FILE ON EDOC'S _____ YES _____ NO
SITE NAME _____
SITE # 130004
COUNTY _____ TOWN _____
FOILABLE _____ YES _____ NO
SC/PSA _____ RI/FS _____
RD _____ RA _____
SM _____ OTHER _____
NAME DESCRIPTION:
Report.hw130004.2005-06-01.RPI_HASP

Health and Safety Plan

Bayer MaterialScience Hicksville Facility

Bayer MaterialScience LLC
125 New South Road
Hicksville, New York
USEPA ID No. NYD002920312

June 2005

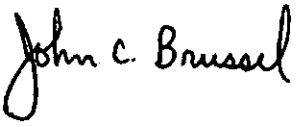
BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Approvals and Acknowledgements

Approvals

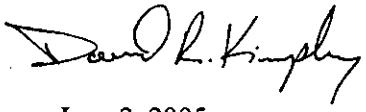
I have read and approved this HASP with respect to project hazards, regulatory requirements, and BBLES procedures.

Project Name: Bayer MaterialScience Facility, Hicksville, New York
Project Number: 32303.008



June 2, 2005
Project Manager/Date

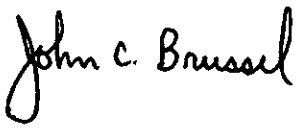
June 2, 2005
Health and Safety Officer/Date



June 2, 2005
Health and Safety Supervisor/Date

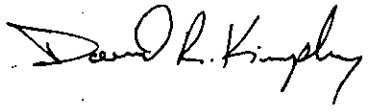
Acknowledgments

The final approved version of this HASP has been provided to the Site Supervisor. I acknowledge my responsibility to provide the Site Supervisor with the equipment, materials and qualified personnel to implement fully all safety requirements in this HASP. I will formally review this plan with the Health and Safety Staff every six months until project completion.



June 2, 2005
Project Manager/Date

I acknowledge receipt of this HASP from the Project Manager, and that it is my responsibility to explain its contents to all site personnel and cause these requirements to be fully implemented. Any change in conditions, scope of work, or other change that might affect worker safety requires me to notify the Project Manager and/or the Health and Safety Officer.



June 2, 2005
Site Supervisor/Date

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Health and Safety Plan Acknowledgment

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

Name (Print)	Signature	Representing	Date

Table of Contents

Attachments (continued)

F *Incident/Near-Miss Investigation Report*
G Loss Prevention Observation (LPO) Form
H Hazardous Energy Control (LO/TO) Form
I Fall Protection Standard Operating Procedure (SOP)
J Equipment Pre-Operation Checklist
K Confined Space Entry Checklist
L Air Monitoring Log
M Health and Safety Inspection Form
N Safety Meeting Log

1. Introduction

1.1 Objective

This Health and Safety Plan (HASP) has been prepared in support of interim corrective measure (ICM) removal activities and demolition activities to be performed at the Bayer MaterialScience LLC (Bayer) facility located at 125 New South Road in Hicksville, New York. ICM activities will consist of: removing a former gasoline underground storage tank (UST); removing standing water in select foundation sumps; removing accumulated debris from select manholes/catch basins, sumps, and floor trenches; and soil sampling and excavation. Site demolition activities will consist of: performing pre-demolition material characterization sampling; demolishing concrete building floor slabs, ramps, driveways, and former equipment/tank pads; crushing and reusing demolition debris as on-site fill (as appropriate); and site restoration. Activities to be conducted are expected to consist of the following general tasks:

- Mobilization (BBL Environmental Services, Inc. [BBLES] and BBLES Subcontractor);
- Installation of soil borings (BBLES and BBLES Subcontractor);
- Environmental sampling (soil, building materials, and asbestos containing material [ACM]) (BBLES);
- Excavation and handling of soil (BBLES Subcontractor - BBLES oversight and post-removal sampling);
- UST removal (BBLES Subcontractor - BBLES oversight and post-removal sampling);
- Subsurface structure water and debris removal (BBLES Subcontractor - BBLES oversight);
- Concrete demolition and crushing (BBLES Subcontractor - BBLES oversight);
- Site restoration (BBLES Subcontractor - BBLES oversight);
- Decontamination; and
- Demobilization (BBLES and BBLES Subcontractor).

The objective of this Health and Safety Plan (HASP) is to provide a mechanism for establishing safe working conditions at the site. The safety organization, procedures, and protective equipment have been established based on an analysis of potential physical, chemical, and biological hazards. Specific hazard control methodologies have been evaluated and selected to minimize the potential of injury, illness, or other hazardous incident.

1.2 Site and Facility Description

The Site consists of a 14-acre triangular-shaped parcel located just southeast of the intersection of New South Road and Commerce Road in the City of Hicksville, New York. The Site is bordered to the north by industrial properties, to the south and west by the Long Island Railroad and commercial/industrial properties, and to the east by warehouses and the Northrop Grumman Corporation (Northrop Grumman) complex. Aside from the Administration Building located in the northern portion of the Site, all other buildings and aboveground structures formerly used in connection with Site operations were demolished down to their floor slabs in 2003. Access to the Site is limited by a chain-link fence and locking gates. Access to the site is controlled and security is not expected to be an issue. All personnel will communicate with the designated site contact prior to entry.

Non-masonry building materials generated by the demolition activities were transported for offsite reclamation/ disposal. Brick and mortar wall materials generated by demolition activities were crushed and remain stockpiled onsite for future use as hard fill material.

The building floor slabs remaining onsite are constructed of concrete and are generally elevated approximately 2 to 4 feet above the surrounding grade. The ground surface in the vicinity of the floor slabs is generally covered

with asphalt or concrete. Varying amounts of construction and demolition debris are scattered on the ground surface in the vicinity of the slabs. Remaining areas of the Site are covered with crushed stone/gravel or vegetation (grass or brush).

1.3 Relevant Site History

The Site was formerly used as a production facility for polyester resin, polyurethane dispersions, and polyvinyl chloride (PVC). The facility was originally constructed in 1945 and operations were expanded in subsequent years. The facility was previously owned/operated by the Hooker Chemical and Plastic Corporation/Occidental Chemical Corporation (HCPC/OCC) from 1966 to 1982. The facility was designated as a Superfund site and placed on the National Priorities List (NPL) established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in the early 1980s. Various soil and groundwater investigation/ remedial activities have been implemented since that time.

Ruco Polymer Corporation (Ruco) purchased the facility from HCPC/OCC in 1982. The purchase agreement indemnified Ruco for environmental liabilities associated with facility operations conducted prior to the sale. Ruco operated an onsite Resource Conservation and Recovery Act (RCRA) interim status drum storage facility in the early 1980s, which formed the basis for RCRA Facility Investigation (RFI) and ICM activities. Ruco was acquired by Sybron Chemical Corporation (Sybron) in 1988. Sybron was, in turn, acquired by Bayer Corporation in 2000. Facility ownership was transferred from Bayer Corporation to Bayer Polymers LLC in 2003 as part of a corporate restructuring. As part of further restructuring, Bayer Polymers LLC became Bayer MaterialScience LLC in 2004. As the successor to Ruco, Bayer received the HCPC/OCC indemnification for environmental liabilities associated with former facility operations.

Based on economic evaluation, manufacturing operations were discontinued during 2002 and transferred to existing Bayer facilities in Georgia and West Virginia. In an effort to prepare the Site for future sale and economic redevelopment, all raw materials, products, and hazardous chemicals were removed from the Site. In addition, facility equipment was decommissioned and tanks/piping were closed pursuant to applicable regulations. Asbestos-containing materials were removed and the onsite buildings and aboveground structures were demolished in 2003.

1.4 Policy Statement

The policy of BBLES is to provide a safe and healthful work environment. No aspect of operations is of greater importance than injury and illness prevention. A fundamental principle of safety management is that all injuries, illnesses, and incidents are preventable. BBLES will take every reasonable step to eliminate or control hazards in order to minimize the possibility of injury, illness, or incident.

This HASP prescribes the procedures that must be followed during activities at the site. Operational changes that could affect the health and safety of personnel, the community, or the environment will not be made without the prior approval of the Project Manager (PM) and the Health and Safety Officer (HSO). This document will be reviewed periodically to ensure that it is current and technically correct. Any changes in site conditions and/or the scope of work will require a review and modification to this HASP. Such changes will be completed in the form of an addendum or a revision to the plan.

The provisions of this plan are mandatory for all BBLES personnel and BBLES subcontractors. All visitors to BBLES work areas of the site must also abide by the requirements of this plan. This HASP does not cover activities conducted by employees of other businesses or other contracted organizations at the site.

In addition to the requirements of this HASP, all on-site personnel must abide by any Bayer facility safety rules or procedures. An acknowledgement form is located at the front of this HASP and must be signed by all on-site personnel following review of this HASP and the attached documentation.

1.5 References

This HASP complies with applicable Occupational Safety and Health Administration (OSHA) regulations, United States Environmental Protection Agency (USEPA) regulations, and BBLES health and safety policies and procedures. This plan follows the guidelines established in the following:

- *Standard Operating Safety Guides*, USEPA (Publication 9285.1-03, June 1992).
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, NIOSH, OSHA, USCG, USEPA (86116, October 1985).
- *Title 29 of the Code of Federal Regulations* (CFR), Part 1910.
- *Title 29 of the Code of Federal Regulations* (CFR), Part 1926.
- *Pocket Guide to Chemical Hazards*, DHHS, PHS, CDC, NIOSH (2003).
- *Threshold Limit Values*, ACGIH (2005).
- *Guide to Occupational Exposure Values*, ACGIH (2005).
- *Quick Selection Guide to Chemical Protective Clothing*, Forsberg, K. and S.Z. Mansdorf, 2nd Ed. (1993).
- *Health and Safety Policies and Procedures Manual* (1996), Blasland, Bouck & Lee, Inc.

1.6 Definitions

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

- *Contamination Reduction Zone (CRZ)* - Area between the exclusion zone and support zone that provides a transition between contaminated and clean areas. Decontamination stations are located in this zone.
- *Exclusion Zone (EZ)* - Any portions of the site where hazardous substances are, or are reasonably suspected to be present, and pose an exposure hazard to on-site personnel.
- *Incident* - All losses, including first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions.
- *Near Miss* - An incident in which no injury, illness, motor vehicle accident, equipment or property damage, etc., occurred, but under slightly different circumstances, could have occurred.

- *On-Site Personnel* - All BBLES and subcontractor personnel involved with the project.
- *Project* - All on-site work performed under the scope of work.
- *Site* - The area described in Section 1.2.1, Site Description, where the work is to be performed by BBLES personnel and subcontractors.
- *Support Zone (SZ)* - All areas of the site, except the EZ and CRZ. The SZ surrounds the CRZ and EZ. Support equipment and break areas are located in this zone.
- *Subcontractor* - Includes contractor personnel hired by BBLES.
- *Visitor* - All other personnel, except the on-site personnel.
- *Work Area* - The portion of the site where work activities are actively being performed. This area may change daily as work progresses and includes the SZ, CRZ, and EZ. If the work area is located in an area on the site that is not contaminated, or suspected of being contaminated, the entire work area may be a SZ.

1.7 Acronyms

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

- *ACGIH* - American Conference of Governmental Industrial Hygienists
- *BBLES* - BBLES Environmental Services, Inc.
- *COC* - Constituent(s) of Concern
- *CRZ* - Contamination Reduction Zone
- *EZ* - Exclusion Zone
- *GFCI* - Ground Fault Circuit Interrupter
- *HASP* - Health and Safety Plan
- *HSO* - Health and Safety Officer
- *HSS* - Health and Safety Supervisor
- *II* - Incident Investigation
- *JSA* - Job Safety Analysis
- *LEL* - Lower Explosive Limit
- *LPO* – Loss Prevention Observation

- *MSDS* - Material Safety Data Sheet
- *OSHA* - Occupational Safety and Health Administration
- *PCBs* - Polychlorinated Biphenyls
- *PEL* - Permissible Exposure Limit
- *PID* - Photoionization Detector
- *PM* - Project Manager
- *PO* - Project Officer
- *PPE* - Personal Protective Equipment
- *SPSA* - Safe Performance Self-Assessment
- *SS* - Site Supervisor
- *SVOCs* - Semi-Volatile Organic Compounds
- *SZ* - Support Zone
- *TLV* - Threshold Limit Value
- *USCG* - United States Coast Guard
- *USEPA* - United States Environmental Protection Agency
- *VOC* - Volatile Organic Compound

2. Roles and Responsibilities

2.1 All Personnel

All BBLES and subcontractor personnel must adhere to the procedures outlined in this HASP during the performance of their work. Each person is responsible for completing tasks safely, and reporting any unsafe acts or conditions to their supervisor. No person may work in a manner that conflicts with these procedures. After due warnings, the PM will dismiss from the site any person or subcontractor who violates safety procedures.

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

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

2.2 BBLES Personnel

2.2.1 Project Officer (PO)

The PO is responsible for providing resources to assure project activities are completed in accordance with this HASP, and for meeting all regulatory and contractual requirements.

2.2.2 Health and Safety Officer (HSO)

The HSO, or his designee, the Health and Safety Manager, has overall responsibility for the technical health and safety aspects of the project, including review and approval of this HASP. Inquiries regarding BBLES health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSO must approve changes or addenda to this HASP.

2.2.3 Project Manager (PM)

The PM is responsible for verifying that project activities are completed in accordance with the requirements of this HASP. The PM is responsible for confirming that the Site Supervisor (SS) has the equipment, materials, and qualified personnel to fully implement the safety requirements of this HASP, and/or that subcontractors assigned to this project meet the requirements established by BBL. It is also the responsibility of the PM to perform the following duties:

- Consult with the HSO on site health and safety issues;
- Verify that subcontractors meet health and safety requirements prior to commencing work;
- Review Loss Prevention Observation (LPO) forms;
- Verify that all incidents are thoroughly investigated;

- Approve, in writing, addenda or modifications to this HASP; and
- Suspend work or modify work practices, as necessary, for personal safety, protection of property, and regulatory compliance.

2.2.4 Health and Safety Supervisor

The Health and Safety Supervisor (HSS) is responsible for field health and safety issues, including the execution of this HASP. Questions in the field regarding health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSS will advise the PM on health and safety issues, and will establish and coordinate the project air monitoring program if one is deemed necessary (see Section 6.1, Air Monitoring). The HSS is the primary site contact on health and safety matters. It is the responsibility of the HSS to perform the following duties:

- Provide onsite technical assistance, if necessary;
- Participate in all incident investigations (IIs), and confirm that they are reported to the Principal-in-Charge (PIC), PO, HSM/HSO, Client and PM by end of shift;
- Coordinate site and personal air monitoring, as required, including equipment maintenance and calibration;
- Conduct site safety orientation training and safety meetings;
- Verify that BBL personnel and subcontractors have received the required physical examinations and medical certifications;
- Review site activities with respect to compliance with this HASP;
- Maintain required health and safety documents and records;
- Assist the SS in instructing field personnel on project hazards and protective procedures; and
- Review LPO forms.

2.2.5 Site Supervisor

The SS is responsible for implementing this HASP, including communicating requirements to onsite personnel and subcontractors. The SS will be responsible for informing the PM of changes in the work plan, procedures, or site conditions so that those changes may be addressed in this HASP. Other responsibilities are to perform the following duties:

- Consult with the HSS on site health and safety issues;
- Conduct LPOs at the site and complete the LPO forms;
- Verify via questioning, the conduct of SPSAs
- Stop work, as necessary, for personal safety, protection of property, and regulatory compliance;

- Obtain a site map, determine and post routes to medical facilities, and post emergency telephone numbers;
- Notify local public emergency representatives (as appropriate) of the nature of the site operations and post their telephone numbers (e.g., local fire department personnel who would respond for a confined-space rescue);
- Observe onsite project personnel for signs of ill-health effects;
- Investigate and report any incidents to the PIC, PO, HSO, and PM;
- Verify that all onsite personnel have completed applicable training;
- Verify that onsite personnel are informed of the physical, chemical, and biological hazards associated with the site activities and the procedures and protective equipment necessary to control the hazards; and
- Issue/obtain any required work permits (hot work, confined space, etc.).

2.3 Subcontractors

Subcontractors and their personnel must understand and comply with applicable regulations and site requirements established in this HASP.

All subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. All subcontractor personnel will attend an initial hazard briefing prior to beginning work at the site. Additionally, on-site subcontractor personnel must attend and participate in the daily site safety meetings.

Subcontractors must designate individuals to function as the PM, HSO, HSS, and SS. In some firms, it is not uncommon for the duties of the HSO to be carried out by the PM. This is acceptable provided the PM has the required knowledge, training, and experience to properly address all hazards associated with the work, and to prepare, approve, and oversee the execution of the site-specific HASP. A subcontractor may designate the same person to perform the duties of both the HSS and the SS. However, depending on the level of complexity of a contractor's scope of work, it may be infeasible for one person to perform both functions satisfactorily.

2.4 All On-Site Personnel

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

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

All on-site personnel must perform a Safe Performance Self-Assessment (SPSA) prior to beginning each work activity. The SPSA process is presented in Section 4.1.1. This process must be performed prior to beginning

each activity, and must be performed after any near miss or other incident in order to determine if it is safe to proceed. On-site personnel will immediately report the following to the SS or HSS:

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

2.5 Visitors

All visitors to BBLES work areas must check in with the SS. Visitors will be cautioned to avoid skin contact with surfaces, soils, groundwater, or other materials that may impacted or be suspected to be impacted by constituents of concern (COCs).

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

2.6 Stop Work Authority

Every BBLES employee and sub-contractor is empowered, expected and has the responsibility to stop the work of another co-worker if the working conditions or behaviors are considered unsafe.

2.7 Short Service Employee (SSE) Program

Recognizing that employees who are new to BBLES are at a greater risk for incidents, the following guidelines are established to identify those employees and ease their transition. Short Service Employees (SSEs) will have an assigned field mentor to assist them in adjusting to the project requirements and procedures. SSEs will be identified in the field by wearing an orange hardhat or baseball-type cap. The following procedures apply to SSEs:

- BBLES employees new to the industry and new to BBLES will be designated SSEs for 6 months.

- BBLES employees experienced in the industry but new to BBLES will be designated SSEs for 3-months.

Additionally, the following apply:

- A crew of 2-3 may have 1 SSE on site;
- A crew of 5 may have 2 SSEs on site; and
- A crew of 10 or more may have no more than 3 SSEs on site.

2.8 Near-Miss Reporting Hotline

In an effort to streamline near-miss reporting, especially for employees conducting field work who do not have real-time access to the web, BBL has established a toll-free Near-Miss Reporting Hotline. The hotline will be checked daily and data will be entered into the BBL LPS Database with the caller listed as the primary contact for the event. All entries will be saved as initial and can be accessed by the caller when they return to their computers. Entry into the database does not relieve the caller from the responsibility of following through with the near-miss investigation or of notifying other employees in the office or project team of the occurrence.

THE NEAR-MISS REPORTING NUMBER IS 1-866-242-4304

Callers will be prompted to provide the following information:

- Name and phone number;
- Date of near-miss;
- Location;
- Project number (if applicable);
- A brief description of what happened;
- Name of division or office VP;
- What they think could have happened if this situation had resulted in an injury or damage; and,
- Any other information they think may be important.

The intent of this service is to enable employees to phone in near-misses immediately and have the events entered into the BBL LPS Database. Following all near-misses employees are expected to immediately conduct an SPSA in accordance with Section 4.2.1 to ensure that it is safe to continue with the task.

TABLE 1
KEY PERSONNEL

Bayer Personnel		
Role	**Name**	**Address/Telephone No.**
Bayer Project Manager	Joel E. Robinson	Center for Environmental Control 100 Bayer Road, Building 14 Pittsburgh, PA 15205-9741 (412) 777-4871
Bayer Assistant Project Manager	Terence Sullivan	Center for Environmental Control 100 Bayer Road, Building 14 Pittsburgh, PA 15205-9741 (412) 777-7474
Hicksville Administration Building	----	125 New South Road Hicksville, NY 11801 Tel: (516) 931-8104 Fax: (516) 931-8104
BBLES Personnel		
Role	**Name**	**Address/Telephone No.**
Project Officer	Richard P. DiFiore	6723 Towpath Road P.O. Box 66 Syracuse, NY 13214-0066 (315) 446-9120, ext. 265
Demolition Project Manager	Joseph Molina, III, P.E.	295 Woodcliff Drive Third Floor, Suite 301 Fairport, NY 14450 (585) 385-0090, ext. 12
ICM Project Manager	John Brussel, P.E.	6723 Towpath Road P.O. Box 66 Syracuse, NY 13214-0066 (315) 446-9120, ext. 441
Health and Safety Officer	Jay D. Keough, CIH	8 South River Road Cranbury, NJ 08512 (609) 860-0590, ext. 101
Health and Safety Manager	Charles P. Webster, CSP	6723 Towpath Road P.O. Box 66 Syracuse, NY 13214-0066 (315) 446-9120, ext. 297
Site Supervisor/Health and Safety Supervisor	David R. Kingsley	295 Woodcliff Drive Third Floor, Suite 301 Fairport, NY 14450 (585) 385-0900, ext. 17

Subcontractors		
Company/Role	**Name**	**Address/Telephone No.**
Royal Environmental Project Manager	Lyle Grant	720 Lexington Avenue Rochester, NY 14614 (585) 254-1850

3. Project Hazards and Control Measures

3.1 Scope of Work

Activities to be conducted are expected to consist of the following general tasks:

- Mobilization (BBL Environmental Services, Inc. [BBLES] and BBLES Subcontractor);
- Installation of soil borings (BBLES and BBLES Subcontractor);
- Environmental sampling (soil, building materials, and asbestos containing material [ACM]) (BBLES);
- Excavation and handling of soil (BBLES Subcontractor - BBLES oversight and post-removal sampling);
- UST removal (BBLES Subcontractor - BBLES oversight and post-removal sampling);
- Subsurface structure water and debris removal (BBLES Subcontractor - BBLES oversight);
- Concrete demolition and crushing (BBLES Subcontractor - BBLES oversight);
- Site restoration (BBLES Subcontractor - BBLES oversight);
- Decontamination; and
- Demobilization (BBLES and BBLES Subcontractor).

3.2 Field Activities, Hazards, and Control Procedures

The following job safety analyses (JSAs) identify potential health, safety, and environmental hazards associated with each type of field activity. Because of the complex and changing nature of field projects, supervisors must continually inspect the site to identify hazards that may affect on-site personnel, the community, or the environment. The SS must be aware of these changing conditions and discuss them with the PM whenever these changes impact employee health, safety, the environment, or performance of the project. The SS will keep on-site personnel informed of the changing conditions, and the PM will write and/or approve addenda or revisions to this HASP as necessary.

3.2.1 Mobilization

Site mobilization will include establishing excavation locations, determining the location of utilities and other installations, and establishing work areas. Mobilization may also include setting up equipment and establishing a temporary site office (i.e., within the Administration Building). A break area will be set up outside of regulated work areas. Mobilization may involve clearing areas for the SZ and CRZ. During this initial phase, project personnel will walk the site to confirm the existence of anticipated hazards, and identify safety and health issues that may have arisen since the writing of this plan.

The hazards of this phase of activity are associated with heavy equipment operation, manual materials handling, installation of temporary on-site facilities, and manual site preparation.

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

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

Control procedures for these hazards are discussed in Section 4, General Safety Practices.

3.2.2 Environmental Cleaning and Sampling

Equipment cleaning will be performed to control the transfer of COCs from the site. Equipment will be cleaned by either scrubbing with a mild detergent/citrus solvent, high pressure water, or high pressure steam to remove visible dirt and dust.

Hazards - Sources of chemical hazards from equipment cleaning activities are decontamination detergents or solvents, foreign matter and COC on the equipment prior to decontamination, and rinsate from the decontamination process. Physical hazards associated with this activity are back strain, slippery surfaces, skin irritation, cuts and burns from high pressure steam or water and hearing loss due high levels of noise generated by the equipment.

Control - Control procedures for these hazards are discussed in Section 4, General Safety Practices. Situations that require employees to work on equipment that may expose them to injuries due to hazardous energy, unexpected start-up of equipment, and hazardous materials shall be locked out and tagged in accordance with the standards in 29 CFR 1910.147 and BBLES PPM #1.02.12, Lockout/Tagout Control of Hazardous Energy/Materials. Decisions regarding PPE will be based on the potential chemical and physical hazards on the site, and measurements and observations made prior to and during work activities. PPE for this activity is specified in Section 5, Personal Protective Equipment. Removal of hazardous substances and waste materials and cleaning of equipment shall be in compliance with 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER).

3.2.2.1 Building Material Sampling

Samples of concrete/masonry building materials may be obtained by using an electric hammer drill and masonry drill bit. The primary hazards for this type of sampling are dust and noise. Air monitoring will be conducted in accordance with Section 6, Air Monitoring. Noise hazards will be controlled through the use of hearing protection with a minimum Noise Reduction Rating (NRR) of 28 dB. To minimize dermal contact with materials a minimum of Level D PPE with sampling gloves will be used.

3.2.2.2 Pressure Washing

Equipment will be decontaminated before leaving the site. Personnel involved in decontamination activities may be exposed to skin contact with residuals containing site constituents, volatile emissions from heavily soiled equipment, high pressure water spray, and noise.

