS

Butane Capacity, minimum	210 mg/g
Ash, maximum	15%
Abrasion No., minimum	75
Screen Analysis -	
+ 10 mesh, maximum	1%
- 30 mesh, maximum	2%

Physical properties of Calgon Carbon Type MRX-P are as follows:

Total Surface Area - (N <sub>2</sub> BET Method), m <sup>2</sup> /g	900
Apparent Density, g/cc	0.50
Real Density, g/cc	2.1
Particle Density, g/cc	0.76
Total Pore Volume, cc/g	0.84
pH	7.2

### COMMERCIAL INFORMATION

Shipping Point: Catlettsburg, Kentucky  
Packaging: Type MRX-P is packaged in four-ply kraft bags, 55 lbs. net weight, 56 lbs. gross weight. Also available in bulk and 74 cubic foot tote bins.

**APPENDIX F**  
**RECORD OF HAZARDOUS WASTE ACTIVITY**



**APPENDIX G**  
**INJURY/EXPOSURE REPORT**

**REMEDATION TECHNOLOGIES, INC.  
INJURY/EXPOSURE REPORT**

CLIENT:		PROJ. NO.:	
LOCATION:		DATE:	
PROJ. MGR.:		SITE ENG.:	
SITE HEALTH AND SAFETY OFFICER:			
<b>PERSONAL INFORMATION</b>			
NAME OF INJURED:			
ADDRESS:			
TITLE/CLASSIFICATION:			OFFICE:
SSN:	AGE:	SEX:	YRS. OF SVC:
DATE OF INJURY/EXPOSURE:		TIME:	
ACCIDENT CATEGORY: (motor vehicle, fire, property damage, chemical exposure, other please explain if other)			
SEVERITY OF INJURY/EXPOSURE (non-disabling, disabling, medical treatment, fatality):			
AMOUNT OF DAMAGE:        \$		PROPERTY DAMAGE:	
ESTIMATED NUMBER OF DAYS AWAY FROM WORK:			
NATURE OF INJURY/EXPOSURE:			
<b>CLASSIFICATION OF INJURY/EXPOSURE: (PLEASE CHECK)</b>			
FRACTURES	BITES	BLISTERS	HEAT EXHAUSTION
DISLOCATIONS	RESPIRATORY ALLERGY	TOXIC RESPIRATORY EXPOSURE	CONCUSSION
SPRAINS	HEAT BURNS	TOXIC INGESTION	FAINT/DIZZINESS
ABRASIONS	CHEMICAL BURNS	COLD EXPOSURE	TOXIC RESPIRATORY
LACERATIONS	RADIATION BURNS	FROSTBITE	DERMAL ALLERGY
PUNCTURES	BRUISES	HEATSTROKE	
PARTS OF BODY AFFECTED:			
DEGREE OF DISABILITY:			
DATE MEDICAL CARE WAS RECEIVED:			
FACILITY WHERE MEDICAL CARE WAS RECEIVED:			

Site  
Health

INJURY/EXPOSURE INFORMATION	
Causative agent most directly related to injury/exposure (object, substance, material, machinery, equipment, conditions):	
Was weather a factor?	
Unsafe mechanical/physical/environmental conditions at time of exposure injury (be specific):	
Personal factors (improper attitude, lack of knowledge or skill, slow reaction, fatigue):	
Level of personal protective equipment specified in the Site Health and Safety Plan:	
Modification:	
Was injured person/persons using required PPE?	
If not, how did the actual equipment used differ from that specified in the Site Health and Safety Plan?	
What can be done to prevent a recurrence of this type of accident? (modification of equipment, mechanical changes, additional training, etc.):	
Present a detailed narrative description of the injury/exposure. How did it occur? Why? Objects, equipment, tools used, circumstances, assigned duties, etc. (be specific):	
Witnesses to injury/exposure (names and their eye witness accounts):	

FOR CORPORATE HEALTH AND SAFETY USE ONLY		
TEMP. TOTAL:	PERMANENT TOTAL:	DEATH OR PERMANENT TOTAL:
START LOSING TIME:	PART OF BODY:	
RETURN TO WORK:	PERCENT LOSS OR LOSS OF USE:	
TIME CHARGE:		
NAME OF HOSPITAL:		
ADDRESS:		
NAME OF PHYSICIAN:		
ADDRESS:		

NOTE: RETURN THIS COMPLETED FORM TO THE CORPORATE HEALTH AND SAFETY OFFICER.

**APPENDIX H**

**NOTIFICATION OF ACCESS TO EMPLOYEE  
EXPOSURE AND MEDICAL RECORDS**

# NOTICE

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**TO ALL EMPLOYEES:** THIS NOTICE IS TO PROVIDE INFORMATION FOR COMPLIANCE WITH 29 CFR PART 1910 SUBPART C—GENERAL SAFETY AND HEALTH PROVISIONS—PARAGRAPH 1910.20, ACCESS TO EMPLOYEE EXPOSURE AND MEDICAL RECORDS.

- (i) The existence, location, and availability of any records covered by this section is as follows:

REMEDIATION TECHNOLOGIES, INC.  
3040 William Pitt Way  
Pittsburgh, Pennsylvania 15238  
ATTN: Corporate Health and Safety Officer

- (ii) The person responsible for maintaining and providing access to these records is RETEC's Corporate Health and Safety Officer.
- (iii) Each employee has the right to access these records.
- (iv) A copy of this standard and it's appendices are available to all affected employees at each RETEC office location.

**FOR MORE INFORMATION OR QUESTIONS CONTACT**

**MR. WILLIAM A. ODENTHAL  
CORPORATE HEALTH AND SAFETY OFFICER**

**(412) 826-3340**