Hydro blasting is the process of using a stream of water at high pressure to clean or prepare surfaces by removing foreign matter and contaminants. The hazards of high pressure water cleaning are related to the high pressure of the water, which may exceed 10,000 pounds per square inch (psi) at the nozzle. Contact with the water spray may cause severe lacerations, which may then be contaminated with hazardous material. Because of the high pressure involved, the opportunity for slicing or injecting the water stream through soft tissues of the body exists. Hydro blasters will also cut through bone at high enough pressures. A second hazard is repetitive

motion, or cumulative trauma disorder. These serious disorders are related to repeatedly squeezing the trigger or constantly fighting the pressure of the spray gun with the forearm or wrist. When pressure washing, steaming, or hydro blasting, the health and safety precautions for hydro blasting outlined below must be observed.

Pressure washing presents a splash hazard. Protection against splash to face and skin is mandatory. The pressure washer is not to be pointed at a person at any time. Steam cleaning presents a thermal burn hazard in addition to the hazards presented by pressure washing. Adequate protection from the hot surfaces must be provided.

Only persons trained in use and maintenance of a hydro blaster may use such equipment. Hydro blasting operations will be conducted only by qualified subcontractor personnel.

The following general requirements are provided for high-pressure water cleaning activities:

- The gun, pressure piping, pressure hose ends, and couplings will have a burst pressure of at least four times the operating pressure;
- No equipment or component of such equipment will be operated beyond the manufacturer's specifications or beyond the rated working pressure;
- The maximum operating pressure will be permanently displayed on the pumping unit;
- Wear safety glasses, face-shield, hearing protection, and safety shoes;
- Alternate hands frequently during long periods of use;
- Rotate personnel periodically;
- Use a washer with a gun which supplies water to the wand in a straight line as opposed to supplying water through the grip. This eliminates the gun's twisting motion;
- Keep the equipment in good condition;
- Check to see that releasing the trigger stops the flow of water. Do not wire back the trigger;
- A hose safety shroud will be placed on hoses whenever operating pressure exceeds 2,000 psi;
- The pressure control will be a "deadman" type to safely reduce the nozzle discharge pressure when control is released;
- The pressure discharge gauge indicating pump pressure will be clearly visible for monitoring pump pressure;
- A pressure relief device set to relieve at 110% of the maximum working pressure of the unit or its components, whichever is lower, will be installed on the pump. The relief will be clearly marked and displayed on the device;
- A strainer or filter should be installed on the water supply system to prevent debris from entering the water

blasting units and clogging the gun, control, or other device;

- The maximum operating pressure will be permanently displayed on the pumping unit;
- Keep the equipment in good condition; and
- Pay close attention to the water line. It is under pressure, and may whip about if broken. If a water line breaks, relieve the pressure before trying to grab the line.

3.2.2.3 Drum Handling

Drums may be used to containerize wastes generated during the cleaning of structures and equipment. Drums may also be used to containerize wastes encountered at the site. These drums will be removed for disposal to an off-site facility.

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

Powered Equipment Operations - Site workers are exposed to serious hazards during drum moving when using powered equipment. Workers may be struck by the machinery or by the drums carried by the machinery. Workers will remain in view of the machine operator and will remain outside of the swing area. Drums carried by heavy machinery will be secured in the machine's bucket by using a rope or other means. Personnel operating forklifts shall be trained and certified in accordance with 29 CFR 1910.178(l). Certification shall be made available to the SS upon request.

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

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

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

3.2.3 Soil Sampling

This task involves collecting soil samples for subsequent analysis and evaluation of potential impact by COCs. The physical hazards of these operations are primarily associated with the sample collection methods and

procedures used. In addition, personnel may be exposed to hazards associated with working in or near excavations and heavy equipment.

3.2.3.1 Hazards

Inhalation and absorption of COCs are the primary routes of entry associated with soil sampling due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. During this project, several different soil sampling methodologies may be used based on equipment accessibility and the types of materials to be sampled. These sampling methods may include the use of hand-auger/sampling probes, sampling spoons, or trowels. The primary hazards associated with these specific sampling procedures are not potentially serious; however, other operations in the area, or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with soil sampling procedures are generally limited to strains or sprains, and potential eye hazards. Exposure to soil containing COCs is also possible. In addition to the safety hazards specific to sampling operations, hazards associated with the operation of vehicles (especially large vehicles with limited operator visibility), is a concern. Of particular concern will be the backing up of trucks, excavation equipment, and other support vehicles.

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

3.2.3.2 Control

To control dermal exposure during soil sampling activities, a minimum of Modified Level D protection will be worn. If necessary, based on field observations and site conditions, air monitoring may be conducted during soil sampling activities to assess the potential for exposure to airborne COCs. If the results of air monitoring indicate the presence of organic vapors in a concentration causing concern, personnel will upgrade to Level C protection. Each level of personal protection is described in Section 5, Personal Protective Equipment. Control procedures for environmental and general hazards are discussed in Section 4, General Safety Practices. Collecting subsurface soil samples may involve advancing test pit excavations with excavation equipment. The equipment poses a hazard if it is not properly operated. The presence of overhead utilities and underground obstacles poses a hazard if the excavator contacts them. Safety hazards and procedures associated with activities conducted around excavations are presented in the following subsections.

3.2.3.3 Soil Boring Installation

Installing soil borings to collect soil samples may also involve the use of direct-push-type boring equipment (Geoprobe® or equivalent). The equipment poses a hazard if it is not properly operated. The equipment is hydraulically powered and uses static force and dynamic percussion force to advance small-diameter sampling tools. The presence of overhead utilities and underground obstacles poses a hazard if boring equipment contacts them. As the hazards are similar to those encountered when using a conventional drill rig, the required control procedures are also the same as a conventional rig and are included in the following sections.

3.2.3.4 Hazards

The primary physical hazards for this activity are associated with the use of drilling equipment, since tools and equipment (such as elevators, cat lines, and wire rope) have the potential for striking, pinning, or cutting personnel.

Potential hazards are summarized in the list below.

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

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

- *Rig Accidents*—Rig accidents can occur as a result of improperly placing the rig on uneven or unstable terrain, or failing to adequately secure the rig prior to starting operations.

- *Utility Lines*—Underground and overhead utility lines can create hazardous conditions if contacted by drilling equipment.

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

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

3.2.3.5 Controls

The following control procedures are required for this activity:

- *Drill Crews*—All drillers must possess required state or local licenses to perform drilling work. All members of the drill crew must receive site-specific training prior to beginning work. The driller is responsible for the safe operation of the drill rig, as well as the crew's adherence to the requirements of this HASP. The driller must confirm that all safety equipment is in proper condition and is properly used. The members of the crew must follow all instructions of the driller, wear appropriate PPE, and be aware of all hazards and control procedures. The drill crews must participate in the daily safety meetings and be aware of all emergency procedures.

- *Rig Inspection*—Each day, prior to starting work, the drill rig and associated equipment must be inspected by the driller and/or drill crew. The following items must be inspected:

  - Vehicle condition;
  - Proper storage of equipment;
  - Condition of all wire rope and hydraulic lines;
  - Fire extinguisher; and
  - First-aid kit.

- *Drill Rig Set Up*—The drill rig must be properly blocked and leveled prior to raising the derrick. The wheels that remain on the ground must be chocked even if the rig's parking brake has been applied. The leveling jacks must not be raised until the derrick is lowered. The rig should be moved only after the derrick has been lowered.

- *Site Drilling Rules*—Before drilling activities commence, the existence and location of underground pipe, electrical equipment, and gas lines must be determined. The Long Island One-Call Center must be contacted for underground utility markouts at least 1 week, but no more than 2 weeks, prior to subsurface activities. BBLES' SS will meet with electrical and natural gas locators on site prior to marking out the underground utilities. During this meeting, BBLES' SS will provide the electrical and natural gas locators with a site figure showing the locations where excavation and drilling activities will be completed. BBLES' SS will conduct a site walkover with the electrical and natural gas locators to visually identify each location where excavation and drilling activities are to be completed during site operations. The Underground/Overhead Utility Checklist (see Attachment A) will be used to document that nearby utilities have been marked on the ground and that the excavation and drilling areas have been cleared. The completed Underground/Overhead Utility Checklist will be in the possession of the SS prior to commencing any intrusive investigation.

The following additional site drilling rules apply to project sites:

  - Combustible gas readings of the general work area will be made regularly (see Section 6).

  - Operations must be suspended and corrective action taken if the airborne flammable concentration reaches 10% of the LEL in the immediate area (a 1-foot radius) of the point of drilling, or near any other ignition sources.

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

- *Overhead Electrical Clearances*—If drilling activities are conducted in the vicinity of overhead power lines, the power to the lines must be de-energized, tested de-energized, marked up, and guaranteed, or the equipment must be positioned such that no part (including the excavation boom) can come within the minimum clearances as shown below.

Table 2

Minimum Overhead Electrical Clearances (All Equipment)

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

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

- *Rig Set Up*—Three control procedures apply to rig set up:

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

  - All rigs will be properly blocked and leveled prior to raising the derrick. Blocking provides a more stable drilling structure by evenly distributing the weight of the rig. Proper blocking confirms that differential settling of the rig does not occur. Wheels remaining on the ground will be chocked and the parking brake will be applied.

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

- *Hoisting Operations*—The following control procedures apply to hoisting operations:

  - Drillers should never engage the rotary clutch without watching the rotary table so that it is clear of personnel and equipment.

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

  - Auger strings or casing should be picked up slowly.

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

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

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

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

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

- *Cat-Line Operations*—The following control procedures apply to cat-line operations:

  - Only experienced workers will be allowed to operate the cathead controls. The kill switch must be clearly labeled and operational prior to operating the cat line. The cathead area must be kept free of obstructions and entanglements.

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

- Personnel should not stand near, step over, or go under a cable or cat line that is under tension.

- Employees rigging loads on cat lines must:

  ✓ Keep out from under the load;
  ✓ Keep fingers and feet where they will not be crushed;
  ✓ Be sure to signal clearly when the load is being picked up;
  ✓ Use standard visual signals only and not depend on shouting to co-workers for communication; and
  ✓ Make sure the load is properly rigged, since a sudden jerk in the cat line will shift or drop the load.

- *Wire Rope*—The following control procedures apply to the use of wire rope:

  - When two wires are broken or rust or corrosion is found adjacent to a socket or end fitting, the wire rope must be removed from service or resocketed. Special attention must be given to the inspection of end fittings on boom support, pendants, and guy ropes.

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

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

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

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

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

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

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

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

- *Auger Handling*—The following control procedures apply to auger handling:

  - Auger sections must be transported by cart or carried by two persons. Individuals should not carry auger sections without assistance.

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

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

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

3.2.4 Construction Observation

BBLES personnel will conduct demolition/decommissioning observation of others during some aspects of this job. BBLES will observe/provide oversight for the following activities that will be completed by others:

- UST cleaning and removal
- Excavation and handling of soil
- Slab demolition
- Site restoration

Construction observation activities may involve a potential for exposure to physical and health hazards. Hazards may be associated with the site, the equipment used, and environmental conditions.

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

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

Control - Prior to initiating any field activity, the site conditions will be discussed with all employees. Hazards will be identified and protective measures will be explained. Control procedures for these hazards are discussed in Section 4, General Safety Practices and in task specific sections of this HASP. Decisions regarding PPE will be based on the potential chemical and physical hazards on the site, and measurements and observations made prior to and during work activities. A minimum of Level D protection will be worn by personnel conducting observation activities. See Section 5, Personal Protective Equipment, for a description of PPE requirements. Personnel conducting observation activities will do so from a safe distance. The following sections describe excavation hazards and control procedures, hazards and control procedures associated with general construction activities, and pilot testing activities. The information in the following sections is provided for the use of BBLES oversight personnel only. They are not meant for use by others conducting activities at the site.

3.2.4.1 Underground Storage Tank Cleaning and Removal

This task will involve the cleaning and removal of the gasoline UST located northeast of the former Plant 1 building. During tank removal activities BBLES and BBLES subcontractor personnel may be working in areas of active excavation. Excavation involves removing earthen materials from a designated area, thereby creating a man-made cut, trench, or depression in the earth's surface. Excavation activities will be conducted in accordance with this section and all applicable state and federal regulations.

The following procedures will be instituted as appropriate.

- *Tank Isolation* – Any electric or mechanical utilities or installations will be removed.
- *Tank/Structure Excavation*- pavement and soil above the structure will be removed.
- *Product Removal* – Product will be removed from the structure as required using a vacuum truck
- *Tank Cleaning* – The tank will be cleaned, using remote methods only. If Confined space entry is required BBLES confined space entry guidelines will be followed.
- *Air Monitoring* – After tank cleaning has been completed air monitoring for flammable vapors will be conducted
- *Hot Work Permit* – A hot work permit will be completed (see Attachment B) at the site prior to any cutting or torching on or near any tanks that were used to store combustible or flammable materials
- *Tank Removal* — The tank will be removed with a sling or similar device attached to an excavator if possible, or will be removed in pieces with an excavator.
- *Tank Abandonment* — if necessary if a tank cannot be removed it will be filled in place with a flowable concrete mix.
- *Site restoration* –The excavation will be backfilled with clean gravel.

During UST removal, excavation activities will be conducted. Excavation activities will be conducted in accordance with this section and all applicable OSHA regulations.

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

Excavations pose significant hazards to employees if they are not carefully controlled. There exists a chance for the excavation to collapse if it is not dug properly, sloped, benched, or shored as required by 29 CFR 1926 Subpart P. Protective systems, as required by 29 CFR 1926 Subpart P, must be utilized if the potential for hazardous cave-ins exist. The excavation also is a fall hazard, and employees must pay careful attention to what they are doing or they risk a fall into the excavation. Fall protection, as required by 29 CFR 1926 Subpart M, will be required.

Personnel are not permitted to enter excavations. All activities shall be done remotely, without entering the excavation.

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

At the end of each workday, equipment will be moved to a location away from high-voltage electrical equipment and away from routes necessary to access high-voltage electrical equipment.

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

Before excavation activities commence, the existence and location of underground pipe, electrical equipment, and gas lines shall be determined. This will be done, if possible, by contacting the appropriate client representative to mark the location of the lines. If the client's knowledge of the area is incomplete, an appropriate device, such as a magnetometer, will be used to locate the line. The Underground/Overhead Utility Checklist (see Attachment A) shall be used to document that nearby utilities have been marked on the ground, and that the excavation and drilling areas have been cleared. The completed checklist will be in the possession of the SS prior to commencement of any intrusive investigation.

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

3.2.4.1.1 Excavation Hazards and Control Procedures

During field activities, BBLES and BBLES subcontractor personnel may be working in areas of active excavation and near test-pit locations. This task involves excavating at specified locations to obtain subsurface soil samples from a designated area, thereby creating a man-made cut, trench, or depression in the earth's surface. Excavation activities will be conducted in accordance with this section, and appropriate federal and state regulations.

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

Excavations pose significant hazards to employees if they are not carefully controlled. There exists a chance for the excavation to collapse if it is not dug properly, sloped, benched, or shored as required by 29 Code of Federal Regulations (CFR) 1926 Subpart P. Protective systems, as required by 29 CFR 1926 Subpart P, must be used if the potential for hazardous cave-ins exists. The excavation also is a fall hazard and employees must pay careful attention to what they are doing or they risk a fall into the excavation. Fall protection, as required by 29 CFR 1926 Subpart M, will be required.

The following control procedures are required during soil sampling activities:

- Activities must be done remotely whenever feasible.
- At the end of each workday, equipment will be moved to a location away from high-voltage electrical equipment and away from routes necessary to access high-voltage electrical equipment.
- Airborne concentrations of COCs in the site soil and the dust from the excavation procedure pose the potential for inhalation exposure. PPE for this phase is described in Section 5, Personal Protective Equipment. Airborne particulate generation will be controlled during site excavations. Dry, dusty soil will be wetted with a water spray from a potable water source to control the generation of dust. Soil will not be wetted to a degree that will cause runoff or erosion.
- Before excavation activities commence, the existence and location of underground pipe, electrical equipment, and gas lines must be determined. The Long Island One-Call Center must be contacted at least 1

week, but no more than 2 weeks, prior to subsurface activities. BBLES' SS will meet with electrical and natural gas locators on site prior to marking out the underground utilities. During this meeting, BBLES' SS will provide the electric and natural gas locators with a site figure that shows the locations where excavation and drilling activities will be completed. BBLES' SS will conduct a site walkover with the electrical and natural gas locators to visually identify each location where excavation and drilling activities are to be completed during site operations. The Underground/Overhead Utility Checklist (see Attachment A) must be used to document that nearby utilities have been marked on the ground, and that the excavation and drilling areas have been cleared. The completed Underground/Overhead Utility Checklist will be in the possession of the SS prior to commencing any intrusive investigation.

- If excavation operations are located near underground installations, the exact location of the installations must be determined by safe and acceptable means. Subsurface work conducted near expected utility locations will be conducted with a hand auger or shovel until utilities can be located. While the excavation is open, underground installations must be protected, supported, or removed as necessary to safeguard employees.

3.2.4.1.2 Inspections by a Competent Person

Daily inspections of excavations, the adjacent areas, and protective systems must be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection must be conducted by the competent person from the firm that is installing the excavation prior to starting work and as needed throughout the shift (see the Daily/Periodic Excavation Inspection Checklist in Attachment C). **BBLES competent person inspections should be conducted prior to entry to verify that conditions are acceptable for BBLES employees**. All inspections conducted by BBLES are for the sole use of BBLES and their employees, and are not intended to meet the requirements for excavation contractors to document compliance with the 29 CFR 1926 Subpart P.

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

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

3.2.4.1.3 Soil Classification

29 CFR 1926 Subpart P, Appendix A describes methods for classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils. This appendix applies during the following conditions:

- Sloping or benching system is designed in accordance with the requirements set forth in 1926.652(b) (2) as a method of protection for employees from cave-ins.

- Timber shoring for excavations is designed as a method of protection from cave-ins in accordance with Appendix C to Subpart P of Part 1926, and when aluminum hydraulic shoring is designed in accordance with 29 CFR Subpart P, Appendix D.

- If other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in 1926.652(c), and the use of the data are predicated on the use of the soil classification system set forth in Appendix A of 29 CFR 1926.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V). Short-term exposure means a period of time less than or equal to 24 hours that an excavation is open. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from Table 3, below. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope that is at least one-half horizontal to one vertical (½H:1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope and confirm that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P, Appendix B.

Table 3

Maximum Allowable Slopes

(29 CFR 1926 Subpart P Appendix B)

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

Notes:

1 Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

2 Sloping or benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.

3 A short-term maximum allowable slope of ½H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be ¾H:1V (53°).
(Source: Table B-1, 29 CFR 1926 Subpart P Appendix B, Maximum Allowable Slopes.)

3.2.4.1.4 Overhead Electrical Clearances

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

When excavation equipment is in transit, the equipment clearance must be at least 4 feet for voltages less than 50kV, 10 feet for voltages of 50kV to 345kV, and 16 feet for voltages above 345kV.

3.2.4.1.5 Excavation Entry Procedure

Persons entering an excavation must do so under controlled conditions. The excavation must be properly sloped, benched, or shored, and ladders or ramps must be available every 25 feet laterally in the excavation. Each entry must have an attendant who observes the entrant(s) and is prepared to render assistance.

Duties of Workers Entering an Excavation

Workers entering an excavation are responsible for the following information and actions:

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants.
- Communicate with the attendant as necessary to enable the attendant to monitor entrant status and alert entrants of the need to evacuate the space.
- Alert the attendant whenever:
  - The entrant recognizes any warning sign or symptom of exposure to a dangerous situation; or
  - The entrant detects a prohibited condition.
- Exit from the excavation as quickly as possible whenever:
  - An order to evacuate is given by the attendant or the supervisor;
  - The entrant recognizes any warning sign or symptom of exposure to a dangerous situation; or
  - The entrant detects a prohibited condition.

Duties of Attendants

Attendants at an excavation have the following responsibilities:

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants.
- Continuously maintain a count of entrants in the excavation.
- Remain outside the excavation during entry operations until relieved by another attendant.
- Communicate with authorized entrants, as necessary, to monitor entrant status and to alert entrants to evacuate the excavation if the attendant detects any of the following situations:
  - A prohibited condition;
  - Behavioral effects of hazard exposure in an entrant;
  - A situation outside the excavation that could endanger the entrants; or
  - If the attendant cannot effectively and safely perform his duties.

- Summon rescue and other emergency services if the entrants need assistance to evacuate the excavation.

3.2.4.1.6 Heavy Equipment Materials Handling

Excavation activities involve using heavy equipment to remove, transport, and replace earthen materials. During field activities, BBLES and BBLES subcontractor personnel may be working in areas where heavy equipment is in operation. Heavy equipment operation will be conducted in accordance with this section and appropriate federal and state regulations.

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

Audible Alarms

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

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

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

- In lieu of the above requirements, administrative controls must be established such as:

    - A spotter or flagger in clear view of the operator who must direct the backing operation;
    - Other procedures that will require the operator to dismount and circle the vehicle immediately prior to starting a backup operation;
    - Prohibiting all foot traffic in the work area; and
    - Other means must be provided that will provide safety equivalent to the foregoing for personnel working in the area.

The operator of all vehicles must not leave the controls of the vehicle while it is moving under its own engine power. Hauling or earth-moving operations must be controlled in such a manner as to confirm that equipment or vehicle operators know of the presence of other personnel in the areas of their operations.

Equipment Inspection and Maintenance

All vehicles in use must be checked at the beginning of each shift to confirm that the following parts, equipment, and accessories are in safe operating condition and free of apparent damage that could cause failure while in use:

- Service brakes, including trailer brake connections;
- Parking system (hand brake);
- Emergency stopping system (brake);
- Tires;
- Horn;
- Steering mechanism;
- Coupling devices;
- Seat belts;
- Operating controls; and
- Safety devices.

All defects affecting safe operation must be corrected before the vehicle is placed in service. These requirements also apply to equipment such as lights, reflectors, windshield wipers, defrosters, fire extinguishers, etc., where such equipment is necessary.

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

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

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

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

Equipment Parking and Loading

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

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

Equipment Fueling

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

Good metal to metal contact must be kept between fuel supply tank or nozzle of supply hose and the fuel tank. No open lights, welding, or sparking equipment must be used near internal combustion equipment being fueled or near storage tanks. Smoking is not permitted at or near the gasoline storage area or on equipment being fueled. A conspicuous sign must be posted in each fuel storage and fueling area stating: "**No Smoking Within 50 Feet**" Class I liquids must not be dispensed by pressure from drums, barrels, and similar containers. Approved pumps taking suction through the top of the container or approved self-closing faucets must be used. No repairs must be made to equipment while it is being fueled.

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

Flaggers

Flaggers must be used at locations on a construction site where barricades and warning signs cannot control the moving traffic. When flaggers are required, they must be placed in relation to the equipment or operation so as to give effective warning. Placement of warning signs must be according to the state Department of Transportation (DOT).

Flaggers must wear orange warning garments such as vests, jackets, or shirts. Rainwear, when worn, must be orange or other color provided an orange outer warning garment is worn. While working in darkness, flaggers' stations must be illuminated such that the flagger will be clearly visible to approaching traffic, and flaggers must be outfitted with reflective garments. The retro-reflective material must be orange, white (including silver-coated reflecting coatings or elements that reflect white light), yellow, fluorescent red-orange or fluorescent yellow-orange.

Flaggers must be trained in the proper fundamentals of flagging moving traffic before being assigned as flaggers. Signaling directions used by flaggers must conform to the DOT standards.

Additional Safety Requirements

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

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

- Prior to operating any heavy equipment, the authorized operator must conduct a pre-operation inspection to determine if the heavy equipment is in safe operating condition prior to each work shift.
- All mobile equipment must be equipped with an audible back-up alarm.
- Personnel will not be allowed to stand or pass under the elevated portion of any heavy equipment, whether loaded or empty.
- Personnel will not place arms and legs between pinch or scissor points of the equipment, or outside the operator enclosure.
- A safe distance must be maintained from the edge of excavations, ditches, ramps, or platforms.
- Operators will maintain sufficient clearance under overhead utilities, installations, lights, pipes, etc.
- Heavy equipment must never be used for lifting or transporting personnel.
- The operator is required to look in the direction of, and maintain a clear view of the path of travel.
- Heavy equipment must not be operated without an overhead guard and roll-over protection to protect the operator against falling objects and equipment roll-over.
- Heavy equipment must not be driven up to anyone standing in front of any object.
- Stunt driving and horseplay are strictly prohibited.
- Operators will yield the right-of-way to other site vehicles.
- Other heavy equipment traveling in the same direction at intersections, blind spots, or other dangerous locations, must not be passed.
- A safe distance must be maintained from other heavy equipment, and the equipment must be kept under control at all times.
- The heavy equipment operator must slow down for wet and slippery conditions. Under all travel conditions, the equipment will be operated at a speed that will permit it to be brought to a stop safely.
- Operators will avoid running over loose objects on operating surfaces.

- Grades and ramps must be ascended and descended slowly.
- On all grades, the load will be tilted back and raised only as far as necessary to clear the operating surface.
- The operator will slow down and sound the horn at intersections, when entering buildings, and other locations where vision may be obstructed.
- If the load being carried obstructs forward view, the operator will travel with the load trailing.
- While negotiating turns, speed will be reduced to a safe rate, and turning will be in done a smooth, sweeping motion to avoid abrupt turns and potential equipment or load upset.
- Authorized operators will only handle stable or safely arranged loads that are within the rated capacity of the heavy equipment and will not affect the stability of the heavy equipment.
- When a piece of heavy equipment is left unattended, hydraulics will be fully lowered, controls will be neutralized, power will be shut off, and brakes set. Wheels will be blocked or chocked if the heavy equipment is parked on an incline. When internal combustion-engine-powered heavy equipment is used indoors, near confined spaces, or near excavations, carbon monoxide levels must be monitored to prevent personnel exposure.

3.2.5 Subsurface structure water and debris removal

Subsurface structure water and debris removal involves a BBLES subcontractor utilizing a mechanical means (shovel, pumps, vac truck, etc.) to remove standing water and accumulated debris from various structures including trenches, manholes and trenchbasins. Water and debris will be placed into appropriate containers for characterization and subsequent off site transportation and disposal.

Hazards involved include; slips, trips falls caused by uneven or wet surfaces, ergonomic issues from manual lifting/shoveling/hauling, spray from ruptured vacuum lines and potential atmospheric issues involved with confined space entry.

Control measures for the above can be found in Section 4.0, General Safety Practices.

3.2.5.1 Slab Demolition

Slab demolition activities involve a potential for exposure to many physical and health hazards. In addition, construction and installation of temporary facilities, and selective demolition may be conducted.

3.2.5.1.1 Hazards

Hazards may be associated with the materials used in construction, equipment utilized, or the dismantlement and removal activities themselves. BBLES requires subcontractors to address all physical and health hazards presented by the dismantlement, removal, demolition, and construction activities (hereafter collectively know as construction activities) in accordance with 29 CFR 1926. Subcontractors may utilize their company's standard safe operating procedures for construction activities as long as the minimum requirements of this HASP and 29 CFR 1926 are met.

The physical hazards involved with construction activities relate to the work conducted with heavy equipment, hand and power tools, and the construction environment itself. During construction related activities there exists a potential for incidents involving personnel being struck by or against equipment or materials, which may result in fractures, lacerations, punctures, and abrasions. Walking and working surfaces during construction activities may present slip, trip, or fall hazards. Slippery surfaces can increase the likelihood of slips and falls in addition to back and overexertion injuries. Hot work activities such as cutting and welding may present the risk of a fire or explosion hazard. Overhead hazards such as electrical conduit or process piping may be present due to elevated work.

Demolition activities pose the potential for personnel being struck by debris and objects associated with the demolition activities and the equipment being used. Improper planning and procedures may place employees in unsafe situations that may result in serious injury or death.

Electricity may pose a hazard to employees during the use of portable electrical equipment and lead cords. Sources of energy that are not locked out and/or tagged out expose personnel to various forms of energy (electrical, mechanical, high pressure, etc.) that could be hazardous during the performance of construction tasks. Additionally, employees installing temporary and permanent wiring are exposed to electrical hazards if proper precautions and procedures are not followed, or inexperienced or unqualified personnel conduct the work.

Improper operation of heavy equipment (forklifts, front end loaders, aerial lifts, cranes, etc.) may result in personnel being struck by the equipment or loads being handled, resulting in contusions, fractures, and lacerations. Personnel may be injured and equipment damaged if it is not used for the purpose intended, overloaded, or used improperly by inexperienced or unauthorized individuals. Loads being lifted by cranes may shift causing them to fall and strike personnel causing serious injury or death.

Due to the type of work involved in many construction activities, the primary health hazards involve repetitive motion diseases, and lifting and other ergonomic disorders. Noise may also present a hazard to employees exposed to high decibel levels. Operation of heavy equipment, power tools, pneumatic tools, and powder actuated tools often result in high noise levels. Exposure to construction materials that may release harmful vapors during their use and curing periods are also possible. Personnel may be exposed to hazardous or toxic vapors created during hot work activities.

3.2.5.1.2 Hazards Control

Prior to initiating any field activity, the site conditions will be discussed with all employees (including subcontractors). Hazards will be identified and protective measures will be explained. Equipment will be inspected prior to usage and be in proper working condition. Employees will receive training in the use and care of equipment that they will be expected to operate. Tasks should be scheduled in a manner that reduces the likelihood of performing a repetitive task for prolonged periods. Proper lifting techniques should be employed and mechanical means should be used for heavy lifting tasks. Hearing protection is required for use when exposed to noise levels exceeding 85 dBA, or a level that commonly results in difficult conversation.

Control procedures for general electrical hazards are discussed in Section 4.11, Electrical Safety. Control procedures for hot work are discussed in Section 4.15, Hot Work Safety Program. Safety during elevated work will conform to the requirements of 29 CFR 1926 Subpart M Fall Protection. Safety procedures governing the use of scaffolding and aerial lifts and the use of ladders shall conform to the requirements of 29 CFR 1926 Subpart L Scaffolds and Subpart X Stairways and Ladders, respectively.

Lockout/tagout procedures as specified in 29 CFR 1910.147 shall be followed by personnel that may be exposed to hazardous energy sources. Line breaking activities shall follow all required procedures and regulations (lockout/tagout), and be performed under the supervision of a competent person. If required by Bayer, line-breaking activities shall not be conducted until the appropriate facility personnel have been consulted.

Demolition work shall conform to the requirements of 29 CFR 1926 Subpart T, Demolition. A pre-demolition survey as required by 29 CFR 1926.850(a) shall be completed by the contractor prior to demolition activities. This survey must be documented and reviewed with all affected personnel and contractors. All tasks requiring the use of a crane or rigging will be done in accordance with 29 CFR 1926 Subpart N. Removal of hazardous substances and waste materials and cleaning/decontamination of equipment shall be in compliance with 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER). Asbestos abatement shall be done in strict accordance with Code Rule 56 and associated federal regulations. Lead work (removal, encapsulation, hot work) will be done in accordance with 29 CFR 1926.62, Lead.

3.2.5.1.3 Demolition Safety

Prior to permitting employees to start demolition activities, an "engineering survey" of the structure shall be made by a competent person to determine the condition of the slabs, and the possibility of an unplanned collapse of any portion of the structure. Any adjacent structure where employees may be exposed shall also be similarly checked.

When employees are required to work within a structure, which has been damaged by fire, flood, explosion, or other cause, the walls, and floor shall be braced or shored. All electric, gas, water, steam, sewer, and other service lines shall be shut off, capped or otherwise controlled outside the building before demolition work is started. In each case, any utility company that is involved shall be notified in advance.

If it is necessary to maintain any power, water, or other utilities during demolition, such lines shall be temporarily relocated as necessary and protected. It shall also be determined if any type of hazardous chemicals, gases, flammable materials, or similarly dangerous substances have been used in any pipes, tanks, or other equipment on the site. When the presence of any such substances is apparent or suspected, testing and purging shall be performed and the hazard eliminated before demolition is initiated.

Where the hazard exists from the fragmentation of glass, such hazards shall be removed. Where a hazard exists to employees from falling through wall openings, the opening shall be protected to a height of 42 inches. When debris is dropped through holes in the floor without the use of chutes, the area onto which the material is dropped shall be completely enclosed with barricades which are not less than 42 inches high and not less 6 feet back from the edge of the opening above. Signs, warning of the hazard of falling materials shall be posted at the lower (and ground) level. Removal shall not be allowed in this lower level until debris handling ceases above.

Mechanical Demolition

Personnel shall not be permitted in any area that can be adversely affected by mechanical demolition operations. Only those workers necessary for the performance of the operations shall be permitted in the area. The area shall be barricaded as necessary to prevent unauthorized personnel or anyone not associated with the demolition operation from entering the area.

When removing walls or portions thereof, all steel members affected shall be cut prior to wall removal. All roof cornices or other ornamental stonework shall be removed prior to removing the walls.

During demolition, continuing inspections by a competent person shall be made as the work progresses to detect hazards resulting from the weakened or deteriorated floors, walls, or loosened material. No employee shall be permitted to work where such hazards exist until they are corrected by shoring, bracing, or other effective means.

3.2.6 Decontamination

Equipment decontamination will be performed to control the transfer of COCs from the site. Equipment will be decontaminated by scrubbing with a mild detergent/citrus solvent to remove visible dirt and dust.

Hazards – Sources of chemical hazards from decontaminating equipment are decontamination detergents or solvents, foreign matter and COCs on the equipment prior to decontamination, and rinsate from the decontamination process. Physical hazards associated with this activity are back strain, slippery surfaces, and exposure to COC-impacted equipment.

Control – All equipment shall be decontaminated before leaving the site. In addition, all operations that have the potential to generate or release hazardous material will be conducted in a controlled area using the appropriate engineering controls. Specific decontamination techniques will be established based on site conditions. Decontamination procedures will be reviewed with all personnel on-site. A decontamination pad on a suitable surface (concrete or paved area) with polyethylene sheeting or other appropriate containment system will be established. Manual scrubbing with a stiff bristle brush will be used to decontaminate equipment. COC impacted equipment will be determined "clean" by using visual inspection of all equipment.

The decontamination facility will be inspected on a daily basis for evidence of leaks or loss of integrity to the containment system. If any deficiencies are noted they will be corrected immediately. All wastewater and waste materials generated on-site will be contained in the decontamination system for characterization and proper disposal.

Personnel involved in decontamination activities may be exposed to skin contact with contaminated materials and chemicals brought to the site as part of the project work. All personnel will review the operating procedures and PPE prior to decontamination. PPE for this activity is specified in Section 5, Personal Protective Equipment.

3.2.7 Demobilization

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

Manual materials handling may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. Heavy equipment operation presents noise and vibration hazards, and hot surfaces, to operators. Personnel in the vicinity of heavy equipment operation may be exposed to physical hazards resulting in fractures, contusions, and lacerations and may be exposed to high noise levels. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces, and unstable soil.

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

Control procedures for these hazards are discussed in Section 4, General Safety Practices.

3.3 Chemical Hazards

The chemical hazards associated with site operations are related to inhalation, ingestion, and skin exposure to COCs and any construction materials brought to the site.

Based on previous investigation activities on the site, it is anticipated that the primary COCs may potentially include polychlorinated biphenyls (PCBs), benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, phenol, pyrene, naphthalene, glycols, barium, cadmium, chromium, copper, lead, mercury, nickel, and zinc. Based on the COCs at the site, levels of PPE to be used with each work activity were selected by BBLES and are discussed in Section 5, Personal Protective Equipment. As analytical data becomes available, this HASP may be amended to address the specific constituents detected and MSDSs for the specific chemicals will be attached to this HASP.

A MSDS must accompany all materials brought to the site. No material shall be used or installed by any subcontractor prior to review of the MSDS by the SS or HSS. Following review of MSDS' by the SS or HSS, copies shall be made and placed in this HASP. The location of the HASP shall be communicated to all on-site employees. All provisions of the BBLES Hazard Communication PPM and 29 CFR 1910.1200 are to be followed with regard to materials that are to be used during construction activities.

If airborne concentrations of hazardous vapors or fumes may become measurable during certain tasks, air monitoring of potentially hazardous atmospheres will be conducted during such operations.

The MSDS for the COCs and the materials brought to the site are included in Attachment D. Chemical Hazard Information for the COCs can be found in Table 3-1 located at Attachment E.

4. General Safety Practices

4.1 General Safety Rules

General safety rules for site activities include, but are not limited to, the following:

- At least one copy of this HASP must be in a location at the site that is readily available to personnel, and all project personnel shall review the plan prior to starting work;
- Consume or use food, beverages, chewing gum, and tobacco products only in the SZ or other designated area outside the EZ and CRZ. Cosmetics shall not be applied in the EZ or CRZ;
- Wash hands before eating, drinking, smoking, or using toilet facilities;
- Wear all PPE as required, and stop work and replace damaged PPE immediately;
- Secure disposable coveralls, boots, and gloves at the wrists and legs and ensure closure of the suit around the neck;
- Upon skin contact with materials that may be impacted by COC, remove contaminated clothing and wash the affected area immediately. Contaminated clothing must be changed. Any skin contact with materials potentially impacted by COC must be reported to the SS or HSS immediately. If needed, medical attention should be sought;
- Practice contamination avoidance. Avoid contact with surfaces either suspected or known to be impacted by COC, such as standing water, mud, or discolored soil. Equipment must be stored on elevated or protected surfaces to reduce the potential for incidental contamination;
- Remove PPE as required in the CRZ to limit the spread of COC-containing materials;
- At the end of each shift or as required, dispose of all single-use coveralls, soiled gloves, and respirator cartridges in designated receptacles designated for this purpose;
- Removing soil containing site COC from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air is prohibited;
- Inspect all non-disposable PPE for contamination in the CRZ. Any PPE found to be contaminated must be decontaminated or disposed of appropriately;
- Recognize emergency signals used for evacuation, injury, fire, etc;
- Report all injuries, illnesses, near misses, and unsafe conditions or work practices to the SS or HSS;
- Use the "buddy system" during all operations requiring Level C PPE, and when appropriate, during Modified Level D operations;
- Obey all warning signs, tags, and barriers. Do not remove any warnings unless authorized to do so;

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

- Personnel are to perform only tasks for which they have been properly trained and will advise their supervisor if they have been assigned a task for which they are not trained;

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

- Remain upwind during site activities whenever possible.

4.2 Loss Prevention System (LPS)

LPS is a behavior based safety system meant to prevent or reduce the occurrence of injury, illness, or other incident. This program seeks the prevention or reduction of losses by:

- Emphasizing proactive activities;

- Capitalizing on the on-the-job expertise of field employees;

- Maximizing the use of positive reinforcement;

- Integrating with daily field operations; and

- Solving problems from the bottom up while providing direction from the top down.

Prior to assignment on a in the field, BBL personnel that will be performing or overseeing work on this project must attend a LPS training session. This training session explains the objectives, elements, and requirements of LPS. Personnel will not be allowed to perform work prior to attending an LPS training session. Elements of the LPS program are briefly outlined below in sections 4.2.1-4.2.4.

4.2.1 Safe Performance Self-Assessment

All onsite personnel are required to perform an SPSA prior to beginning any activity. Each individual must perform the following three-step process:

- *Assess* the risk of the task to be performed. Ask the following questions:

  - What could go wrong?
  - What is the worst thing that could happen if something does go wrong?

- *Analyze* the ways the risk can be reduced. Ask the following questions:

  - Do I have all the necessary training and knowledge to do this task safely?
  - Do I have all the proper tools and PPE?

- *Act* to control the risk and perform the task safely:

  - Take the necessary action to perform the job safely.
  - Follow written procedures and ask for assistance if necessary.

This process must be performed prior to beginning any activity and after any near miss or other incident to determine if it is safe to proceed.

4.2.2 Incident Investigation

An incident includes any of the following events:

- First-aid cases;
- Injuries;
- Illnesses;
- Near misses;
- Spills or leaks;
- Equipment and property damage,;
- Motor vehicle accidents;
- Regulatory violations;
- Fires; and
- Business interruptions.

All incidents must be investigated within 24 hours, and reported to the PIC, PO, PM and the HSO.

IIs are conducted to prevent the recurrence of a similar hazardous event. IIs review all incidents in the same manner. Using the information gathered during an II, appropriate measures are to protect personnel from the hazard in question. The Incident/Near-Miss Investigation Report is included in Attachment F.

4.2.3 Loss Prevention Observation

The SS or the HSS will perform the LPO (see Attachment G for the LPO Form). LPOs are conducted to identify and correct potential hazards, and to positively reinforce behaviors and practices that are correct. The SS or HSS must identify potential deviations from safe work practices that could possibly result in an incident, and take prompt corrective action. The LPO process includes the following steps:

- Identify tasks that have the greatest potential for hazardous incidents.
- Review the standard procedure for completing the task.
- Discuss with the observed employee the task and the SS/HSS role in observing the task.
- Observe the employee completing the task.
- Reference the LPO form for criteria. Complete the form, documenting positive actions, as well as areas in need of improvement.
- Discuss the results of the LPO with the employee. Discuss corrective action necessary.

- Implement corrective action.

- Communicate the results of the LPO and corrective action to the PM and the HSO.

4.2.4 Near Miss Reporting

As a part of the philosophy that work-related accidents and losses are preventable, we believe that the practices and standards used to conduct work could sometimes lead to an incident and that changing these practices and standards will reduce the potential for an incident. To achieve this end, we use the practice of "near-miss" reporting. Near-misses are situations where no injury or property damage occurred; however, under slightly different circumstances an injury or property damage could have occurred. The near miss report should identify the work that was conducted, what actually happened, discuss the "what could have happened" had the circumstances been slightly different, and recommend a change to procedures to prevent an incident from occurring from similar work in the future. Near miss reporting is encouraged for all workers at any level in the work force. The worker may feel comfortable completing the report themselves or may seek assistance from their HSS or supervisor. Near miss reporting and job safety assessments can be particularly useful after any changes to work practices are implemented, including changes to personnel, equipment, or means and methods.

4.2.5 Job Safety Analysis

A JSA is a tool used of identifying potential hazards and developing corrective or protective systems to eliminate the hazard. A JSA lists all the potential hazards associated with an activity. Hazards may be physical, such as lifting hazards or eye hazards, or environmental, such as weather or biological (stinging insects, snakes, etc.). Following the identification of the hazards associated with an activity, control measures are evaluated and protective measures or procedures are then instituted. JSAs are reviewed periodically to ensure that the procedures and protective equipment specified for each activity are current and technically correct. Any changes in site conditions and/or the scope of work may require a review and modification to the JSA in question. During this review process, comments on the JSA and its procedures should be obtained from personnel associated with the activity being analyzed.

4.3 Buddy System

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

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

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

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

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

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

4.4 Heat Stress

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

4.4.1 Heat Rashes

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

4.4.2 Heat Cramps

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

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

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

4.4.3 Heat Exhaustion

Heat exhaustion occurs from increased stress on various body organs due to inadequate blood circulation, cardiovascular insufficiency, or dehydration. Signs and symptoms include:

- Pale, cool, moist skin;

- Heavy sweating;
- Dizziness;
- Nausea;
- Headache;
- Vertigo;
- Weakness;
- Thirst; and
- Giddiness.

Fortunately, this condition responds readily to prompt treatment.

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

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

4.4.4 Heat Stroke

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

Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are:

- Confusion;
- Irrational behavior;
- Loss of consciousness;
- Convulsions;
- A lack of sweating (usually);
- Hot, dry skin; and
- An abnormally high body temperature (e.g., a rectal temperature of 41°C [105.8°F]).

If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of workload and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

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

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

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

4.4.5 Heat Stress Safety Precautions

Heat stress monitoring and work rest cycle implementation should commence when the ambient adjusted temperature exceeds 72°F. Screening criteria for heat stress exposure are described in Table 4 and examples of activities within metabolic rate categories are provided in Table 5.

TABLE 4
SCREENING CRITERIA FOR HEAT STRESS EXPOSURE
FOR 8 HOUR WORK DAY FIVE DAYS PER WEEK WITH CONVENTIONAL BREAKS

	Acclimatized				Unacclimatized			
Work Demands	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
100% Work	85.1°F (29.5°C)	81.5°F (27.5°C)	78.8°F (26°C)		81.5°F (27.5°C)	77°F (25°C)	72.5F (22.5°C)	
75% Work; 25% Rest	86.9°F (30.5°C)	83.3°F (28.5°C)	81.5°F (27.5°C)		84.2°F (29°C)	79.7°F (26.5°C)	76.1°F (24.5°C)	
50% Work; 50% Rest	88.7°F (31.5°C)	85.1°F (29.5°C)	83.3°F (28.5°C)	81.5°F (27.5°C)	86°F (30°C)	82.4°F (28°C)	79.7°F (26.5°C)	77°F (25°C)
25% Work, 75% Rest	90.5°F (32.5°C)	87.8°F (31°C)	86°F (30°C)	85.1°F (29.5°C)	87.8°F (31°C)	84.2°F (29°C)	82.4°F (28°C)	79.7°F (26.5°C)

Source: 2004 TLVs and BEIs - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati: American Conference of Governmental Industrial Hygienists (ACGIH), 2004 - page 171.

TABLE 5

EXAMPLES OF ACTIVITIES WITHIN METABOLIC RATE CATEGORIES

Categories	Example Activities
Resting	Sitting quietly
	Sitting with moderate arm movements
Light	Sitting with moderate arm and leg movements
	Standing with light work at machine or bench while using mostly arms
	Using a table saw
	Standing with light or moderate work at machine or bench and some walking about
Moderate	Scrubbing in a standing position
	Walking about with moderate lifting or pushing
	Walking on a level at 6 Km/hr while carrying 3 Kg weight load
Heavy	Carpenter sawing by hand
	Shoveling dry sand
	Heavy assembly work on a noncontinuous basis
	Intermittent heavy lifting with pushing or pulling (e.g., pick-and-shovel work)
Very Heavy	Shoveling wet sand

Source: 2004 TLVs and BEIs - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati: American Conference of Governmental Industrial Hygienists (ACGIH), 2004 - page 172

Acclimatization is a set of physiological adaptations, which allows the body to react to heat stress conditions. Full-heat acclimatization requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the activity under those heat-stress conditions is discontinued, and a noticeable loss occurs after 4 days. With a recent history of heat stress exposures (e.g., 5 of the last 7 days), a worker can be considered acclimatized for the purpose of using the table Screening Criteria for Heat Stress Exposure (Table 4).

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

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

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

4.5 Cold Stress

Cold stress normally occurs in temperatures at or below freezing, or under certain circumstances, in temperatures of 40°F. Extreme cold for a short time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death. Areas of the body that have high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible. Two factors influence the development of a cold weather injury: ambient temperature and the velocity of the wind. For instance, 10°F with a wind of 15 miles

per hour (mph) is equivalent in chilling effect to still air at 18°F. An equivalent chill temperature chart relating the actual dry bulb temperature and wind velocity is presented in Table 6.

TABLE 6
CHILL TEMPERATURE CHART

Estimated Wind Speed (in 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	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute.			GREAT DANGER Flesh may freeze within 30 seconds.				
	Trench foot and immersion foot may occur at any point on this chart.											

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

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

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

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

Safety Precautions for Cold Stress Prevention

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

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

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

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

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

Safe Work Practices

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

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

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

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

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

4.6 Biological Hazards

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

4.6.1 Ticks

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

Symptoms of Lyme disease include a rash or a peculiar red spot, like a bull's eye, which expands outward in a circular manner. The victim may have headache, weakness, fever, a stiff neck, and swelling and pain in the joints, and eventually, arthritis.

Erlichiosis – This disease also commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin. Symptoms of erlichiosis include muscle and joint aches and flu-like symptoms, but there is typically no skin rash.

Rocky Mountain Spotted Fever (RMSF) – This disease is transmitted via the bite of an infected tick. The tick must be attached for 4 to 6 hours before the disease-causing organism (Rickettsia rickettsii) becomes reactivated and can infect humans.

The primary symptom of RMSF is the sudden appearance of a moderate-to-high fever. The fever may persist for 2 to 3 weeks. The victim may also have a headache, deep muscle pain, and chills. A rash appears on the hands and feet on about the third day and eventually spreads to all parts of the body. For this reason, RMSF may be confused with measles or meningitis. The disease may cause death, if untreated, but if identified and treated promptly, death is uncommon.

Control – These diseases are transmitted primarily by the deer tick, which is smaller and redder than the common wood tick. The diseases may be transmitted by immature ticks, which are small and hard to see. The tick may be as small as a period on this page. Tick repellant containing diethyltoluamide (DEET) should be used when working in tick-infested areas, and pant legs should be tucked into boots. In addition, workers should search the entire body every 3 or 4 hours for attached ticks. Ticks should be removed promptly and carefully without crushing, since crushing can squeeze the disease-causing organism into the skin. A gentle and steady pulling action should be used to avoid leaving the head or mouth parts in the skin. Hands should be protected with surgical gloves when removing ticks.

4.6.2 Mosquitoes

Personnel may be exposed to mosquitoes during work activities.

West Nile Virus – Typical exposure to mosquitoes does not present a significant hazard. However, if West Nile virus is prevalent in the area exposure to this virus is increased. West Nile virus results in flu-like symptoms and can be serious if not treated or in immune compromised individuals.

Control – To minimize the threat of mosquito bites all personnel working outside must be aware of the potential for encountering mosquitoes and implement the basic precautions listed below:

- Avoid working at dawn or dusk when mosquitoes are most active;
- Prevent accumulation of standing water at the work-site;
- Apply an insect repellent that contains DEET to exposed skin;
- Wear light colored clothes, preferably with long-sleeves and full-length pants; and
- Do not touch any dead birds or animals that you encounter.

If dead birds are detected near the site, report to the local County Health Department. If flu-like symptoms are present, contact your doctor or the HSO for more information.

4.6.3 Poisonous Plants

Poisonous plants may be present in the work area. Personnel should be alerted to their presence and instructed on methods to prevent exposure. Poison sumac grows as a shrub or small tree with large alternate, compound leaves having 7-13 leaflets without teeth. All plant parts are poisonous. The lack of 1) leaflet glands, 2) "wings" between the leaflets, and 3) teeth on the leaves, in addition to this species' red stems supporting the

leaflets and leaves, help to distinguish this plant from similar-looking nonpoisonous species such as other sumacs and tree-of-heaven. Flowers are shades of green, white and yellow and appear in late spring. Fruits are small white berries that mature in late summer and may last through winter. Occasionally found in moist or wet soils.

Poison ivy is a woody shrub or vine with hairy looking aerial roots. It grows to 10 feet or more, climbing high on trees, walls and fences or trails along the ground. All parts of poison ivy, including the roots, are poisonous at all times of the year.

Poison Sumac

Poison Ivy

The main control for both poison ivy and poison sumac is to avoid contact with the plant, cover arms and hands, and frequently wash potentially exposed skin. Particular attention must be given to avoiding skin contact with objects or protective clothing that have touched the plants. Treat every surface that may have touched the plant as contaminated, and practice contamination avoidance.

Poison ivy and sumac are very easy to treat if you identified your contact with the irritating plant within a few hours of the incident. The urushiol oil present in both plants chemically bonds with the proteins in your skin about 30 minutes after contact. 75% of the population is effected by contact with urushiol, although immunity to urushiol today does not assure immunity tomorrow, and vice versa. Rash symptoms can appear within a few hours but can take two to five days to appear. The rash starts as a red, annoyingly itchy area that starts to swell. The area then gets inflamed and will get covered in clusters of tiny pimples, the pimple eventually merge and turn into blisters. The fluid in the blisters turns yellow, dries up, and becomes crusty. Left completely untreated, this cycle can last as short as five days and in severe cases as long as five to six weeks.

If you come in contact with poison ivy, oak or sumac, or a animal exposed to any of these, or tools, gear, or clothing exposed to any of these, you should wash off with hot water (not so hot that it burns) and strong soap as soon as possible. If you can get washed up in the first six hours, before the first symptoms appear, you have a good chance of avoiding an out break, and an even better chance of minimizing the effects if you do have one.

4.6.4 Snakes

Hazards – The possibility of encountering snakes exists, specifically for personnel working in wooded or vegetated areas. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include:

- Neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties;
- Cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs;
- Defects in coagulation; and
- Effects from local release of substances by enzymatic actions.

Other noticeable effects of venomous snakebites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

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

4.6.5 Spiders

Hazards – Personnel may encounter spiders during work activities. Two spiders of concern are the black widow and the brown recluse. Both prefer dark sheltered areas such as basements, equipment sheds and enclosures, and around woodpiles or other scattered debris. The black widow is shiny black, approximately 1-inch long, and found throughout the United States. There is a distinctive red hourglass marking on the underside of the black widow's body. The bite of a black widow is seldom fatal to healthy adults, but effects include respiratory distress, nausea, vomiting, and muscle spasms. The brown recluse is smaller than the black widow and gets its name from its brown coloring and behavior. The brown recluse is more prevalent in the Southern United States. The brown recluse has a distinctive violin shape on the top of its body. The bite of the brown recluse is painful, and the bite site ulcerates and takes many weeks to heal completely.

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

4.7 Noise

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

Control - All personnel must wear hearing protection, with a Noise Reduction Rating (NRR) of at least 20, when noise levels exceed 85 dBA. When it is difficult to hear a co-worker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss. Noise monitoring is discussed in Section 6.2, Noise Monitoring.

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

4.8 Spill Control

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

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

4.9 Sanitation

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

4.9.1 Break Area

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

4.9.2 Potable Water

The following rules apply to all field operations:

- An adequate supply of potable water will be provided at each project site. Potable water must be kept away from hazardous materials or media, and contaminated clothing or equipment;
- Portable containers used to dispense drinking water must be capable of being tightly closed, and must be equipped with a tap dispenser. Water must not be consumed directly from the container (drinking from the tap is prohibited) nor may it be removed from the container by dipping; and

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

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

4.9.3 Sanitary Facilities

Access to facilities for washing before eating, drinking, or smoking, or alternate methods such as waterless hand-cleaner and paper towels will be provided.

4.9.4 Lavatory

If permanent toilet facilities are not available, an appropriate number of portable chemical toilets will be provided.

This requirement does not apply to mobile crews or to normally unattended site locations so long as employees at these locations have transportation immediately available to nearby toilet facilities.

4.10 Emergency Equipment

Adequate emergency equipment for the activities being conducted on site and as required by applicable sections of 29 CFR 1910 and 29 CFR 1926 will be on site prior to the commencement of project activities. Personnel will be provided with access to emergency equipment, including, but not limited to, the following:

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

4.11 Lockout/Tagout Procedures

Only fully qualified and trained personnel will perform maintenance procedures. Before maintenance begins, lockout/tagout procedures per OSHA 29 CFR 1910.147 will be followed.

Lockout is the placement of a device that uses a positive means, such as lock, to hold an energy or material-isolating device such that the equipment cannot be operated until the lockout device is removed. If a device cannot be locked out, a tagout system shall be used. Tagout is the placement of a warning tag on an energy or material isolating device indicating that the equipment controls may not be operated until the tag is removed by the personnel who attached the tag. Hazardous energy control forms are located at Attachment H.

4.12 Electrical Safety

Electricity may pose a particular hazard to site workers due to the use of portable electrical equipment. If wiring or other electrical work is needed, a qualified electrician must perform it.

General electrical safety requirements include:

- All electrical wiring and equipment must be a type listed by Underwriters Laboratories (UL), Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency;
- All installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or USCG regulations;
- Portable and semi-portable tools and equipment must be grounded by a multi-conductor cord having an identified grounding conductor and a multi-contact polarized plug-in receptacle;
- Tools protected by an approved system of double insulation, or its equivalent, need not be grounded. Double insulated tools must be distinctly marked and listed by UL or FM;
- Live parts of wiring or equipment must be guarded to prevent persons or objects from touching them;
- Electric wire or flexible cord passing through work areas must be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching;
- All circuits must be protected from overload;
- Temporary power lines, switchboxes, receptacle boxes, metal cabinets, and enclosures around equipment must be marked to indicate the maximum operating voltage;
- Plugs and receptacles must be kept out of water unless of an approved submersible construction;
- All extension cord outlets must be equipped with ground fault circuit interrupters (GFCI);
- Attachment plugs or other connectors must be equipped with a cord grip and be constructed to endure rough treatment;
- Extension cords or cables must be inspected prior to each use, and replaced if worn or damaged. Cords and cables must not be fastened with staples, hung from nails, or suspended by bare wire; and
- Flexible cords must be used only in continuous lengths without splice, with the exception of molded or vulcanized splices made by a qualified electrician.

4.13 Lifting Safety

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

- Consider the size, shape, and weight of the object to be lifted. A mechanical lifting device or additional persons must be used to lift an object if it cannot be lifted safely alone;
- *The hands and the object should be free of dirt or grease that could prevent a firm grip;*
- Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, or rough or slippery surfaces;

- Fingers must be kept away from points that could crush or pinch them, especially when putting an object down;
- Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear;
- The load should be kept as low as possible, close to the body with the knees bent;
- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible;
- A worker should not carry a load that he or she cannot see around or over; and
- When putting an object down, the stance and position are identical to that for lifting; the legs are bent at the knees, and the back is straight as the object is lowered.

4.14 Elevated Work Safety

During the course of this project personnel may be exposed to the hazards of working at heights (ladders, scaffolding, roofing work, etc.). The following sections of 29 CFR 1926 are applicable to the elevated work on this project:

- Subpart L, Scaffolds;
- Subpart M, Fall Protection; and
- Subpart X Ladders.

All elevated work will be performed in a safe manner and in compliance with all regulations governing such work, and the requirements of this HASP. All personnel exposed to fall hazards shall be trained regarding the nature of the hazards of elevated work prior to assignment.

4.14.1.1 Fall Protection

All personnel exposed to fall hazards greater than 6 feet shall be protected from the hazard by a fall protection system.

Fall protection systems shall comply with the guidelines established in 29 CFR 1926 Subpart M, Fall Protection and the BBL Fall Protection SOP located at Attachment I.

All personnel exposed to fall hazards shall be trained by a competent person in the following areas:

- The nature of fall hazards in the work area;
- The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used and the employees roles and responsibilities associated with the systems;
- The use and operation of the fall protection systems to be used;

- The correct procedures for the handling and storage of materials and equipment and the erection of overhead protection; and

- The fall protection standards contained in 29 CFR 1926 Subpart M, Fall Protection.

Written certification of fall protection training for personnel exposed to fall hazards shall be maintained by each contractor, and must be made available to the SS upon request.

4.14.1.2 Aerial Lifts

Only trained and authorized personnel shall operate aerial lifts.

The operator shall be trained on the same model of aerial lift as the one to be used during actual work site operations. Under the direction of a qualified person, the trainee shall operate the aerial lift for a sufficient period of time to demonstrate proficiency and knowledge.

Aerial lifts shall be inspected at least daily prior to operation. The inspection should include, but not be limited to, the following:

- Operating and emergency controls;

- Safety devices;

- Personal protective devices, including fall protection;

- Air, hydraulic, and fuel systems for leaks;

- Cables and wiring harness;

- Loose or missing parts;

- Tires, and wheels;

- Placards, warnings, control markings; and operating and safety manual(s);

- Outriggers, stabilizers, extendible axles and other structures;

- Guardrail system; and

- Other items specified by the manufacturer.

Personnel shall maintain a firm footing on the platform floor. Personnel shall not climb on the guardrails of the aerial platform to gain additional height or reach. Additionally, the use of ladders, planks, buckets, and other makeshift devices to gain additional height or reach is prohibited.

Aerial platforms shall not be driven in an elevated position unless designed to do so.

Only trained personnel shall make repairs to aerial lifts.

Personnel working from boom type aerial lifts shall be protected from falling by the use of a safety harness and lanyard properly attached to a manufacturers approved tie off point.

Before the aerial lift is used, the operator shall check the work area for possible hazards such as, but not limited to: holes, bumps or obstacles, debris, overhead obstructions, inadequate surface and support (soft soils), and wind and weather conditions.

Prior to each lift, the operator shall ensure the following:

- All personnel in the platform are wearing the required fall protection equipment and are secured to manufacturer's approved tie off locations;
- Outriggers or extendible axles, if so equipped, are used as required by the manufacturer;
- Guardrails are installed and the access gate is closed;
- The load and the distribution of the load are in accordance with manufacturer's recommendations; and
- There is adequate clearance from overhead obstructions.

If an aerial lift is used in the vicinity of overhead power lines, the lines must be de-energized, or the equipment must be positioned such that no part of the aerial platform or personnel on the platform can come within the minimum clearances as follows:

Table 7
Minimum Overhead Electrical Clearances (Aerial Lifts)

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

Prior to demolition activities, a safety meeting will be held to discuss anticipated hazards and control measures.

Overhead Hazards

During demolition activities, there is a potential for loose material, hand tools, and/or other debris to fall into the area below the personnel platform basket. A demarcated "safety zone" will be established around the perimeter of the stack and maintained during demolition activities. Entry into this zone will not be permitted during active demolition of elevated portions of the stack. The "safety zone" will be large enough to mitigate a potential for injury to on-site personnel in the event of falling debris or tools. In addition, all personnel working on the site will be required to wear an approved hard hat.

4.14.1.3 Scaffolds

Scaffolds shall only be erected, moved, or dismantled under the direction and supervision of a competent person who is experienced in scaffold erection, dismantling, or moving. Only trained and experienced personnel selected by the competent person shall perform such work.

Scaffolds shall be inspected prior to use each day and frequently throughout the work shift by a competent person.

Guard rails and toeboards shall be installed on all open sides and ends of scaffold platforms that are greater than 6 feet in height.

Footing for scaffolding shall be sound and capable of withstanding the load imposed.

All frame-type scaffolds shall rest on base plates and mudsills.

Blocks, barrels, buckets, boxes and other unstable items shall not be used to support scaffolds.

Scaffold platforms shall be fully planked, and the planks shall overlap a minimum of 12 inches or be secured to prevent movement.

An access ladder is required for all scaffolds. Climbing of crossbraces is prohibited.

Personnel working on scaffolds shall be trained in the following subject areas at a minimum:

- The nature of fall hazards, electrical hazards, and falling object hazards in the work area;
- The correct procedures for dealing with electrical hazards, and for erecting, dismantling, and maintaining the fall protection and overhead protection systems to be used;
- The proper use of the scaffold and the handling of material and equipment on the scaffold;
- The load capacities of the scaffold; and
- Applicable sections of 29 CFR 1926 Subpart L, Scaffolds.

In addition to the above training, all personnel involved in the erection, moving, and dismantling of scaffolds must be trained by a competent person in the following areas:

- The correct procedures for erecting, dismantling, moving, operating, inspecting, and maintaining the scaffold being used; and
- The design criteria, maximum load carrying capacity, and intended use of the scaffold.

4.14.1.4 Ladders

When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least 3 feet (9 m) above the upper landing surface to which the ladder is used to gain access; or, when such an extension

is not possible because of the ladder's length, then the ladder shall be secured at its top to a rigid support that will not deflect, and a grasping device, such as a grabrail, shall be provided to assist employees in mounting and dismounting the ladder. In no case shall the extension be such that ladder deflection under a load would, by itself, cause the ladder to slip off its support.

Ladders shall be maintained free of oil, grease, and other slipping hazards.

Ladders shall not be loaded beyond the maximum intended load for which they were built, nor beyond their manufacturer's rated capacity.

Ladders shall be used only for the purpose for which they were designed.

Non-self-supporting ladders shall be used at an angle such that the horizontal distance from the top support to the foot of the ladder is approximately one-quarter of the working length of the ladder (the distance along the ladder between the foot and the top support).

Wood job-made ladders with spliced side rails shall be used at an angle such that the horizontal distance is one-eighth the working length of the ladder.

Fixed ladders shall be used at a pitch no greater than 90 degrees from the horizontal, as measured to the back side of the ladder.

Ladders shall be used only on stable and level surfaces unless secured to prevent accidental displacement.

Ladders shall not be used on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental displacement. Slip-resistant feet shall not be used as a substitute for care in placing, lashing, or holding a ladder that is used upon slippery surfaces, including, but not limited to, flat metal or concrete surfaces that are constructed so they cannot be prevented from becoming slippery.

Ladders placed in any location where they can be displaced by workplace activities or traffic, such as in passageways, doorways, or driveways, shall be secured to prevent accidental displacement, or a barricade shall be used to keep the activities or traffic away from the ladder.

The area around the top and bottom of ladders shall be kept clear.

The top of a non-self-supporting ladder shall be placed with the two rails supported equally unless it is equipped with a single support attachment.

Ladders shall not be moved, shifted, or extended while occupied.

Ladders shall have non-conductive siderails if they are used where the employee or the ladder could contact exposed energized electrical equipment.

Personnel using a stepladder shall not stand or sit on the top, top step, or any step labeled that it or any step above it not be used as a step.

Cross-bracing on the rear section of stepladders shall not be used for climbing unless the ladders are designed and provided with steps for climbing on both front and rear sections.

Ladders shall be inspected by the HSS for visible defects on a daily basis and after any occurrence that could affect their safe use.

Portable ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps; broken or split rails; corroded components; or other faulty or defective components shall either be immediately marked in a manner that readily identifies them as defective, or be tagged with "Do Not Use" or similar language, and shall be withdrawn from service.

Fixed ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps; broken or split rails; or corroded components; shall be withdrawn from service.

Ladder repairs shall restore the ladder to a condition meeting its original design criteria, before the ladder is returned to use.

Single-rail ladders shall not be used.

When ascending or descending a ladder, the user shall face the ladder.

Each employee shall use at least one hand to grasp the ladder when progressing up and/or down the ladder.

An employee shall not carry any object or load that could cause the employee to lose balance and fall.

4.15 Heavy Equipment Materials Handling

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

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

4.15.1 Audible Alarms

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

- An automatic backup audible alarm which would sound immediately on backing, or
- An automatic braking device at the rear of the vehicle that will apply the service brake immediately on contact with any obstruction to the rear, or
- In lieu of the above requirements, administrative controls shall be established such as:
  - A spotter or flagger in clear view of the operator who shall direct the backing operation,
  - Other procedures which will require the operator to dismount and circle the vehicle immediately prior to starting a backup operation, or
  - Prohibiting all foot traffic in the work area, or
  - Other means shall be provided that will furnish safety equivalent to the foregoing for personnel working in the area.

The operator of all vehicles shall not leave the controls of the vehicle while it is moving under its own engine power. Hauling or earth moving operations shall be controlled in such a manner as to ensure that equipment or vehicle operators know of the presence of other personnel in the areas of their operations.

4.15.2 Equipment Inspection and Maintenance

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

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

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

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

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

4.15.3 Equipment Parking and Loading

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

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

4.15.4 Equipment Fueling

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

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

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

4.15.5 Flaggers

Flaggers shall be utilized at locations on a construction site where barricades and warning signs cannot control the moving traffic. When flaggers are required, they shall be placed in relation to the equipment or operation so as to give effective warning. Placement of warning signs shall be according to the State Department of Transportation (DOT).

Flaggers shall wear orange warning garments such as vests, jackets, or shirts. Rainwear, when worn, shall be orange, or other color provided an orange outer warning garment is worn. During the hours of darkness, flaggers' stations shall be illuminated such that the flagger will be clearly visible to approaching traffic and flaggers shall be outfitted with reflective garments. The retro reflective material shall be either orange, white (including silver-coated reflecting coatings or elements that reflect white light), yellow, fluorescent red-orange, or fluorescent yellow-orange.

Flaggers shall be trained in the proper fundamentals of flagging moving traffic before being assigned as flaggers. Signaling directions used by flaggers shall conform to the DOT standards.

4.15.6 Additional Safety Requirements

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

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

- Prior to operating any heavy equipment, the authorized operator must conduct a pre-operation inspection to determine if the heavy equipment is in safe operating condition prior to each work shift;
- All mobile equipment shall be equipped with an audible back-up alarm;
- Personnel will not be allowed to stand or pass under the elevated portion of any heavy equipment, whether loaded or empty;
- Personnel will not place arms and legs between pinch or scissor points of the equipment or outside the operator enclosure;
- A safe distance shall be maintained from the edge of excavations, ditches, ramps, or platforms;
- Operators will maintain sufficient clearance under overhead utilities, installations, lights, pipes, etc.;
- Heavy equipment must never be used for lifting or transporting personnel;
- The operator is required to look in the direction of, and maintain a clear view of the path of travel;
- Heavy equipment shall not be operated without an overhead guard and roll-over protection to protect the operator against falling objects and equipment roll-over;
- Heavy equipment must not be driven up to anyone standing in front of any object;
- Stunt driving and horseplay are strictly prohibited;
- Operators will yield the right-of-way to other site vehicles;
- Other heavy equipment traveling in the same direction, at intersections, blind spots, or other dangerous locations must not be passed;
- A safe distance must be maintained from other heavy equipment, and the equipment must be kept under control at all times;
- The heavy equipment operator must slow down for wet and slippery conditions. Under all travel conditions the equipment will be operated at a speed that will permit it to be brought to a stop in a safe manner;
- Operators will avoid running over loose objects on operating surfaces;

- Grades and ramps must be ascended and descended slowly;
- On all grades, the load will be tilted back, and raised only as far as necessary to clear the operating surface;
- The operator will slow down and sound the horn at intersections, when entering buildings, and other locations where vision may be obstructed;
- If the load being carried obstructs forward view, the operator will travel with the load trailing;
- While negotiating turns, speed will be reduced to a safe rate, and turning will be in a smooth, sweeping motion to avoid abrupt turns and potential equipment or load upset; and
- Authorized operators will only handle stable or safely arranged loads that are within the rated capacity of the heavy equipment and will not affect the stability of the heavy equipment.

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

4.16 Hot Work Safety Program

The purpose of the Hot Work Safety Program is to protect all personnel from hazards associated with activities producing sparks, flames, or other ignition sources, and to prevent the loss of property due to fire. To effectively comply with the provisions of the OSHA standards governing fire prevention and hot work activities, the Hot Work Safety Program establishes procedures to ensure that physical and chemical fire hazards present in the workplace are isolated from hot work activities. The Hot Work Safety Program is applicable to all welding, cutting, burning, grinding, and other spark producing work activities. Contractors may utilize their own hot work safety procedures as long as the requirements of this section are met.

4.16.1 Designated Hot Work Areas

Contractors may establish designated hot work areas at the project site. Hot work conducted within a designated hot work area does not require a work permit. Designated hot work areas must be delineated, and all project site personnel informed of their location.

All project site personnel are responsible for keeping flammable and combustible materials out of designated hot work areas. All hot work conducted outside of designated hot work areas requires a hot work permit.

4.16.2 Conditions Prohibiting Hot Work

Hot work activities are prohibited in any area of the project site where the following conditions exist:

- If the requirements of the hot work permit cannot be met, then the hot work is prohibited and alternative methods shall be employed;
- If areas potentially containing explosive atmospheres due to the presence of flammable gases, vapors, liquids, or dusts; and

- Within 50 feet of an area where flammable or combustible liquids or gases are used or stored.

Hot work activities shall not be conducted within the areas outlined above. All on-site personnel are responsible for preventing hot work activities within prohibited areas. Additionally, no hot work will be conducted on any surface covered with a protective coating whose flammability is not known. Employees conducting hot work activities on toxic preservative coatings shall wear appropriate respiratory protection and the preservative coatings shall be removed a sufficient distance from the area to be heated.

4.16.3 Hot Work Permits

A hot work permit is required for welding, cutting, burning, grinding, or spark producing work conducted outside of designated hot work areas. This section outlines the preparation, issuance, use, and tracking of hot work permits. Contractors may utilize their own hot work permits if they meet the requirements of this section. This procedure has been developed to ensure basic precautions for fire prevention and employee safety are implemented prior to and during hot work activities outside of designated hot work areas. The hot work permit (see Attachment B) contains a checklist to be completed by the authorized personnel conducting the hot work activities. The hot work permit must be reviewed by the SS and the HSS prior to the start of hot work activities. The checklist is designed to ensure the following measures are addressed.

If possible, the object or equipment on which the hot work is to be conducted shall be moved to a designated hot work area.

If an object or equipment on which hot work is to be conducted cannot be moved, all moveable fire hazards shall be moved at least 50 feet from the hot work operation.

If an object or equipment on which hot work is to be conducted cannot be moved, or all fire hazards cannot be removed, then guards, barriers, or screens shall be used to confine any heat, sparks, and slag, and to protect the immovable fire hazards.

All floor, wall, and window openings or cracks within a 35-foot radius shall be protected to prevent exposure of combustible material to heat, sparks, or slag.

Suitable fire fighting equipment shall be on-hand for immediate use.

If hot work takes place in an area where flying sparks and slag may injure personnel working near, above, or below the hot work operation, then additional precautions shall be implemented to prevent injury to the personnel (i.e. screens, barriers, caution tape, PPE, etc.).

A fire watch will begin before hot work is initiated and will continue during and for a minimum of 30 minutes after the hot work concludes to ensure that there are no smoldering fires. A fire watch is required whenever hot work is performed outside of designated hot work areas.

Verify that flammable and combustible materials adjacent to the opposite side of metal partitions, walls, ceilings, or roofs which are likely to be ignited by conduction or radiation are protected by guards, barriers, screens, or are moved 50 feet away from the metal partitions, walls, ceilings, or roofs.

If hot work is to be conducted in a confined space, the requirements for the confined space entry must be reviewed and followed.

Hot work will not be performed in areas where other workers may be affected unless adequate engineering or administrative controls are used to prevent personnel exposure.

Welding, cutting, and other hot work will not be undertaken unless adequate ventilation, PPE, and well maintained equipment are used by trained and authorized personnel.

After welding and cutting has been completed, the area will be thoroughly cleaned, and equipment returned to its proper location.

All personnel involved in hot work activities shall use appropriate PPE.

If any of the basic requirements for fire prevention cannot be implemented prior to or during hot work which is conducted outside a designated hot work area, then the hot work activities will not be conducted. At the conclusion of the hot work activities, the hot work permit will be provided to the contractor's HSS for recordkeeping.

4.16.4 Fire Watch Procedures

A fire watch is required whenever hot work is performed outside designated hot work areas. Fire watch personnel are required to meet the following requirements.

Fire watch personnel must have fire-extinguishing equipment readily available and ready for immediate use.

Fire watch personnel must be trained in the use of the fire fighting equipment provided.

Fire watch personnel must be familiar with the procedure to sound the fire alarm in the event of a fire and know the location of the nearest telephone.

All fire watch personnel shall use appropriate PPE.

Fire watch personnel must watch for fires, try to extinguish them if safe to do so, or otherwise activate the fire alarm system.

If a fire cannot be extinguished with one fire extinguisher, the area shall be evacuated, the fire alarm system shall be activated, and the appropriate professional fire fighting organization contacted.

Fire watch personnel must maintain a fire watch for at least 30 minutes after the hot work operations are completed.

If any of the above requirements cannot be met, hot work shall not be conducted.

4.17 Confined Space Entry

A confined space is defined as a space large enough and so configured that an employee can bodily enter and perform assigned work, has limited means for entry or exit, and is not designed for continuous employee occupancy. Some confined space work may pose additional hazards such as air contamination, flammable or

explosive atmosphere, and oxygen deficiency. Confined space entry may pose the possibility of engulfment. Personnel must be properly trained in order to supervise and participate in confined space entry procedures or serve as standby attendants.

All confined spaces are initially considered permit-required confined spaces (permit spaces). A Confined Space Entry Permit is located at Attachment K.

Identification - The BBLES SS/HSS is responsible to identify all confined spaces into which BBLES employees or subcontractors will enter. Entry is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space. The client is responsible to identify and provide information as to contents, expected atmosphere, and rescue procedures for all confined spaces on his/her property. If a space is not considered permit required by the client but meets the criteria of this procedure, it shall be considered permit required for BBLES-managed entry. If a space does not meet the criteria in this procedure but is considered permit-required by the client, it will be considered a permit-required confined space by BBLES. Confined Space entry will be conducted in accordance with 29 CFR 1910.146 Permit Required Confined Spaces and BBLES/BBLES Confined Space Entry SOP.

The permit spaces to be entered on this project may include but are not limited to: sewer system manholes, catch basins, troughs, sumps, enclosures/pits, outfalls, drains, vessels, and tanks.

4.17.1 Duties of Personnel

Each confined space being entered shall have a minimum of one dedicated attendant and one other support person (who may have other duties) within sight or call.

4.17.1.1 Duties of Entrants

Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

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

Alert the attendant whenever:

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

Exit from the permit space as quickly as possible whenever:

- An order to evacuate is given by the attendant or the entry supervisor;
- The entrant recognizes any warning sign or symptom of exposure to a dangerous situation;
- The entrant detects a prohibited condition; or
- An evacuation alarm is activated.

4.17.1.2 Duties of Attendants

Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

Is aware of possible behavioral effects of hazard exposure in authorized entrants.

Continuously maintains an accurate count of authorized entrants in the permit space and accurately identifies who is in the permit space by tagging the lifelines with the entrant's name, and recording the names of the entrants.

Remains outside the permit space during entry operations until relieved by another attendant.

Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space.

Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions:

- If the attendant detects a prohibited condition;
- If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;
- If the attendant detects a situation outside the space that could endanger the authorized entrants; or
- If the attendant cannot effectively and safely perform all his duties.

Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards.

Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

- Warn the unauthorized persons that they must stay away from the permit space;
- Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and
- Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.

Performs non-entry rescues.

Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

4.17.1.3 Duties of Entry Supervisors

Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.

Terminates the entry and cancels the permit as required.

Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations.

Determines that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

Documents on the entry permit any incidents or circumstances requiring review of the confined space entry program. Such incidents include:

- Unauthorized entry;
- The detection of a condition/hazard not authorized by the permit;
- The occurrence of an injury or near-miss during entry;
- A change in use or configuration of the space; or
- Employee complaints about the program.

Prescribes procedures for coordination of entry when personnel from multiple employers will work simultaneously. Subcontractors shall follow all confined space entry procedures.

4.17.2 Procedures for Permit Space Entry

Acceptable Entry Conditions - The acceptable entry conditions for entry into each space are outlined in the following table.

Isolation Requirements - The confined space must be isolated to prevent the introduction of contaminants during entry. If complete isolation is not practical or possible, entry conditions must be continuously monitored. Procedures for isolating hazardous energy sources will comply with 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tagout) and BBLES/BBLES Policy and Procedure Memo.1.02.12, Lockout/Tagout Control of Hazardous Energy/Materials.

Atmospheric Hazard Control - Atmospheric hazards must be eliminated or controlled to meet the requirements specified in the following table. If necessary, the space shall be purged or made inert, then ventilated. Ventilation equipment may be needed to maintain these conditions.

Table 8
Acceptable Entry Conditions for Confined Spaces

Airborne Contaminant Entry Conditions and Action Levels		
Parameter	**Reading**	**Action/Level of Protection**
Total Organic Vapors	< 5 parts per million (ppm)	Acceptable Normal operations;
	≥ 5 ppm	Stop work; evacuate confined space and investigate cause of reading
Flammable Vapors (LEL)	< 10% LEL	Normal operations, acceptable entry condition
	≥ 10% LEL	Stop work; evacuate confined space; ventilate area; investigate source of vapors
Hydrogen Sulfide	< 5 ppm	Normal operations, acceptable entry condition
	≥ 5 ppm	Stop work; evacuate confined space; ventilate area; investigate source of vapors
Carbon Monoxide	< 25 ppm	Normal operations, acceptable entry condition
	≥ 25 ppm	Stop work; evacuate confined space; ventilate area; investigate source of vapors
Oxygen	> 19.5%, < 23.5%	Acceptable Entry Condition, Normal Operations
	< 19.5%, > 23.5%	Stop work; evacuate confined space; ventilate; re-sample

Inspecting and Testing Procedures - The following equipment shall be available for testing each confined space:

- Multi RAE instrument (our equivalent) with PID, Oxygen, LEL, CO, and Hydrogen sulfide sensors.

All equipment shall be maintained in such quantity and condition, per manufacturer recommendations, to adequately monitor and assess all confined space entries.

Testing Procedures - Procedures for inspecting, monitoring and testing the confined space to verify that acceptable conditions exist prior to and throughout the entry operation are as follows:

Permit required confined spaces shall be tested continuously to detect changes in atmospheric conditions. Priority for atmospheric hazard testing shall be oxygen, combustible gases, and then toxic gases.

Communications - Provisions for continuous communication between entrants and attendants shall consist of powered communication equipment (i.e. radio). Powered communication equipment with the appropriate NEC rating shall be provided. If this is not practical or possible, portable air horns must be provided to all entrants and attendants. The code for air horn blasts is as follows:

- 1 Horn Blast = Are you OK?
- 2 Horn Blasts = Yes, I am OK.
- 3 Horn Blasts = Exit the confined space immediately.

Personal Protective Equipment - (see Section 5, Personal Protective Equipment, for additional PPE requirements):

- Protective suits, boots, and gloves;
- Face, head, and foot protection; and
- A chest or parachute harness with approved lifelines at least ½ inch in diameter and 2,000 pounds test. (NOTE: Wristlets may be used only when a harness presents a greater hazard to the employee and wristlets are the safest, most effective alternative). All lifelines shall be secured to a mechanical device or fixed point outside the confined space. Mechanical devices shall be used for all vertical entry permit spaces greater than five feet deep.

Other Required Equipment - Lighting and electrical shall be of the appropriate National Electrical Code (NEC) rating. Rating should be Class I, Division I unless the space specifically meets other rating requirements.

Ingress and Egress Equipment - Protective barriers to be used to protect entrants from external pedestrian, vehicle or equipment hazards. Ladders shall meet the requirements of 29 CFR 1926 Subpart X, Ladders.

Rescue Equipment - All lifelines must be attached to a mechanical device outside the space such that a rescue can begin as soon as the rescuer becomes aware that a rescue is necessary. A mechanical device must be attached to entrant in order to retrieve personnel from vertical type permit spaces more than 5 feet deep.

Permit System - Before entry is authorized, the contractor's Entry Supervisor shall complete and sign the contractor's entry permit according to their written confined space program and document that all pre-entry requirements have been met and that acceptable entry conditions exist. The complete permit shall be posted at the primary entrance to the permit space. See Attachment K for a copy of the permit.

All Entry Permits are valid for a maximum of one work shift, and shall be canceled by the Entry Supervisor when the shift ends, confined space operations are complete, or whenever a prohibited condition arises in or near the space. All confined spaces shall be securely closed or barricaded whenever the entry permit is canceled. Each contractor's Entry Permit must be completely executed and include all required information.

Emergency Procedures - The SS/HSS or client shall arrange for outside rescue services. The rescue personnel must be offered an opportunity to inspect the space, and practice a rescue if necessary. The means for summoning rescue services must be clearly communicated and documented on the contractor's entry permit.

4.17.3 Training

General - Prior to assignment to confined space entry work, all employees shall receive training in the hazards of confined spaces, work practices to control these hazards, and duties to be performed. Employee proficiency shall be established by testing and/or practical demonstration.

Requirements for Entrants, Attendants, and Supervisors - Basic training requirements for entrants and attendants shall include Confined Space Entry Entrant/Attendant training, and 40-hour HAZWOPER training or equivalent if required.

Basic training for entry supervisors and personnel conducting atmospheric testing shall include 8-hour supervisor training and Confined Space Entry Training.

Personnel assigned to attendant duties shall be trained in non-entry rescue procedures.

Requirements for Emergency Rescue Personnel - The HSS or client must coordinate rescue services by identifying a rescue entity, and contacting them to inform them that an entry will take place. Personnel assigned to provide emergency entry and rescue services shall be trained annually in the proper use of personal protective and rescue equipment. Such training shall include a simulated rescue exercise at least once every 12 months. In addition, rescue personnel shall be trained in the hazards and proper work practices for handling blood or other potentially infectious materials.

4.18 Crane Hazards and Control Procedures

Hazards - The primary physical hazards for this activity are associated with the use of the crane and associated rigging equipment. There exists a potential for incidents involving personnel being struck by or struck against the crane or materials, resulting in fractures, cuts, punctures, or abrasions. Crane operation may present noise hazards, vibration hazards, and a potential for contact with moving parts or hot surfaces to crane operators. Crane accidents can occur as a result of improperly placing the rig on uneven or unstable terrain, or failing to adequately secure the load prior to the start of lifting operations. Overhead utility lines can create hazardous conditions if contacted by the crane or any part of the load being lifted. Rigging equipment such as slings, chokers, wire rope, and hooks have the potential for striking personnel, resulting in fractures, lacerations, punctures, or abrasions.

Control - Only trained and authorized personnel shall operate cranes or provide hand signals to the crane operator. All crane operators must possess any required state or local licenses to perform such work. All members of the lifting crew including the signaler, shall receive site-specific training prior to beginning work.

The crane operator is responsible for the safe operation of the equipment, as well as the crew's adherence to the requirements of this HASP. The crane operator must ensure that all safety equipment is in proper condition and is properly used. The members of the crew must follow all instructions of the crane operator, wear all PPE, and be aware of all hazards and control procedures. The lifting crew must participate in the Daily Safety Meetings and be aware of all emergency procedures.

All manufacturer's instructions, specifications, and limitations applicable to the operation of the crane must be followed. Deviations from manufacturer's guidance documentation must be approved in writing by the manufacturer.

Any attachments used with the crane shall not exceed the capacity, rating, or scope recommended by the manufacturer.

Rated load capacities, recommended operating speeds, special hazard warnings or instruction, shall be conspicuously posted on all equipment. Instructions or warnings shall be visible to operators while they are at their control stations.

Hand signals to the crane operator shall be those prescribed by the applicable American National Standards Institute (ANSI) standard for the type of crane in use. An illustration of the signals must be posted at the job site.

A competent person, designated by the crane/rigging contractor, must inspect all machinery and equipment prior to each use, and during use, to make sure it is in safe operating condition. Any deficiencies must be repaired, or defective parts replaced, before continued use.

A thorough, annual inspection of the hoisting machinery shall be made by a competent person. The crane/rigging contractor must maintain a record of the dates and results of inspections for each hoisting machine and piece of equipment.

Wire rope shall be taken out of service when any of the following conditions exist:

- In running ropes, six randomly distributed broken wires in one lay or three broken wires in one strand in one lay;
- Wear of one-third the original diameter of outside individual wires;
- Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure;
- Evidence of any heat damage from any cause;
- Reductions from nominal diameter of more than one-sixty-fourth inch for diameters up to and including five-sixteenths inch, one-thirty-second inch for diameters three-eighths inch to and including one-half inch, three-sixty-fourths inch for diameters nine-sixteenths inch to and including three-fourths inch, one-sixteenth inch for diameters seven-eighths inch to 1 inches inclusive, three-thirty-seconds inch for diameters 1¼ to 1½ inches inclusive; or
- In standing ropes, more than two broken wires in one lay in sections beyond end connections or more than one broken wire at an end connection.

Wire rope safety factors shall be in accordance with ANSI B30.5-1968 or SAE J959-1966.

Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or other moving parts or equipment shall be guarded if such parts are exposed to contact by employees, or otherwise create a hazard. Guarding shall meet the requirements of the ANSI B15.1-1958 Rev., Safety Code for Mechanical Power Transmission Apparatus.

All windows in cabs shall be of safety glass, or equivalent, with no visible distortion that will interfere with the safe operation of the machine.

Where necessary for rigging or service requirements, a ladder, or steps, shall be provided to give access to a cab roof. Guardrails, handholds, and steps shall be provided on cranes for easy access to the car and cab, conforming to ANSI B30.5.

Platforms and walkways shall have anti-skid surfaces.

An accessible fire extinguisher of 5BC rating, or higher, shall be available at all operator stations or cabs of equipment.

If crane operation or lifting activities are conducted in the vicinity of overhead power lines, the power to the lines must be de-energized, tested de-energized, marked up/guaranteed, and grounded or the equipment must be

positioned such that no part, including the boom, wire rope, or load can come within the minimum clearances as follows:

Table 9
Minimum Overhead Electrical Clearance (Cranes)

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

In addition to the above clearance requirements, equipment in use near power lines must operated in accordance with the following requirements:

- A person shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means;

- Cage-type boom guards, insulating links, or proximity warning devices may be used on cranes, but the use of such devices shall not alter the requirements of any other regulation of this part even if such device is required by law or regulation;

- Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded; and

- Prior to work near transmitter towers where an electrical charge can be induced in the equipment or materials being handled, the transmitter shall be de-energized or tests shall be made to determine if electrical charge is induced on the crane. The following precautions shall be taken when necessary to dissipate induced voltages:

  - The equipment shall be provided with an electrical ground directly to the upper rotating structure supporting the boom;

  - Ground jumper cables shall be attached to materials being handled by boom equipment when electrical charge is induced while working near energized transmitters. Crews shall be provided with nonconductive poles having large alligator clips or other similar protection to attach the ground cable to the load; and

  - Combustible and flammable materials shall be removed from the immediate area prior to operations.

No modifications or additions that affect the capacity or safe operation of the equipment shall be made by the crane/rigging contractor without the manufacturer's written approval. If such modifications or changes are made, the capacity, operation, and maintenance instruction plates, tags, or decals, shall be changed accordingly. In no case shall the original safety factor of the equipment be reduced.

All employees shall be kept clear of loads about to be lifted and of suspended loads.

4.19 Traffic Safety

The project site may be located adjacent to a public roadway where exposure to vehicular traffic is likely. Traffic may also be encountered as vehicles enter and exit the area. To minimize the likelihood of project personnel and activities being affected by traffic, the following procedures will be implemented.

Cones must be placed along the shoulder of the roadway starting 100 feet from the work area to alert passing motorists to the presence of personnel and equipment. A "Slow" or "Men Working" sign must be placed at the first cone. Barricades with flashing lights should be placed between the roadway and the work area.

During activities along a roadway, equipment will be aligned parallel to the roadway to the extent feasible, facing into the oncoming traffic so as to place a barrier between the work crew and the oncoming traffic. All crewmembers must remain behind the equipment and the traffic barrier.

All site personnel who are potentially exposed to vehicular traffic must wear an outer layer of orange warning garments, such as vests, jackets, or shirts. If work is performed in hours of dusk or darkness, workers will be outfitted with reflective garments either orange, white (including silver-coated reflective coatings or elements that reflect white light), yellow, fluorescent red-orange, or fluorescent yellow-orange.

The flow of traffic into and out of the adjacent business must be assessed, and precautions taken to warn motorists of the presence of workers and equipment. Where possible, vehicles should be aligned to provide physical protection of people and equipment.

5. Personal Protective Equipment

5.1 Levels of Protection

PPE is required to safeguard site personnel from various hazards. Varying levels of protection may be required depending on the levels of COC and the degree of physical hazard. This section presents the various levels of protection and defines the conditions of use for each level. The levels of protection in this section do not apply to asbestos abatement activities. Asbestos abatement personnel shall wear PPE as prescribed in the abatement company's HASP. A summary of the levels of protection is presented in Table 10 in this section.

5.1.1 Level D Protection

The minimum level of protection that is required of BBLES personnel and subcontractors at the site is Level D, which is worn when activities do not involve potential dermal contact with contaminants and air monitoring indicates that no inhalation hazard exists. Level D protection includes the following equipment:

- Work clothing as prescribed by weather;
- Steel-toe work boots, meeting ANSI Z41 (puncture resistant soles or insoles based upon JSA);
- Safety glasses with side shields or goggles, meeting ANSI Z87;
- Hard hat, meeting ANSI Z89, when falling object hazards are present;
- Reflective vest;
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used); and
- PFD if working on or near water.

5.1.2 Modified Level D Protection

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

- Nitrile outer gloves worn over nitrile surgical gloves;
- Latex or PVC overboots when contact with COC-impacted media is anticipated;
- Steel-toe work boots, meeting ANSI Z41;
- Safety glasses with side shields or goggles, meeting ANSI Z87;
- Face shield in addition to safety glasses or goggles when projectiles or splash hazards exist;
- Tyvek® or KleenGuard®coveralls when skin contact with COC-impacted media is anticipated;

- Hard hat, meeting ANSI Z89, when falling object hazards are present;
- Reflective vest;
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used); and
- PFD if working on or near water.

5.1.3 Level C Protection

Level C protection will be required when the airborne concentration of COCs reaches one-half of the OSHA Permissible Exposure Limit (PEL) or ACGIH TLV. The following equipment will be used for Level C protection:

- Full-face, National Institute for Occupational Safety and Health- (NIOSH-) approved, air-purifying respirator with combination organic vapor cartridges;
- Polyethylene-coated Tyvek® suit with ankles and cuffs taped to boots and gloves;
- Nitrile outer gloves worn over nitrile surgical gloves;
- Steel-toe work boots, meeting ANSI Z41;
- Chemical-resistant boots with steel toes, or latex or PVC overboots over steel-toe boots;
- Hard hat, meeting ANSI Z89;
- Reflective vest;
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used); and
- PFD if working on or near water.

5.2 Selection of PPE

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

5.3 Site Respiratory Protection Program

Respiratory protection is an integral part of employee health and safety at the site due to potentially hazardous concentrations of airborne COC. The site respiratory protection program will consist of the following (as a minimum):

- All on-site personnel who may use respiratory protection will have an assigned respirator;
- All on-site personnel who may use respiratory protection will have been fit tested and trained in the use of a full-face air-purifying respirator within the past 12 months;
- All on-site personnel who may use respiratory protection must within the past year have been medically certified as being capable of wearing a respirator. Documentation of the medical certification must be provided to the HSS, prior to commencement of site work;
- Only cleaned, maintained, NIOSH-approved respirators will be used;
- If respirators are used, the respirator cartridge is to be properly disposed of at the end of each work shift, or when load-up or breakthrough occurs;
- Contact lenses are not to be worn when a respirator is worn;
- All on-site personnel who may use respiratory protection must be clean-shaven. Mustaches and sideburns are permitted, but they must not touch the sealing surface of the respirator;
- Respirators will be inspected, and a negative pressure test performed prior to each use; and
- After each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag, away from direct sunlight in a clean, dry location, in a manner that will not distort the face piece.

5.4 Using PPE

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

5.4.1 Donning Procedures

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

- Remove bulky outerwear. Remove street clothes and store in clean location;
- Put on work clothes or coveralls;
- Put on the required chemical protective coveralls;
- Put on the required chemical protective boots or boot covers;
- Tape the legs of the coveralls to the boots with duct tape;
- Put on the required chemical protective gloves;

- Tape the wrists of the protective coveralls to the gloves;
- Don the required respirator and perform appropriate fit check (Level C);
- Put hood or head covering over head and respirator straps and tape hood to facepiece (Level C); and
- Don remaining PPE, such as safety glasses or goggles and hard hat.

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

5.4.2 Doffing Procedures

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

- Upon entering the CRZ, rinse contaminated materials from the boots or remove contaminated boot covers;
- Clean reusable protective equipment;
- Remove protective garments, equipment, and respirator (Level C). All disposable clothing should be placed in plastic bags, which are labeled with contaminated waste labels;
- Wash hands, face, and neck (or shower if necessary);
- Proceed to clean area and dress in clean clothing; and
- Clean and disinfect respirator for next use.

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

5.5 Selection Matrix

The level of personal protection selected will be based on air monitoring of the work environment and an assessment by the SS and HSS of the potential for skin contact with COC. The PPE selection matrix is presented in Table 10. This matrix is based on information available at the time this plan was written. The Airborne Contaminant Action Levels in Table 11 should be used to verify that the PPE prescribed in these matrices is appropriate.

TABLE 10
PPE SELECTION MATRIX

Task	Anticipated Level of Protection
Mobilization	Level D
Environmental Sampling	Level D/Modified Level D
Soil Excavation	Modified Level D/Level C
UST Removal	Modified Level D/Level C
Subsurface Structure Water/Debris Removal	Level D/Modified Level D
Slab Demolition Oversight	Level D/Modified Level D
Hot Work	Modified Level D/Level C
Decontamination	Modified Level D
Demobilization	Level D

6. Air Monitoring

6.1 Air Monitoring

Air monitoring will be conducted to determine BBL employee exposure based on the potential for generation of airborne constituents. The monitoring results will dictate work procedures and the selection of PPE. The monitoring devices to be used are an MIE Personal Data Ram 1000 particulate monitor (or equivalent) and a Rae Systems MultiRAE detector (PID with a 11.7 eV lamp/oxygen/LEL/Hydrogen Sulfide sensors). The BBL HSS will be responsible for utilizing the air monitoring results to determine appropriate health and safety precautions for BBL personnel.

Air monitoring will be conducted continuously with the LEL/O2/CO/H2S meter if flammable/explosive vapors are suspected. Prior to any subsurface activities, air monitoring will be conducted to establish background levels for total organic vapors (using a PID) and for dust particulate (using a PDR1000). During events involving intrusive activities, PID and dust measurements will be taken both in the worker breathing zone and at the downwind property boundaries. Airborne monitoring for particulate (dust) and VOCs will also be conducted during ground intrusive and demolition activities in accordance with the NYS Department of Health's Community Air Monitoring Program, dated June 2000.

Continuous real-time monitoring for organic vapors for the purpose of estimating BBL employee exposure level will be conducted in the breathing zone with the PID during field activities conducted during ground intrusive activities. If a reading above 1 ppm in the work zone persists for more than one minute, the air monitoring and corrective actions outlined in Table 11 will be implemented. During operations which may cause airborne particulate (soil excavation, sampling, soil boring installation), a portable dust monitor will be required to measure airborne concentrations of total particulate material. At a minimum, all readings will be manually recorded on an hourly basis on air monitoring logs (Attachment L) or field notebooks.

All work activity must stop where tests indicate the concentration of flammable vapors exceeds 10 percent of the Lower Explosive Limit (LEL) at a location with a potential ignition source. Such an area must be ventilated to reduce the concentration to an acceptable level.

6.2 Noise Monitoring

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

6.3 Monitoring Equipment Maintenance and Calibration

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

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

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

6.4 Action Levels

Table 11 presents airborne constituent action levels that will be used to determine the procedures and protective equipment necessary based on conditions as measured at the site.

6.5 Onsite Monitoring Plan and Response Activities

Soil will be disturbed as part of excavation activities. These activities have the potential to generate organic vapors and particulates. As mentioned above, air monitoring will be conducted in the worker breathing zone to determine the level of protection required for personnel observing intrusive work. If action levels in the worker breathing zone are exceeded for organic vapors or particulates, air monitoring will be required at various onsite/perimeter locations to determine appropriate response activities that are protective of personnel onsite who are not directly involved with the investigation, personnel at adjacent commercial sites, and the surrounding community. If action levels for the remaining monitoring parameters listed in Table 11 are exceeded, work will stop, the HSO will be contacted, and perimeter monitoring will be performed. Additional monitoring (and appropriate response activities) to be implemented if the total organic vapor and particulate levels in the worker breathing zone exceed action levels as discussed below.

Total Organic Vapors

If the sustained level of total organic vapors in the worker breathing zone exceeds 3 ppm above background, then the level of total organic vapors will be manually recorded at the downwind perimeter of the work area (i.e., exclusion zone) at 15 minute intervals. If the sustained level of total organic vapors at the downwind perimeter of the work area exceeds 3 ppm above background, then work activities will be halted and additional downwind monitoring will be performed. Efforts will be undertaken to mitigate the source of organic vapors. The exclusion zone will be enlarged, if necessary, to mitigate the potential for people who are not involved with the investigation from being exposed to organic vapor levels exceeding 3 ppm above background.

During the investigation, it is possible that the downwind perimeter of the work area will coincide with the site perimeter. If, at any time, the sustained level of total organic vapors adjacent to the downwind site perimeter reaches 3 ppm above background, then the level of total organic vapors adjacent to the nearest downwind occupied building or property from the work zone will be monitored. If after 30 minutes, the total organic vapor level adjacent to the nearest occupied building or property has not subsided below 3 ppm above background, then the HSS will inform the local emergency response contacts [in addition to project managers from Bayer, the NYSDEC, the New York State Department of Health (NYSDOH), and BBL] listed in Table 12 and persons who may be exposed will be notified to evacuate occupied buildings or properties. These persons will not be

permitted to return to the properties until after the level of total organic vapors on the properties subsides to below 3 ppm above background.

Particulates

If the level of particulates in the worker breathing zone exceeds .1 mg/m^3 above background for 1 minute, then the level of particulates will be manually recorded at the downwind perimeter of the work area at 15 minute intervals. **The PDR1000 must be set to alarm when the action level is exceeded.** If the level of particulates at the downwind perimeter of the work area is .150 mg/m^3 or greater, then work activities will cease and dust suppression techniques must be employed to maintain particulate levels below .15 mg/m^3. In addition, the exclusion zone will be enlarged if necessary to keep the public from being exposed to particulate levels greater than 150 μg/m^3.

6.6 Odor Control

If any odor complaints are received from members of the surrounding community and are related to the field investigation activities described herein, then the potentially odor-causing activity will be suspended, subsurface openings will be covered, and onsite personnel (in consultation with Bayer and BBL project managers) will evaluate an alternative course of action

TABLE 11
AIRBORNE CONSTITUENT ACTION LEVELS

Parameter	Reading in Breathing Zone (BZ)	Action
Total Organic Vapors	0 ppm to < 1 ppm	Normal operations; record breathing zone monitoring measurements every hour
	> 1 ppm to 5 ppm	Increase recording frequency to at least every 15 minutes and use benzene Drager tube to screen for the presence of benzene
	≥ 5 ppm to ≤ 25 ppm	Upgrade to level C PPE, continue screening for benzene
	>25 ppm	Stop work. Contact HSO.
Total Particulate (15 minute average readings taken **in the breathing zone, above background**)	0 to 0.100 mg/m^3 above background	Normal operations
	> 0.100 mg/m^3 above background	Initiate wetting of work area to control dust; upgrade to Level C if dust control measures do not control dust within 15 minutes, monitor downwind impacts.
	> 0.15 mg/m^3 in breathing zone or at downwind perimeter of work area	Stop work; investigate cause of reading; contact PM and HSO
Oxygen	≤ 19.5 %	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
	> 19.5% to < 23.5 %	Normal operations
	≥ 23.5 %	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO

Parameter	Reading in Breathing Zone (BZ)	Action
Carbon Monoxide	0 ppm to ≤ 20 ppm	Normal operations
	> 20 ppm	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
Hydrogen Sulfide	0 ppm to ≤ 5 ppm	Normal operations
	> 5 ppm	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
Flammable Vapors (LEL)	< 10% LEL	Normal operations
	≥ 10% LEL	Stop work; ventilate area; investigate source of vapors

Note:

If action levels in the worker breathing zone are exceeded for organic vapors or particulates, air monitoring will be required at various onsite/perimeter locations to determine appropriate response activities that are protective of personnel onsite who are not directly involved with the investigation, personnel at adjacent commercial sites, and the surrounding community, as detailed in Section 6.5 of this HASP.

7. Work Zones and Decontamination

7.1 Work Zones

7.1.1 Authorization to Enter

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

7.1.2 Site Orientation and Hazard Briefing

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

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

7.1.3 Certification Documents

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

7.1.4 Entry Log

A log-in/log-out sheet will be maintained at the site by the SS. Personnel must sign in and out on a log sheet as they enter and leave the work area, and the SS may document entry and exit in the field notebook.

7.1.5 Entry Requirements

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

7.1.6 Emergency Entry and Exit

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

7.1.7 Contamination Control Zones

Contamination control zones are maintained to prevent the spread of contamination and to prevent unauthorized people from entering hazardous areas. The following zones comply with 29 CFR 1910.120 HAZWOPER.

7.1.7.1 Exclusion Zone

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

7.1.7.2 Contamination Reduction Zone

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

7.1.7.3 Support Zone

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

7.1.8 Posting

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

7.1.9 Site Inspections

The SS will conduct a daily inspection of site activities, equipment, and procedures to verify that the required elements are in place. The Safety Inspection Form in Attachment M may be used as a guide for daily inspections. LPOs will be conducted per guidance from the PM and entered into the BBL LPS Database.

7.2 Decontamination

7.2.1 Personnel Decontamination

The following decontamination requirements comply with 29 CFR 1910.120 HAZWOPER. All personnel wearing Modified Level D or Level C protective equipment in the EZ must undergo personal decontamination prior to entering the SZ. The personnel decontamination area will consist of the following stations at a minimum:

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

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

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

7.2.2 Equipment Decontamination

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

7.2.3 Personal Protective Equipment Decontamination

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

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

8. Training and Medical Surveillance

8.1 Training

8.1.1 General

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

8.1.2 Basic 40-Hour Course

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

- General safety procedures;
- Physical hazards (fall protection, noise, heat stress, cold stress);
- Names and job descriptions of key personnel responsible for site health and safety;
- Safety, health, and other hazards typically present at hazardous waste sites;
- Use, application, and limitations of PPE;
- Work practices by which employees can minimize risks from hazards;
- Safe use of engineering controls and equipment on site;
- Medical surveillance requirements;
- Recognition of symptoms and signs which might indicate overexposure to hazards;
- Worker right-to-know (Hazard Communication OSHA 1910.1200);
- Routes of exposure to contaminants;
- Engineering controls and safe work practices;
- Components of a health and safety program and a site-specific HASP;
- Decontamination practices for personnel and equipment;
- Confined-space entry procedures; and

- General emergency response procedures.

8.1.3 Supervisor Course

Management and supervisors must receive an additional eight hours of training, which typically includes:

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

8.1.4 Site-Specific Training

Site-specific training will be accomplished by on-site personnel reading this HASP or through a thorough site briefing by the PM, SS, or HSS on the contents of this HASP before work begins. The review must include a discussion of the chemical, physical, and biological hazards; the protective equipment and safety procedures; and emergency procedures.

In addition to the initial hazard briefing, all BBLES and subcontractor personnel that will be performing work on site must attend a Bayer Safety Orientation. Personnel will not be allowed to perform work on the site prior to attending this training session.

8.1.5 Daily Safety Meetings

Twice daily safety meetings will be held to cover the work to be accomplished, the hazards anticipated, the PPE and procedures required to minimize site hazards, and emergency procedures. The SS or HSS should present these meetings prior to beginning the day's fieldwork and again in the afternoon. No work will be performed in an EZ before a safety meeting has been held. A safety meeting must also be held prior to new tasks, and repeated if new hazards are encountered. The Daily Safety Meeting Log is included in Attachment N.

8.1.6 First Aid and CPR

At least one employee current in first aid/CPR will be assigned to the work crew and will be on the site during operations. Refresher training in first aid (triennially) and CPR (annually) are required to keep the certificate current. These individuals must also receive training regarding the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

8.2 Medical Surveillance

8.2.1 Medical Examination

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

8.2.2 Pre-placement Medical Examination

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

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

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

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

8.2.3 Other Medical Examinations

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

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

8.2.4 Periodic Exam

Following the placement examination, all employees must undergo a periodic examination, similar in scope to the placement examination. For employees potentially exposed over 30 days per year, the frequency of periodic examinations will be annual. For employees potentially exposed less than 30 days per year, the frequency for periodic examinations will be 24 months.

8.2.5 Medical Restriction

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

9. Emergency Procedures

9.1 General

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

The SS/HSS will establish evacuation routes and assembly areas for the site. All personnel entering the site will be informed of this route and the assembly area.

9.2 Emergency Response

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

- The SS/HSS will evaluate the incident and assess the need for assistance and/or evacuation;
- The SS/HSS will call for assistance as needed
- The SS/HSS will ensure the PM is notified promptly of the incident; and
- The SS/HSS will take appropriate measures to stabilize the incident scene.

9.2.1 Fire

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

9.2.2 Contaminant Release

In the event of a contaminant release, the following steps will be taken:

- Notify SS/HSS immediately;
- Evacuate immediate area of release;
- Conduct air monitoring to determine needed level of PPE; and
- Don required level of PPE and prepare to implement control procedures.

The SS/HSS has the authority to commit resources as needed to contain and control released material and to prevent its spread to off-site areas.

9.3 Medical Emergency

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

- Ensure that the injured employee receives prompt first aid and medical attention;
- In emergency situations, the worker is to be transported by appropriate means to the nearest urgent care facility (normally a hospital emergency room); and
- If the injured person is a BBLES employee, notify BBL Human Resources at 315-446-9120, ext. 336 as soon as possible after the injured employee has been safely evacuated from the scene.

9.3.1 Emergency Care Steps

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

- Do a primary survey of the victim. Check for airway obstruction, breathing, and pulse. Assess likely routes of chemical exposure by examining the eyes, mouth, nose, and skin of the victim for symptoms;
- Contact 911. Give the location, telephone number used, caller's name, what happened, number of victims, victim's condition, and help being given;
- Maintain airway and perform rescue breathing as necessary;
- Perform CPR as necessary; and
- Do a secondary survey of the victim. Check vital signs and do a head-to-toe exam.

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

9.4 First Aid - General

All persons must report any injury or illness to their immediate supervisor or the SS. Trained personnel will provide first aid. Injuries and illnesses requiring medical treatment must be documented. The SS and HSS must conduct an II as soon as emergency conditions no longer exist and first aid and/or medical treatment have been ensured. IIs must be completed and submitted to the PM within 24 hours after the incident.

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

9.4.1 First Aid - Inhalation

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

9.4.2 First Aid - Ingestion

Call EMS and consult a poison control center for advice. If available, refer to the MSDS for treatment information. If the victim is unconscious, keep them on their side and clear the airway if vomiting occurs.

9.4.3 First Aid - Skin Contact

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

9.4.4 First Aid - Eye Contact

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

9.5 Reporting Injuries, Illnesses, and Near Miss Incidents

Injuries and illnesses, however minor, will be reported to the SS immediately. The SS will complete an injury report and submit it to the HSM/HSO, PIC, Client and the PM within 24 hours.

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

9.6 Emergency Information

The means to summon local public response agencies such as police, fire, and ambulance will be reviewed in the daily safety meeting. These agencies are identified in Table 12.

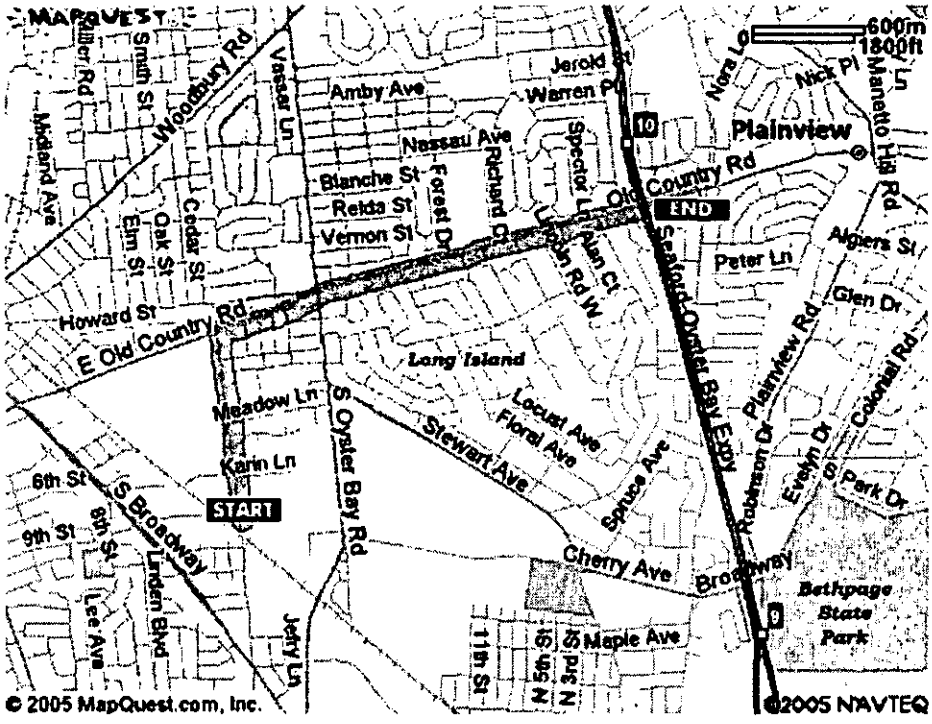
TABLE 12
EMERGENCY CONTACTS

Agency/Name	Telephone No.
Off-Site Emergencies	911
North Shore University Hospital:	(516) 719-3000
BBLES Project Manager – John Brussel	*(315) 446-9120*
Bayer Project Manager – Joel Robinson	(412) 303-5742

9.6.1 Directions to North Shore University Hospital

The estimated travel time is 0 hours, 6 minutes for 2.24 miles of travel, total of 3 steps.

Step	Directions	Elapsed Distance
1	Begin at **125 New South Road** and travel **North** on New South Road for 0.6 miles	0.6
2	*Turn right on* **E. Old Country Road** *and go 1.6 miles*	2.2
3	Stop at **888 Old Country Road**	2.2



Attachment A

Underground/Overhead Utility Checklist

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Underground / Overhead Utility Checklist

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

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

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

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

Reviewed By

Name	Job Title	Date
	Client Representative	
	BBL Project Manager	
	BBL Site Supervisor	

Attachment B

Hot Work Permit

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Site Hot Work Permit

Permit #: **ALL COPIES OF PERMIT MUST REMAIN AT JOB SITE UNTIL THE WORK IS COMPLETE**

Project:

Location and Description of Hot Work:

Checklist	YES	NO	N/A	COMMENT
Is there any alternate procedure to use instead of hot work?				
Is it possible to move the hot work to a designated hot work area?				
Is it possible to move all fire hazards at least 35 feet away?				
If all fire hazards cannot be removed, can guards, barriers, or screens be used to confine any heat, sparks, or slag, and to protect the immovable fire hazards?				
Are there any flammable or combustible liquid storage areas within 50 feet?				
Is the area where the work is to be performed free of combustible material to heat, sparks, flying sparks, or slag?				
Are combustible materials adjacent to the opposite side of partitions, walls, or ceilings protected by guards or moved 35 feet away from the surface?				
Is everything moved or protected that could be damaged by sparks or water?				
Is suitable fire extinguishing equipment on hand and ready for immediate use?				
Is the sprinkler system in the area operational?				
Are the surrounding employees in an area where flying sparks and slag may injure them?				
Have precautions been implemented to prevent injury to employees?				
Has the area supervisor been notified?				
Is a fire watch in place?				
Is hot work to be conducted in a confined space?				
Is appropriate personal protective equipment and respiratory protection being used?				

The area where hot work is being conducted must remain attended for at least 30 minutes after completion of the work.

Monitoring Frequency: **Continuous** **Every 30 min.** **Other**

Monitor's Name: _____

Time of Reading	Hot Work Air Monitoring Parameters		
	% Oxygen>19.5%	% LEL <10%	Other

Air Monitor _____
Print Name

Signature Date Time

Attachment C

Daily/Periodic Excavation Inspection Checklist

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Daily / Periodic Excavation Inspection Checklist

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

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

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

Soil Classified On: By:

Type of Protective System in Use: Sloping Shoring Other _____

Description:

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

Attachment D

Material Safety Data Sheets

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

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

Issue Date: 2000-07

Barium
MSDS 297
BAR1500

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Barium
CAS Number: 7440-39-3
Chemical Formula: Ba
Structural Chemical Formula: Ba
Synonyms: BARIO; BARIUM; BARYUM
General Use: Occurs in barite and witherite.
Used as "getter" in vacuum tubes. Carrier for radium.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Barium	7440-39-3	100

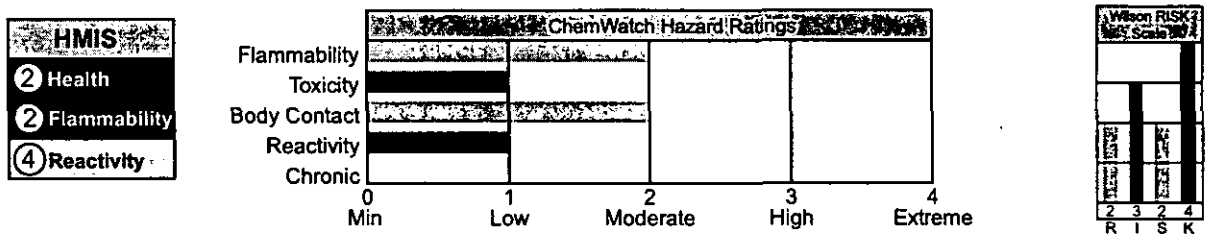
OSHA PEL
TWA: 0.5 mg/m^3; as Ba.

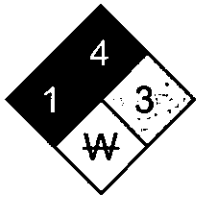
NIOSH REL
TWA: 0.5 mg/m^3; as Ba soluble.

DFG (Germany) MAK
TWA: 0.5 mg/m^3; as Ba.

ACGIH TLV
TWA: 0.5 mg/m^3; as Ba.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word

Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

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

Inhalation: The dust may be discomforting to the upper respiratory tract and may cause severe mucous membrane damage.
Barium fumes are respiratory irritants. Over-exposure to barium dusts and fume may result in rhinitis, frontal headache, wheezing, laryngeal spasm, salivation and anorexia. Long term effects include nervous disorders and adverse effects on the heart, circulatory system and musculature. Heavy exposures may result in a benign pneumoconiosis.

Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The material is moderately discomforting to the skin.
Solution of material in moisture on the skin, or perspiration, may increase irritant effects.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed.
Reaction with acid in the stomach environment will produce soluble barium compounds.

Ingestion of soluble barium compounds may result in ulceration of the mucous membranes of the gastrointestinal tract, tightness in the muscles of the face and neck, gastroenteritis, vomiting, diarrhea, muscular tremors and paralysis, anxiety, weakness, labored breathing, cardiac irregularity due to contractions of smooth striated and cardiac muscles (often violent and painful), slow irregular pulse, hypertension, convulsions and respiratory failure.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems. The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

Section 4 - First Aid Measures

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

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

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

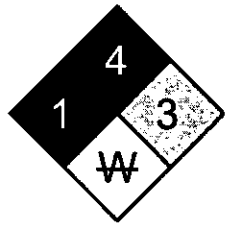
Ingestion: If swallowed, do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: Long-term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

Section 5 - Fire-Fighting Measures

Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water. Contact with water liberates highly flammable gases.
Do NOT use CO_2 extinguishers.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Flammable solid. Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.

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

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

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective neoprene gloves and chemical goggles.
Use dry clean up procedures and avoid generating dust.
Place in suitable containers for disposal.
DO NOT return unused product to containers.

Large Spills: Clear area of personnel. Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources.
Use dry clean up procedures and avoid generating dust.
DO NOT use water.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling. Collect residues and place in labeled plastic containers with vented lids.
DO NOT put the wetted material into a container.
After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Material from spill may be contaminated with water resulting in generation of highly flammable hydrogen gas with pressurizing of closed containers. Hold spill material in vented containers only and plan for prompt disposal.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practice. Observe manufacturer's storing and handling recommendations. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Avoid smoking, bare lights, heat or ignition sources.
Use spark-free tools when handling.
Avoid contact with incompatible materials.
Handle and open container with care.
WARNING: Contact with water generates heat.
DO NOT return unused product to containers.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Heavy gauge metal packages/heavy gauge metal drums.
Storage Requirements: Air-sensitive.
Observe manufacturer's storing and handling recommendations. Keep dry.
Store in original containers. Store away from sources of heat or ignition / bare lights. Store in a cool, dry and well-ventilated area. Store away from incompatible materials.
No smoking, bare lights, heat or ignition sources.
Protect containers against physical damage.
Keep containers securely sealed. Check regularly for spills and leaks.
CARE: Packing of high density product in light weight metal or plastic packages may result in container collapse with product release.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Metal dusts must be collected at the source of generation as they are potentially explosive.
1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.
2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.
If exposure to workplace dust is not controlled, respiratory protection is required; wear NIOSH-approved dust respirator. Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. DO NOT wear contact lenses.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: PVC gloves. Rubber gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >0.5 to 5 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >5 to <50 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range 50 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)
Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Silvery- to yellowish-white malleable, lustrous metal.

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

Section 10 - Stability and Reactivity

Stability/Polymerization: Reacts with ammonia, halogens, oxygen and most acids. Is pyrophoric at room temperatures when in powder form. Easily oxidized - kept under petroleum or other oxygen-free liquid to exclude air. Presence of water. Presence of heat source and ignition source. Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.
Reacts slowly with water. CAUTION contamination with moisture will liberate explosive hydrogen gas, causing pressure build up in sealed containers.
Reacts violently with acids and chlorinated solvents.

Section 11 - Toxicological Information

No significant acute toxicological data identified in literature search.
See NIOSH, *RTECS* CQ 8370000, for additional data.

Section 12 - Ecological Information

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

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options.
Recycle if possible, otherwise dispose in a chemically secure landfill.
Follow applicable federal, state, and local regulations.
Puncture containers to prevent reuse.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: BARIUM
BARIUM (non-pyrophoric)
Hazard Class: 4.3
ID No.: 1400
Packing Group: II
Label: Dang. when Wet [4]

Additional Shipping Information:

Section 15 - Regulatory Information

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

Section 16 - Other Information

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

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 51/57

Material Name: Benzo[*b*]fluoranthene **CAS Number:** 205-99-2
Chemical Formula: $C_{20}H_{12}$
EINECS Number: 205-911-9
Synonyms: B B F; B E F; B (B) F; B(B)F; B(E)F; BBF; BEF; 3,4-BENZ(E)ACEPHENANTHRYLENE; BENZ(E)ACEPHENANTHRYLENE; 2,3-BENZFLUORANTHENE; 3,4-BENZFLUORANTHENE; BENZO(B) FLUORANTHENE; BENZO[*B*]FLUORANTHENE; 2,3-BENZOFLUORANTHENE; 3,4-BENZOFLUORANTHENE; BENZO(B)FLUORANTHENE; BENZO(E)FLUORANTHENE; BENZO[B]FLUORANTHENE; 2,3-BENZOFLUORANTHRENE
Derivation: No manufacturing information available; found in coal tar, coke oven emissions, cigarette smoke and automobile exhaust. There is no commercial production of this compound in the U.S.
General Use: Used as a research chemical.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Benzo[*b*]fluoranthene	205-99-2	ca 100% wt

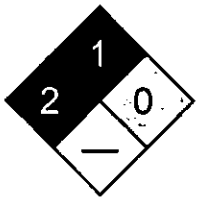
(Note that, except when in the form of a laboratory research chemical, benzo[*b*]fluoranthene is typically found in mixtures with other PAHs (polycyclic aromatic hydrocarbons), such as coal tar pitch).

OSHA PEL
No data found.

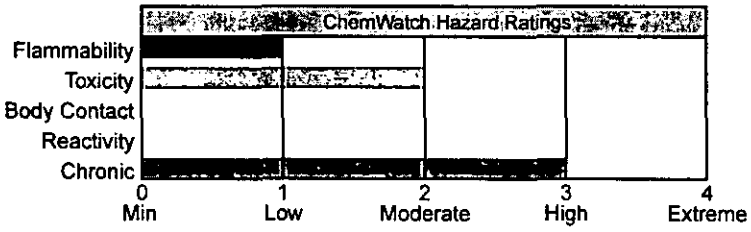
NIOSH REL
No data found.

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

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Target Organs: Eyes, skin, respiratory system, gastrointestinal (GI) system, blood, liver, kidneys
Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption
Acute Effects
Inhalation: Irritation may result from inhalation of benzo[*b*]fluoranthene dust or fumes.
Eye: Contact may result in irritation.
Skin: Contact may cause irritation.
Ingestion: None reported.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Although there is no direct epidemiological evidence linking benzo[*b*]fluoranthene with cancer, it is frequently a component of mixtures associated with human cancer. Epidemiological studies demonstrate increased incidence of cancer (skin, lung, urinary tract, GI system) with exposure to mixed PAHs and substances that contain them. Coal tar pitch volatiles are reported to cause an excess of bronchitis. In animal studies, benzo[*b*]fluoranthene has been found to be tumorigenic and mutagenic.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain and/or irritation develop.

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

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

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

Note to Physicians: Treat overexposure symptomatically and supportively. Medical surveillance may be necessary for high exposures (skin, mouth, GI, respiratory system). Animal testing suggests a synergism (combined effect greater than sum of parts) of mutagenicity between benzo[*b*]fluoranthene and other PAHs.

Section 5 - Fire-Fighting Measures

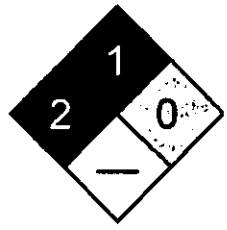
Flash Point: Probable combustible solid

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Flammability Classification: Probable combustible solid



Fire Diamond

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

General Fire Hazards/Hazardous Combustion Products: Heating benzo[*b*]fluoranthene to decomposition can produce carbon monoxide (CO) and carbon dioxide (CO_2).

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, isolate area and deny entry. Remove sources of ignition, and provide maximum ventilation.

Small Spills: Vacuum or carefully scoop up material and deposit in sealed containers. Absorb liquid containing benzo[*b*]fluoranthene with vermiculite, earth, sand or similar material.

Large Spills: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Stay upwind and have cleanup personnel protect against inhalation and contact.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid dust inhalation, and skin and eye contact. Avoid sunlight exposure of contaminated skin. Use only with ventilation sufficient to reduce airborne concentrations as low as possible. Wear protective gloves, goggles, and clothing (see Sec. 8). Keep away from heat and ignition sources.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Periodically inspect stored materials.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Work with benzo[*b*]fluoranthene only under an exhaust hood. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Have employees with potential for exposure submit to preplacement and periodic medical examinations with emphasis on oral cavity (including sputum cytology), respiratory tract, skin (chronic disorders, lesions), blood (complete count), bladder and kidneys (urinalysis: specific gravity, albumin, glucose, microscopic examination of sediment; urinary cytology). Repeat medical exam on an annual basis, or on a semi-annual basis for employees 45 years or older or with 10 or more years of exposure to pitch volatiles. Periodically inspect lab atmospheres, and surfaces such as walls, floors, and benches and interior of fume hoods and air ducts for contamination. Post appropriate signs and labels on doors leading to areas where benzo[*b*]fluoranthene is used.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Wear splash-proof chemical safety goggles, and face shield (8-inch minimum), per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For any detectable concentration (of coal tar pitch volatiles) use SCBA with full facepiece operated in pressure-demand or other positive pressure mode, or supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive pressure mode; escape, air purifying full face respirator (gas mask) with a chin-style or a front- or back-mounted organic vapor canister and with a full facepiece and a fume or high-efficiency filter, or escape-type SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless needles
Physical State: Solid
Vapor Pressure (kPa): 5 x10^{-7} mm Hg at 68 °F (20 °C)
Formula Weight: 252.32
Freezing/Melting Point: 334.4 °F (168 °C)
Water Solubility: 0.0012 mg/L

Other Solubilities: 95% ethanol: <1 mg/mL at 66 °F (19 °C); acetone: 10-50 mg/mL at 66 °F (19 °C); benzene: slightly soluble; DMSO: 10-50 mg/mL at 66 °F (19 °C).

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Benzo[*b*]fluoranthene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Heat, sunlight.

Storage Incompatibilities: Include strong oxidizing agents.

Hazardous Decomposition Products: Thermal oxidative decomposition of benzo[*b*]fluoranthene will produce carbon monoxide (CO) and carbon dioxide (CO_2).

Section 11 - Toxicological Information

Other Effects:

Tumorgenicity, mouse, skin: 88 ng/kg/120 weeks intermittently produced toxic effects: tumorigenic - carcinogenic by RTECS criteria; skin and appendages - tumors; tumorigenic - tumors at site of application.

Hamster, lung cells: 100 µg/L produced morphological transformation.

Mouse, skin: 4037 µg/kg/20 days intermittently produced toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors.

Rat, intraperitoneal: 100 mg/kg resulted in DNA adducts.

Mouse, skin: 72 mg/kg/60 weeks intermittently produced toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors; tumorigenic - tumors at site of application.

Rat, intraperitoneal: 100 mg/kg induced sister chromatid exchange.

Rat, implant: 5 mg/kg produced toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; lungs, thorax, or respiration - tumors; tumorigenic - tumors at site of application.

Human, lymphocyte cells: 55 µg/L produced mutation.

See NIOSH, *RTECS* CU1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Benzo[*b*]fluoranthene has a low vapor pressure and Henry's Law Constant, and will not readily evaporate from water or soil. In surface water, it will partition from the water column to suspended sediments. Limited bioconcentration in aquatic organisms may occur (polychaete worms, BCF = 9.1); however, fish have an enzyme (microsomal oxidase) capable of rapidly metabolizing PAHs. Photolysis, photo-oxidation, and volatilization of dissolved benzo[*b*]fluoranthene may occur, but adsorption to suspended sediments is expected to inhibit these processes. Release to the soil may result in some biodegradation. Photolysis is not expected to be significant after release to soil. In the atmosphere it is likely to be adsorbed to particulate matter, and will be subject to wet and dry deposition. In the atmosphere, benzo[*b*]fluoranthene will rapidly degrade by reaction with photochemically produced hydroxyl radicals (half life 1.00 day). A high K_{oc} indicates significant sorption and low mobility in the soil column.
Ecotoxicity: Evidence suggests that PAHs in lake bottom sediments may cause tumors in fish.
Henry's Law Constant: 1.38×10^{-4} atm-m^3/mole, estimated
Octanol/Water Partition Coefficient: log K_{ow} = 6.124
Soil Sorption Partition Coefficient: K_{oc} = 5.88, estimated

Section 13 - Disposal Considerations

Disposal: Benzo[*b*]fluoranthene is a good candidate for rotary kiln incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

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

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Not listed

Section 16 - Other Information

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

Material Safety Data Sheet Collection

Genium group inc.
1171 RiverFront Center Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2005-05

Benz[a]anthracene
BEN2040

Section 1 - Chemical Product and Company Identification 55/60

Material Name: Benz[a]anthracene
CAS Number: 56-55-3
Chemical Formula: $C_{18}H_{12}$
EINECS Number: 200-280-6
ACX Number: X1002793-9
Synonyms: B(A)A; BA; BAA; 1,2-BENZ(A)ANTHRACENE; 1,2-BENZANTHRACENE; BENZ(A)ANTHRACENE; BENZANTHRACENE; BENZ[A]ANTHRACENE; 1,2-BENZANTHRAZEN; 1,2-BENZANTHRENE; BENZANTHRENE; 1,2-BENZOANTHRACENE; BENZO(A)ANTHRACENE; BENZOANTHRACENE; 2,3-BENZOPHENANTHRENE; BENZO(A) PHENANTHRENE; BENZO(B)PHENANTHRENE; 2,3-BENZPHENANTHRENE; NAPHTHANTHRACENE; TETRAPHENE
General Use: research chemistry

Section 2 - Composition / Information on Ingredients

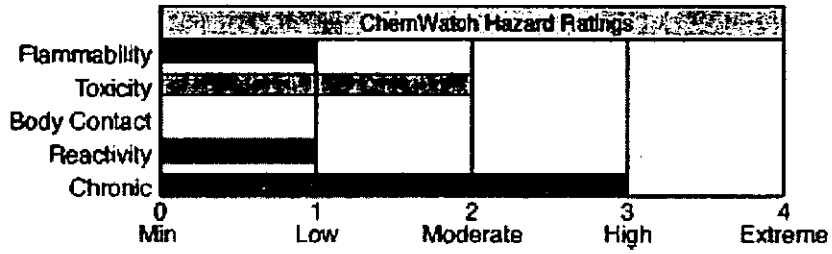
Name	CAS	%
benz[a]anthracene	56-55-3	>98

OSHA PEL

NIOSH REL

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

Section 3 - Hazards Identification



ANSI Signal Word
Danger!

♦♦♦♦♦ Emergency Overview ♦♦♦♦♦

Colorless plates. May cause irritation. Poison. Other Acute Effects: may be fatal if inhaled, swallowed, or absorbed through skin. Chronic Effects: may cause heritable genetic damage; may alter genetic material. Carcinogen. Will burn.

Potential Health Effects

Target Organs: No data found.

Primary Entry Routes: accidental skin and eye contact, inhalation of generated dusts

Acute Effects

Inhalation: The dust is harmful and discomforting to the upper respiratory tract. Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Eye: The dust may be discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/ or other transient eye damage/ ulceration.

Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material. Toxic effects may result from skin absorption.

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

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Chronic Effects:

Cited in many publications and by a number of regulatory authorities as a suspected human carcinogen. Subcutaneous injection produces sarcomas (soft tissue growths) in rats and mice. When administered by gavage benz[a]anthracene induced papillomas to the forestomach in mice and hamsters and mammary tumors in female rats.

Section 4 - First Aid Measures

Inhalation: • If dust is inhaled, remove to fresh air.
• Encourage patient to blow nose to ensure clear breathing passages.
• Rinse mouth with water. Consider drinking water to remove dust from throat.
• Seek medical attention if irritation or discomfort persist.
• If fumes or combustion products are inhaled, remove to fresh air.
• Lay patient down. Keep warm and rested.
• Other measures are usually unnecessary.

Eye Contact: • Immediately hold the eyes open and flush with fresh running water.
• Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
• Seek medical attention if pain persists or recurs.
• Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

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

Ingestion: Contact a Poison Control Center. If more than 15 minutes from a hospital:
• INDUCE vomiting with IPECAC SYRUP, or fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. NOTE: Wear a protective glove when inducing vomiting by mechanical means.
• SEEK MEDICAL ATTENTION WITHOUT DELAY.
• In the meantime, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
• If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided.
• If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: Not available; probably combustible
Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
• Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, e.g., flame or spark, will cause fire or explosion.
• Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
• Build-up of electrostatic charge may be prevented by bonding and grounding.
• Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e., nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves for fire only.
• Prevent, by any means available, spillage from entering drains or waterways.
• Use fire fighting procedures suitable for surrounding fire.
• Do not approach containers suspected to be hot.
• Cool fire-exposed containers with water spray from a protected location.
• If safe to do so, remove containers from path of fire.
• Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: • Clean up all spills immediately.
• Avoid contact with skin and eyes.
• Wear protective clothing, gloves, safety glasses and dust respirator.
• Use dry clean up procedures and avoid generating dust.
• Vacuum up or sweep up.
• Place in clean drum then flush area with water.
Large Spills: • Clear area of personnel and move upwind.
• Contact fire department and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves.
• Prevent, by any means available, spillage from entering drains or waterways.
• No smoking, bare lights or ignition sources.
• Increase ventilation.
• Stop leak if safe to do so.
• Water spray or fog may be used to disperse/absorb vapor.
• Contain or absorb spill with sand, earth or vermiculite.
• Collect recoverable product into labeled containers for recycling.
• Collect solid residues and seal in labeled drums for disposal.
• Wash area and prevent runoff into drains.
• After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
• If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid all personal contact, including inhalation.
• Wear protective clothing when risk of overexposure occurs.
• Use in a well-ventilated area.
• Prevent concentration in hollows and sumps.
• DO NOT enter confined spaces until atmosphere has been checked.
• Do not allow material to contact humans, exposed food or food utensils.
• Avoid smoking, bare lights or ignition sources.
• When handling, DO NOT eat, drink or smoke.
• Avoid contact with incompatible materials.
• Keep containers securely sealed when not in used.
• Avoid physical damage to containers.
• Always wash hands with soap and water after handling.
• Working clothes should be laundered separately. Launder contaminated clothing before reuse.
• Follow good occupational work practices.
• Observe manufacturer's storage/handling recommendations.
• Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Glass container. Plastic container. Metal can. Metal drum. Check that all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required. If risk of overexposure exists, wear NIOSH-approved respirator. Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields or chemical goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, e.g. PVC. Wear safety footwear.
Other: • Overalls.
• PVC Apron.
• PVC protective suit may be required if exposure severe.
• Eyewash unit.
• Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Light yellow to tan crystalline powder.

Physical State: colorless plates
Vapor Pressure (kPa): 5 x10^{-9} torr at 20 °C
Formula Weight: 228.29
Evaporation Rate: Half life 89 hours
Boiling Point: Sublimes at 435 °C (815 °F)
Freezing / Melting Point: 162 °C (323.6 °F)
Volatile Component (% Vol): Negligible
Water Solubility: 0.014 mg/L in Water at 25 °C

Section 10 - Stability and Reactivity

Stability / Polymerization / Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Toxicity
Intravenous (rat) LD_{50}: > 200 mg/kg

Irritation
Nil reported

See *RTECS* CV9275000 for additional data.

Section 12 - Ecological Information

Environmental Fate: When released into water it will rapidly become adsorbed to sediment or particulate matter in the water column, and bioconcentrate into aquatic organisms. In the unadsorbed state, it will degrade by photolysis in a matter of hours to days. Its slow desorption from sediment and particulate matter will maintain a low concentration in the water. Because it is strongly adsorbed to soil it will remain in the upper few centimeters of soil and not leach into groundwater. It will very slowly biodegrade when colonies of microorganisms are acclimated but this is too slow a process (half-life ca 1 year to be significant). In the atmosphere it will be transported long distances and will probably be subject to photolysis and photooxidation although there is little documentation about the rate of these processes in the literature.
Ecotoxicity: Algae: Anabaena flos-aquae 2w EC_{50} growth +0.014 mg/l NOEC growth +0.003 mg/l

BCF: daphnia 4.0

Octanol/Water Partition Coefficient: log K_{ow} = 5.61

Soil Sorption Partition Coefficient: K_{oc} = sediments 55 to 1.87 x10^6

Section 13 - Disposal Considerations

Disposal:
- Recycle wherever possible or consult manufacturer for recycling options.
- Follow applicable local, state, and federal regulations.
- Bury residue in an authorized landfill.
- Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

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

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7
Packaging:
Exceptions: None
Non-bulk: 211
Bulk: 242
Quantity Limitations:
Passenger aircraft/rail: 5 kg
Cargo aircraft only: 50 kg
Vessel Stowage:
Location: B
Other:

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging:
Exceptions: None
Non-bulk: 212
Bulk: 242
Quantity Limitations:
Passenger aircraft/rail: 25 kg
Cargo aircraft only: 100 kg

Vessel Stowage:
Location: B
Other:

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging:
Exceptions: 153
Non-bulk: 213
Bulk: 240
Quantity Limitations:
Passenger aircraft/rail: 100 kg
Cargo aircraft only: 200 kg
Vessel Stowage:
Location: A
Other:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U018 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 43/57

Material Name: Benzo(a)pyrene **CAS Number:** 50-32-8
Chemical Formula: $C_{20}H_{12}$
EINECS Number: 200-028-5
Synonyms: B(A)P; BAP; BENZO(D,E,F)CHRYSENE; 3,4-BENZOPIRENE; 1,2-BENZOPYRENE; 3,4-BENZOPYRENE; 6,7-BENZOPYRENE; BENZO(A)PYRENE; 3,4-BENZPYREN; 3,4-BENZ(A)PYRENE; 3,4-BENZPYRENE; BENZ(A)PYRENE; BENZ[A]PYRENE; 3,4-BENZYLPYRENE; 3,4-BENZYPYRENE; 3,4-BP; BP; COAL TAR PITCH VOLATILES: BENZO(A)PYRENE
Derivation: Synthesized from pyrene and succinic anhydride.
General Use: Benzo(a)pyrene is no longer used or produced commercially in the US. In its pure form, benzo(a)pyrene may be used as a research laboratory reagent. It also occurs in combustion products of coal, oil, petroleum, wood and other biological matter; in motor vehicle and other gasoline and diesel engine exhaust; in charcoal-broiled foods; in cigarette smoke and general soot and smoke of industrial, municipal, and domestic origin. It occurs naturally in crude oils, shale oils, coal tars, gases and fly ash from active volcanoes and forest fires.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Benzo(a)pyrene	50-32-8	ca 100% wt

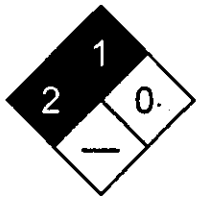
Except in laboratories, benzo(a)pyrene is usually mixed with other coal tar pitch chemicals. Consider exposure limits for coal tar pitch volatiles as a guideline. However, because benzo(a)pyrene is considered a probable carcinogen to humans, it is recommended that exposures to carcinogens be limited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

OSHA PEL
TWA: 0.2 mg/m^3.

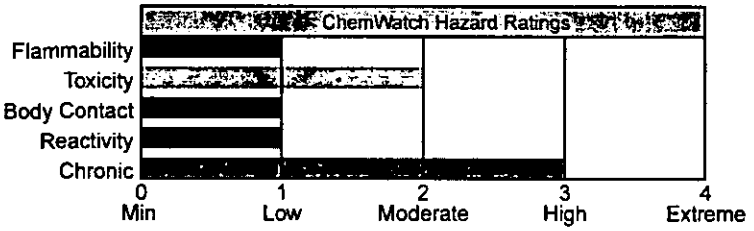
NIOSH REL
No data found.

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

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Target Organs: Respiratory system, bladder, kidneys, skin.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects
Inhalation: Respiratory tract irritation. Pregnant women may be especially susceptible to exposure effects of benzo(a)pyrene; exposure may damage the fetus. In general, polyaromatic hydrocarbons such as benzo(a)pyrene tend to localize primarily in body fat and fatty tissues (for ex. breasts) and are excreted in breast milk. Benzo(a)pyrene may also affect the male reproductive system (testes and sperm).
Eye: Irritation and/or burns on contact.

Skin: Irritation with burning sensation, rash, and redness; dermatitis on prolonged exposure. Sunlight enhances effects (photosensitization).

Ingestion: None reported.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: Respiratory system, bladder, kidney, and skin disorders.

Chronic Effects: Inhalation: Cough and bronchitis. Eye: Photosensitivity and irritation. Skin: Skin changes such as thickening, darkening, pimples, loss of color, reddish areas, thinning of the skin, and warts. Sunlight enhances effects (photosensitization). Other: Gastrointestinal (GI) effects include leukoplakia (a pre-cancerous condition characterized by thickened white patches of epithelium on mucous membranes, especially of the mouth). Cancer of the lung, skin, kidneys, bladder, or GI tract is also possible. Smoking in combination with exposure to benzo(a)pyrene increases the chances of developing lung cancer. Persons with a high degree of inducibility of the enzyme aryl hydrocarbon hydroxylase may be a high risk population.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of tepid water for at least 15 min. Consult an ophthalmologist if irritation or pain persist.

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

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. Inducing vomiting is not necessary since benzo(a)pyrene has a low acute toxicity and therefore, is generally an unnecessary procedure. Consider activated charcoal/cathartic.

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

Note to Physicians: Monitor CBC and arterial blood gases, conduct liver, renal, and pulmonary function tests (if respiratory tract irritation is present), and urinalysis. Biological monitoring techniques testing for metabolites in blood or urine, or DNA adducts in blood or tissues are useful for epidemiological studies that determine if exposure has occurred. Because neither normal nor toxic levels have been established, those techniques may not be useful for evaluating individual patients.

Special Precautions/Procedures: Emergency personnel should protect against exposure.

Section 5 - Fire-Fighting Measures

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

Autoignition Temperature: None reported.

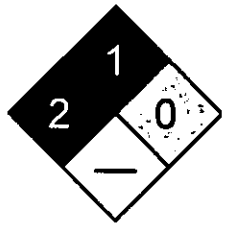
LEL: None reported.

UEL: None reported.

Extinguishing Media: For small fires, use dry chemical, sand, water spray, or foam. For large fires, use water spray, fog, or foam.

General Fire Hazards/Hazardous Combustion Products: Carbon monoxide and carbon dioxide.

Fire-Fighting Instructions: Isolate hazard and deny entry. If feasible and without undue risk, move containers from fire hazard area. Otherwise, cool fire-exposed containers with water spray until well after fire is extinguished. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel of large spills, remove heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and skin or eye contact. Clean up spills promptly.

Small Spills: Carefully scoop up spilled material and place into appropriate containers for disposal. For liquid spills, take up with a noncombustible, inert absorbent and place into appropriate containers for disposal.

Large Spills: For large spills, dike far ahead of liquid spill or contain dry spill for later disposal. Do not release into sewers or waterways. *Do not* dry sweep! Use a vacuum with a HEPA filter or a wet method to reduce dust. After cleanup is complete, thoroughly decontaminate all surfaces. *Do not* reuse contaminated cleaning materials.

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

Section 7 - Handling and Storage

Handling Precautions: Handle with extreme caution and take all necessary measures to avoid exposure to benzo(a)pyrene because it is a carcinogen and mutagen. Follow good personal hygiene procedures and thoroughly wash hands with soap and water after handling. Use safety pipettes for all pipetting.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed and properly labeled containers in a cool, well-ventilated area.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use a Class I, Type B, biological safety hood when working with benzo(a)pyrene in a laboratory. Decrease the rate of air extraction, so that benzo(a)pyrene can be handled without powder being blown around the hood. Keep glove boxes under negative pressure. Use vertical laminar-flow, 100% exhaust, biological safety cabinets for containment of in vitro procedures. The exhaust air flow should be sufficient to provide an inward air flow at the face opening of the cabinet. Ensure contaminated air sheaths that are under positive pressure are leak-tight. Never use horizontal laminar-flow hoods or safety cabinets where filtered air is blown across the working area towards the operator. Test cabinets before work begins to ensure they are functioning properly. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical examinations with emphasis on the oral cavity, bladder, kidneys, skin, and respiratory tract. Conduct urinalysis including specific gravity, albumin, glucose, and microscopic examination of centrifuged sediment for red blood cells. Also, include 14" x 17" chest roentgenogram, FVC + FEV1, and CBC to detect any leukemia or aplastic anemia. It is recommended that this exam be repeated on an annual basis and semiannual basis for employees 45 yr of age or older or with 10 or more years of exposure to coal tar pitch volatiles. Train workers about the hazards of benzo(a)pyrene and the necessary protective measures to prevent exposure. Periodically inspect lab atmospheres, surfaces such as walls, floors, and benches, and interior of fume hoods and air ducts for contamination. Post appropriate signs and labels on doors leading into areas where benzo(a)pyrene is used.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. In animal laboratories, wear protective suits (disposable, one-piece and close-fitting at ankles and wrists), gloves, hair covering, and overshoes. In chemical laboratories, wear gloves and gowns. Wear protective eyeglasses or chemical safety, gas-proof goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. The following respirator recommendations are for coal tar pitch volatiles. For any unknown concentration, wear any SCBA with a full facepiece and operated in a pressure- demand or other positive pressure mode, or any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive pressure mode. For escape, wear any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister having a high-efficiency particulate filter, or any appropriate escape-type SCBA. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Shower and change clothes after exposure or at the end of the workshift. Separate contaminated work clothes from street clothes. Launder before reuse. Remove benzo(a)pyrene from your shoes and clean personal protective equipment. Use procedures to ensure laundry personnel are not exposed. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Pale yellow monoclinic needles with a faint, aromatic odor.

Physical State: Solid

Vapor Pressure (kPa): >1 mm Hg at 68 °F (20 °C)

Formula Weight: 252.30

Specific Gravity (H_2O=1, at 4 °C): 1.351

Boiling Point: >680 °F (>360 °C); 540 °F (310 °C) at 10 mm Hg

Freezing/Melting Point: 354 °F (179 °C)

Water Solubility: Insoluble; 0.0038 mg (+/- 0.00031 mg) in 1 L at 77 °F (25 °C)

Other Solubilities: Ether, benzene, toluene, xylene, concentrated hydrosulfuric acid; sparingly soluble in alcohol, methanol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Benzo(a)pyrene is stable at room temperature in closed containers under normal storage and handling conditions. It undergoes photo-oxidation when exposed to sunlight or light in organic solvents and is also oxidized by chromic acid and ozone. Hazardous polymerization cannot occur. Avoid heat and ignition sources and incompatibles.

Storage Incompatibilities: Strong oxidizers (chlorine, bromine, fluorine) and oxidizing chemicals (chlorates, perchlorates, permanganates, and nitrates).

Hazardous Decomposition Products: Thermal oxidative decomposition of benzo(a)pyrene can produce carbon monoxide and carbon dioxide.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral: 15 mg/kg produced gastrointestinal and musculoskeletal tumors.

Irritation Effects:

Mouse: 14 µg caused mild irritation.

Other Effects:

Rat, oral: 40 mg/kg on the 14th day of pregnancy caused changes in the extra embryonic structures.

Rat, oral: 2 g/kg administered 28 days prior to mating and 1-22 days of pregnancy produced a stillbirth.

Tumorgenicity, mouse, oral: 75 mg/kg administered to the female during the 12- 14 day of pregnancy produced biochemical and metabolic effects on the newborn.

Mouse, inhalation: 200 ng/m^3/6 hr administered intermittently over 13 weeks produced tumors of the lungs.

Human, HeLa cell: 1500 nmol/L caused DNA inhibition.

Human, lung cell: 1 µmol/L caused DNA damage.

Human, liver cell: 100 nmol/L caused DNA damage.

Rabbit, skin: 17 mg/kg administered intermittently over 57 weeks produced tumors of the skin and appendages.

See NIOSH, *RTECS* DJ3675000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to water, benzo(a)pyrene adsorbs very strongly to particulate matter and sediments, bioconcentrates in aquatic organisms which cannot metabolize it, but does not hydrolyze. Direct photolysis at the water surface, evaporation, or biodegradation may be important, but adsorption may significantly retard these processes. Adsorption to particulates may also retard direct photolysis when benzo(a)pyrene is released to air. Benzo(a)pyrene may be removed from air by reaction with nitrogen dioxide (half-life, 7 days) or ozone (half-life, 37 min), or photochemically produced hydroxyl radicals (estimated half-life, 21.49 hr). It will adsorb very strongly to the soil. Although it is not expected to appreciably leach to the groundwater, groundwater samples indicate that it can be transported there. It is not expected to significantly evaporate or hydrolyze from soils and surfaces. However, it may be subject to appreciable biodegradation in soils. It will adsorb very strongly to the soil. Although it is not expected to appreciably leach to the groundwater, groundwater samples indicate that it can be transported there. It is not expected to significantly evaporate or hydrolyze from soils and surfaces. However, it may be subject to appreciable biodegradation in soils.

Ecotoxicity: Oysters, BCF (bioconcentration factor): 3000; rainbow trout, BCF: 920; *Daphnia pulex*, BCF: 13,000.

BCF: Some marine organisms such as phytoplankton, certain zooplankton, scallops (*Placopecten sp*), snails (*Litternia littorea*), and mussels (*Mytilus edulis*) lack a metabolic detoxification enzyme system to metabolize benzo(a)pyrene and therefore, tend to accumulate benzo(a)pyrene. Humic acid in solution may decrease bioconcentration.

Octanol/Water Partition Coefficient: log K_{ow} = 6.04

Section 13 - Disposal Considerations

Disposal: Small quantities: 10 mL of a solution containing 0.3 mol/L of potassium permanganate and 3 mol/L of sulfuric acid will degrade 5 mg of benzo(a)pyrene. Also, can treat with sodium dichromate in strong sulfuric acid (1-2 days). Benzo(a)pyrene is also a good candidate for fluidized bed incineration at a temperature range of 842 to 1796 °F (450 to 980 °C) or rotary kiln incineration at 820 to 1600°C. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

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

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U022 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 55/ 57

Material Name: Benzo[k]fluoranthene **CAS Number:** 207-08-9
Chemical Formula: $C_{20}H_{12}$
EINECS Number: 205-916-6
Synonyms: B; B (K) F; B K F; 8,9-BENZFLUORANTHENE; BENZO(K) FLUORANTHENE; 11,12-BENZO(K)FLUORANTHENE; 11,12-BENZOFLUORANTHENE; 8,9-BENZOFLUORANTHENE; BENZO(K)FLUORANTHENE; BENZO[K]FLUORANTHENE; 11,12-BENZOFLURANTHENE; 2,3,1',8'-BINAPHTHYLENE; 2,3,1',8'-BINAPTHYLENE; BKF; DIBENZO(B,JK)FLUORENE
General Use: there is no commerical use of this compound

Section 2 - Composition / Information on Ingredients

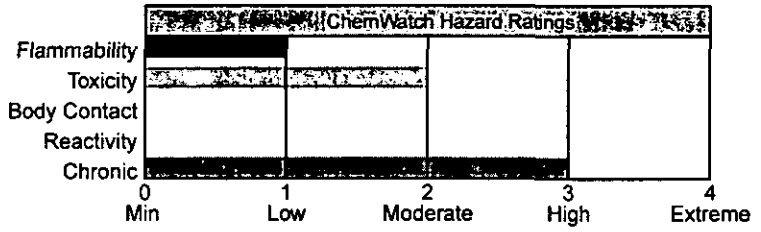
Name	CAS	%
benzo[k]fluoranthene	207-08-9	>98

OSHA PEL
No data found.

NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Pale yellow needles. Irritating to eyes/skin/respiratory tract. Toxic. Probable human carcinogen. Will burn.

Potential Health Effects

Target Organs: eyes, skin, respiratory system
Primary Entry Routes: skin contact/absorption, inhalation of generated dust
Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract. Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/ or other transient eye damage/ ulceration.

Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The material is moderately discomforting and harmful if swallowed in large quantity.

Carcinogenicity: NTP - Listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: When injected into pulmonary tissue of female rats benzo[k]fluoranthene induced squamous cell carcinomas. Topical administration initiated skin tumors in female mice whilst subcutaneous injection induced local sarcomas in mice of both sexes. Although there is no adequate data available to evaluate carcinogenicity of PAHs in humans, there are a number of epidemiologic and mortality studies to show increased incidences of cancer in humans

exposed to mixtures of PAHs. Lung and genitourinary cancer mortality amongst coke oven workers and skin tumors in workers exposed to creosote are examples.

Section 4 - First Aid Measures

Inhalation: • If dust is inhaled, remove to fresh air.
• Encourage patient to blow nose to ensure clear breathing passages.
• Rinse mouth with water. Consider drinking water to remove dust from throat.
• Seek medical attention if irritation or discomfort persist.
Eye Contact: • Immediately hold the eyes open and flush with fresh running water.
• Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
• Seek medical attention if pain persists or recurs.
• Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: • Immediately remove all contaminated clothing, including footwear (after rinsing with water).
• Wash affected areas thoroughly with water (and soap if available).
• Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center. If more than 15 minutes from a hospital:
• INDUCE vomiting with IPECAC SYRUP, or fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. NOTE: Wear a protective glove when inducing vomiting by mechanical means.
• SEEK MEDICAL ATTENTION WITHOUT DELAY.
• In the meantime, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
• If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided.
• If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: Not available; probably combustible
Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
• Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, e.g., flame or spark, will cause fire or explosion.
• Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
• Build-up of electrostatic charge may be prevented by bonding and grounding.
• Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting. Combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: • Use water delivered as a fine spray to control fire and cool adjacent area.
• Do not approach containers suspected to be hot.
• Cool fire-exposed containers with water spray from a protected location.
• If safe to do so, remove containers from path of fire.
• Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: • Clean up all spills immediately.
• Avoid contact with skin and eyes.
• Wear impervious gloves and safety glasses.
• Use dry clean up procedures and avoid generating dust.
• Vacuum up or sweep up.
• Place spilled material in clean, dry, sealable, labeled container.
Large Spills: • Clear area of personnel and move upwind.
• Contact fire department and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves.
• Prevent, by any means available, spillage from entering drains or waterways.
• Stop leak if safe to do so.

- Contain spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Neutralize/decontaminate residue.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
- If contamination of drains or waterways occurs, advise emergency services.

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

Section 7 - Handling and Storage

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

Recommended Storage Methods: Metal can. Metal drum. Check that all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

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

Hands/Feet: Wear general protective gloves, e.g. light weight rubber gloves.

Other: Overalls; impervious protective clothing. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Yellow powder.

Physical State: pale yellow needles

Vapor Pressure (kPa): 0.0000000000959 mm Hg at 25 °C

Vapor Density (Air=1): > 1

Formula Weight: 252.32

Boiling Point: 480 °C (896 °F) at 760 mm Hg

Freezing/Melting Point: 217 °C (422.6 °F)

Water Solubility: Insoluble in Water

Section 10 - Stability and Reactivity

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

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Tumors at site of application.

NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

See NIOSH, *RTECS* DF6350000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Its presence in distant places indicates that it is reasonably stable in the atmosphere and capable of long distant transport. Atmospheric losses are caused by gravitational settling and rainout. On land it is strongly adsorbed to soil and remains in the upper soil layers and should not leach into groundwater. Biodegradation may occur but will be very slow (half-life ca 2 years with acclimated microorganisms). It will get into surface water from dust and precipitation in addition to runoff and effluents. In the water it will sorb to sediment and particulate matter in the water column. It would be expected to bioconcentrate in fish and seafood.
Ecotoxicity: No data found.
Henry's Law Constant: estimated at 4.2×10^{5}
BCF: fish 4.97
Octanol/Water Partition Coefficient: log $K_{ow} = 6.84$
Soil Sorption Partition Coefficient: K_{oc} = nearly 1×10^{6}

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Not listed

Section 16 - Other Information

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

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

Issue Date: 2002-02

Section 1 - Chemical Product and Company Identification 54

Material Name: di-sec-Octyl Phthalate **CAS Number:** 117-81-7
Chemical Formula: $C_{24}H_{38}O_4$
Structural Chemical Formula: $C_6H_4[COOCH_2CH(C_2H_5)(CH_2)_3]_2$
Synonyms: BEHP; 1,2-BENZENEDICARBOXYLIC ACID,BIS(2-ETHYLHEXYL) ESTER; 1,2-BENZENEDICARBOXYLIC ACID,BIS(ETHYLHEXYL) ESTER; BIS(2-ETHYLHEXYL) 1,2-BENZENEDICARBOXYLATE; BIS(2-ETHYLHEXYL)-1,2-BENZENEDICARBOXYLATE; BIS-(2-ETHYLHEXYL)-1,2-BENZENEDICARBOXYLATE; BIS-(2-ETHYLHEXYL)ESTER KYSELINY FTALOVE; BIS(2-ETHYLHEXYL)ESTER PHTHALIC ACID; BIS(2-ETHYLHEXYL)PHTHALATE; BIS-(2-ETHYLHEXYL)PHTHALATE; BISOFLEX 81; BISOFLEX DOP; COMPOUND 889; DAF 68; DEHP; DI(2-ETHYLHEXYL) PHTHALATE; DI(ETHYLHEXYL) PHTHALATE; DIETHYLHEXYL PHTHALATE; DI(2-ETHYLHEXYL)ORTHOPHTHALATE; DI(2-ETHYLHEXYL)PHTHALATE; DI-2-ETHYLHEXYLPHTHALATE; DI-SEC-OCTYL PHTHALATE; DIOCTYL PHTHALATE; DOF; DOP; ERGOPLAST FDO; ERGOPLAST FDO-S; 2-ETHYLHEXYL PHTHALATE; ETHYLHEXYL PHTHALATE; EVIPLAST 80; EVIPLAST 81; FLEXIMEL; FLEXOL DOP; FLEXOL PLASTICIZER DOP; GOOD-RITE GP 264; HATCOL DOP; HERCOFLEX 260; JAYFLEX DOP; KODAFLEX DOP; MOLLAN O; NUOPLAZ DOP; OCTOIL; OCTYL PHTHALATE; PALATINOL AH; PHTHALIC ACID DIOCTYL ESTER; PHTHALIC ACID,BIS(2-ETHYLHEXYL) ESTER; PITTSBURGH PX-138; PLATINOL AH; PLATINOL DOP; RC PLASTICIZER DOP; REOMOL D 79P; REOMOL DOP; SICOL 150; STAFLEX DOP; TRUFLEX DOP; VESTINOL AH; VINICIZER 80; WITCIZER 312
General Use: Used as a plasticizer for resins, elastomers, vinyl products, films for packaging, containers and electrical cables.
High purity grades used as electrical insulating (dielectric) fluid.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
di-sec-octyl phthalate	117-81-7	>99

OSHA PEL
TWA: 5 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 5 mg/m^3; STEL: 10 mg/m^3.

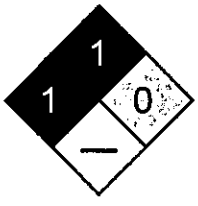
ACGIH TLV
TWA: 5 mg/m^3.

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

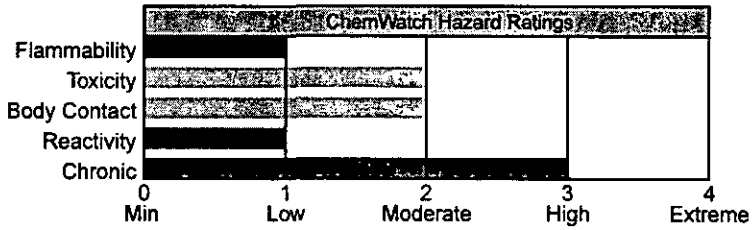
IDLH Level
5000 mg/m^3.

DFG (Germany) MAK
TWA: 10 mg/m^3; ceiling, substances with systemic effects, onset of effect greater than 2 hours, half-life greater than shift length, strongly cumulative.

Section 3 - Hazards Identification



Fire Diamond



☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Light colored liquid; slight odor. Mildly irritating to eyes/skin/respiratory tract. Also causes: conjunctivitis, keratitis, bronchial irritation, eczema, staggering, abdominal cramps, nausea, diarrhea, CNS depression. Possible cancer hazard.

Potential Health Effects

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

Acute Effects

Inhalation: Not normally a hazard due to nonvolatile nature of product. Inhalation hazard is increased at higher temperatures.

The mist is discomforting to the upper respiratory tract.

Inhalation of concentrated mists can cause coughing, sneezing, severe irritation, dizziness, headache and nausea.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration. The mist is moderately discomforting to the eyes.

The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

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

Irritation and skin reactions are possible with sensitive skin.

The material may accentuate any pre-existing dermatitis condition.

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

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

The liquid is discomforting and is regarded as harmful if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Phthalates (aromatic dicarboxylic acid esters), in general, exhibit low toxicity, partly because of poor absorption but mainly as a result of rapid metabolism in which the esters are saponified to phthalic acid (which is rapidly excreted) and the parent alcohol (which is subsequently metabolized). The pathology of these compounds seems to be related to the released alcohol and its biological effects. Testicular atrophy produced in rats during feeding studies depends on the length and structure of the alcohol; in general the lower molecular weight esters produce the more severe effects.

The toxicity of phthalic acid isomers decreases in the order o-phthalic acid, isophthalic acid and terephthalic acid.

Phthalic acid is not metabolized but is excreted, unchanged, in the urine and feces.

Terephthalic acid appears to potentiate the biological effects of substances such as antibiotics, thiamine and sulfonamides.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: Oral studies of 90-days to 2-years in rat, 1-year in guinea pig and up to 1-year in dog have shown a no-effect level of about 60 mg/kg/day. Higher doses produced growth retardation and increased weights of livers and kidneys.

Rats and mice fed on diets containing 6000-12000 (rats) and 3000-6000 (mice) mg/kg body weight for 103 weeks showed an increased incidence of hepatocellular carcinomas in female rats and male and female mice, and an increased incidence of either hepatocellular carcinomas or neoplastic nodules in male rats. About 35% of the hepatocellular carcinomas in mice had metastasised to the lungs.

The substance can cause testicular damage in rats (dietary and gavage studies) with a no-effect level in 0.3% to 0.5% in the diet. Inhalation or dermal exposures did not produce testicular effects. When the substance was fed to pregnant rats (5 mL/kg) it produced slight effects on embryonic and fetal development with skeletal abnormalities more common.

A Russian study describes exposure by workers to mixed phthalates (and other plasticizers) - pain, numbness and spasms in the upper and lower extremities were related to duration of exposures. Symptoms usually developed after the sixth or seventh year of work. Neurological studies revealed the development of polyneuritis in about 30% of the workers involved in this study. About 30% of the workforce showed depression of the vestibular receptors. Because the study described mixed exposures it is difficult to determine what, if any, unique role was played by the phthalates.

Increased incidences of anovulatory reproductive cycles and low estrogen concentrations were reported among Russian women working with phthalate plasticizers; the abnormal cycles were associated with spontaneous abortion. The specific phthalates implicated, dose levels and other data were not reported.

It has been alleged that the phthalates mimic or interfere with sex hormones. Phthalates are added as plasticizers in plastics (including food packaging) and are used as ingredients in paints, inks and adhesives. Their potential for entering the human body is marked. They have been added to a list of chemicals (including alkyl phenolics, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and dioxins) which are implicated in reducing sperm counts and fertility in males a phenomenon which has apparently arisen since the mid 1960s.

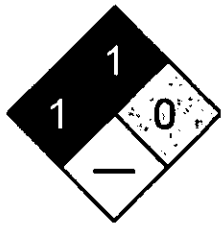
Although the human fetus is "bathed" in naturally occurring estrogens during pregnancy it is suggested that it has developed a protective mechanism against natural estrogens but is not safe from synthetic variants. These tend to accumulate in body fats which sets them apart from the natural product. During early pregnancy, fats are broken down and may flood the body with concentrated pollutants.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
Eye Contact: Immediately hold eyes open and flush continuously with running water for at least 15 minutes. Ensure irrigation under eyelids.
Seek medical attention without delay.
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: 215 °C Open Cup
Autoignition Temperature: 391 °C
LEL: 0.3% v/v
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Combustible. Slight fire hazard when exposed to heat or flame.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit acrid smoke.
Mists containing combustible materials may be explosive.
Hot organic vapors or mist are capable of sudden spontaneous combustion when mixed with air even at temperatures below their published autoignition temperatures. The temperature of ignition decreases with increasing vapor volume and vapor/air contact times and is influenced by pressure change.
Ignition may occur under elevated-temperature process conditions especially in processes performed under vacuum subjected to sudden ingress of air or in processes performed at elevated pressure, where sudden escape of vapors or mists to the atmosphere occurs.



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Wipe up. Place in a suitable labeled container for waste disposal.
Large Spills: Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
Shut off all possible sources of ignition and increase ventilation.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.
Absorb or cover spill with sand, earth, inert material or vermiculite.
Recover liquid and place in labeled, sealable container for recycling.

Collect residues and seal in labeled drums for disposal.
Wash spill area with detergent and water.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use in a well-ventilated area.
Avoid generating and breathing mist and vapor.
Avoid contact with incompatible materials.
Avoid prolonged and repeated skin contact.
Avoid smoking, bare lights or ignition sources.
Avoid physical damage to containers.
Keep containers securely sealed when not in use.
Wear personal protective equipment when handling.
When handling, DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: None under normal operating conditions. OTHERWISE: General exhaust is adequate under normal operating conditions.
If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.
If mist is present, use air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream and Nitrile rubber gloves or Neoprene rubber gloves.
Safety footwear.
Respiratory Protection:
Exposure Range >5 to 50 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to 500 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >500 to <5000 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 5000 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)
Other: Overalls. Eyewash unit.
Glove Selection Index:
BUTYL.....Best selection
VITON.....Best selection
NITRILE.....Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Light-colored, odorless and oily liquid. Mixes with mineral oil and most organic solvents.
Physical State: Liquid
Vapor Pressure (kPa): 0.17 at 200 °C
Vapor Density (Air=1): 13.45
Formula Weight: 390.54
Specific Gravity (H_2O=1, at 4 °C): 0.99 at 20 °C
Water Solubility: < 0.01% at 25 °C
Evaporation Rate: Very Slow
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 230 °C (446 °F) at 5 mm Hg
Freezing/Melting Point Range: -50 °C (-58 °F)

Section 10 - Stability and Reactivity

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

Section 11 - Toxicological Information

TOXICITY
Oral (rat) LD_{50}: 30000 mg/kg
Oral (human) TD_{Lo}: 143 mg/kg
Oral (mouse) LD_{50}: 1500 mg/kg
Oral (rabbit) LD_{50}: 34000 mg/kg
Dermal (rabbit) LD_{50}: 25000 mg/kg
Intraperitoneal (rabbit) LD_{50}: >31 mL/kg
Oral (guinea pig) LD_{50}: 26000 mg/kg
Dermal (g.pig) LD_{50}: 10000 mg/kg

IRRITATION
Skin (rabbit): 500 mg/24 hr mild
Eye (rabbit): 500 mg/24 hr mild

Gastrointestinal changes, respiratory system changes, somnolence, hemorrhage, necrotic changes in GI tract, lowered blood pressure, liver, endocrine tumors, feto toxicity, paternal effects, maternal effects, specific developmental abnormalities (hepatobiliary system, musculoskeletal system, cardiovascular system, urogenital system, central nervous system, eye/ear), fetolethality recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

See NIOSH, *RTECS* TI 0350000, for additional data.

Section 12 - Ecological Information

Environmental Fate: In water it will biodegrade (half-life 2-3 wk), adsorb to sediments and bioconcentrate in aquatic organisms. Atmospheric material will be carried long distances and be removed by rain.

Ecotoxicity: LC_{50} Gammarus pseudolimnaeus more than 32 mg/l/96 hr at 21 °C; juvenile /static bioassay; LC_{50} Ictalurus punctatus (channel catfish) more than 100 mg/l/96 hr at 20 °C; wt 1.5 g /static bioassay; EC_{50} Gymnodinium breve growth rate 3.1% vol/vol/96 hr /Conditions of bioassay not specified; LC_{50} Oncorhynchus kisutch (coho salmon) more than 100 mg/l/96 hr at 16 °C; wt 1.5 g /static bioassay; LC_{50} Daphnia magna: 1,000-5,000 ug/l/48 hr /Conditions of bioassay not specified; LC_{50} Chironomus plumosus (Midge): > 18,000 ug/l/48 hr /Conditions of bioassay not specified

Henry's Law Constant: 1×10^{-4}

BCF: fish 2

Biochemical Oxygen Demand (BOD): acclimated < 1 lb/lb, 5 days

Octanol/Water Partition Coefficient: log $K_{ow} = 4.89$

Soil Sorption Partition Coefficient: $K_{oc} = 4$ to 5

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NONE
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U028 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Cadmium **MSDS No. 23**

Issue Date: 1999-10

Section 1 - Chemical Product and Company Identification 53

Product/Chemical Name: Cadmium
Chemical Formula: Cd
CAS Number: 7440-43-9 **EINECS Number:** 231-152-8
Synonyms: colloidal cadmium
Derivation: Cadmium is collected as dust or fume from roasting zinc ores, mixed with coal or coke and sodium or zinc chloride, and sintered. The cadmium fume is collected in an electrostatic precipitator, leached, fractionally precipitated, and distilled; collected as sludge from zinc sulfate purification; prepared from direct distillation of cadmium-bearing zinc; obtained by recovery from electrolytic zinc process; may be prepared from cadmium sulfate in the laboratory.
General Use: Cadmium is used as a constituent of easily fusible alloys; soft solder and solder for aluminum; in electroplating; as a deoxidizer for nickel plating; for process engraving; electrodes for cadmium vapor lamps; photoelectric cells; photometry of ultraviolet sun-rays; in Ni-Cd storage batteries; to charge Jones reductors; as an amalgam in dentistry; power transmission wire; TV phosphors; basis of pigments used in ceramic glazing, machinery enamels, baking enamels; Weston-standard-cell control of atomic fission in nuclear reactors; reactor control rods; fungicide; photography and lithography; selenium rectifiers.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Cadmium, ca 99.5+% wt
Trace Impurities: < 10 ppm

OSHA PELs
8-hr TWA: 0.005 mg/m^3
Fume* TWA: 0.1 mg/m^3; Ceiling 0.3 mg/m^3
Dust* TWA: 0.2 mg/m^3; Ceiling 0.6 mg/m^3

ACGIH TLVs
TWA: 0.01 mg/m^3 (inhalable fraction); 0.002 mg/m^3 (respirable fraction)

NIOSH REL
Reduce to lowest feasible level (LOQ 0.1 mg/m^3)

DFG (Germany) MAK
None established

IDLH Level
9 mg/m^3

AIHA WEEL
8-hr Dust TWA: (0.002 mg/m^3)

*Applies to operations or sectors for which the cadmium standard, 1910.1027, is stayed or otherwise not in effect.

Section 3 - Hazards Identification

ANSI Signal Word: Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Cadmium is a lustrous metal solid of silver-white to bluish color without odor. It is toxic by inhalation. Cadmium is irritating to the respiratory tract and mildly irritating to the skin. Chronic health effects include kidney damage and obstructive lung disease. Cadmium dust ignites spontaneously in air. It is an experimental carcinogen and teratogen.

Wilson Risk Scale	
R	1
I	4
S	1
K	1

HMIS	
H	3*
F	4**
R	0
PPE†	

*Chronic effects
** Fine dust
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation and ingestion
Target Organs: Respiratory system, kidneys
Acute Effects
Inhalation: Initial signs/symptoms of cadmium poisoning resemble those of the flu. Inhalation of dust or fumes causes throat dryness, cough, headache, vomiting, chest pain, dyspnea (shortness of breath), central nervous system (CNS) effects, extreme restlessness and irritability, pneumonitis, possibly bronchopneumonia, pulmonary edema, and death due to respiratory failure in severe cases. Symptoms may be delayed up to 24 hours. Residual emphysema and fibrosis may result. Note: heating of cadmium may produce cadmium oxide, the inhalation of which can result in metal fume fever, characterized by fever, chills, malaise, headache, myalgias, fatigue, cough, thirst, and abdominal discomfort, with symptom onset about 3 to 10 hours after exposure. Symptoms do not usually last beyond 24 to 48 hours.
Eye: May cause irritation.
Skin: Contact may cause irritation, skin eruptions and pruritus. Significant dermal absorption rarely occurs.
Ingestion: Causes increased salivation, dry mouth, choking, nausea, vomiting, abdominal pain and cramping, blurred vision, anemia, kidney dysfunction, diarrhea, gastroenteritis, and substernal pain.
Carcinogenicity: IARC - Group 1, Carcinogenic to humans; NIOSH - listed as carcinogen; NTP - Class 2A, Reasonably anticipated to be a carcinogen; OSHA - listed as a carcinogen; EPA - Class B1, Probable human carcinogen based on epidemiologic studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only; ACGIH - A2, Suspected human carcinogen.

Medical Conditions Aggravated by Long-Term Exposure: Kidney disorders, respiratory disorders.
Chronic Effects: Include chronic obstructive lung disease such as emphysema, kidney damage (renal tubular disorder and proteinuria (low molecular weight)), bone demineralization, microfractures and osteomalacia, respiratory cancer, gastrointestinal symptoms, anosmia (loss of sense of smell), rhinitis and discoloration of the teeth. It is implicated as the causative agent in Itai-Itai disease in Japan.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation persist.
Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. ***After first aid, get appropriate in-plant, paramedic, or community medical support.***
Note to Physicians: Consider a chest X-ray after acute exposure.

Section 5 - Fire-Fighting Measures

Flash Point: Data not found.
Autoignition Temperature: 482 °F (250 °C) (layer cadmium metal dust)
LEL: Data not found.
UEL: Data not found.
OSHA Flammability Classification: Flammable
Extinguishing Media: Extinguish with carbon dioxide, dolomite, dry powder, graphite, soda ash, sodium chloride, dry chemical, or sand.
Unusual Fire or Explosion Hazards: The finely divided material is pyrophoric. The more finely divided the powder the greater the fire/explosion hazard.
Hazardous Combustion Products: When heated to decomposition, toxic fumes of cadmium are emitted.
Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Cleanup personnel should protect against exposure (Sec. 8). Prevent entry into water, sewers, basements or confined areas.
Small Spills: If in solid form, *do not* sweep! Absorb or cover with dry earth, sand or other noncombustible material. Carefully scoop up or vacuum (with a HEPA filter).
Large Spills: *Do not* release into sewers or waterways.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120 and 1910.1027).

Section 7 - Handling and Storage

Handling Precautions: Wear personal protective clothing and equipment to prevent dust inhalation and any contact with skin or eyes (Sec. 8). Wash thoroughly after handling cadmium.
Storage Requirements: Store in tightly closed containers in a cool, well-ventilated area away from heat, light, ignition sources, incompatibles, and air. Cadmium slowly oxidizes in air to form cadmium oxide.
Regulatory Requirements: Areas where cadmium is used or stored must be labeled according to 29 CFR 1910.1027.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid dust dispersion into the work area.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below exposure limits (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.
Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on kidney functions (including urine screening for micro-globulins), lungs and blood. Follow written procedures set forth by OSHA in 29 CFR 1910.1027.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select respirator based on exposure range as follows. Exposure range >0.005 to 0.05 mg/m^3 use air purifying respirator, negative-pressure, half-mask; >0.05 to 0.5 mg/m^3 use air purifying respirator, negative-pressure, full-face; >0.5 to 5 mg/m^3/use supplied-air respirator, constant flow/pressure-demand, full-face; >5 mg/m^3/use a SCBA, pressure-demand, full-face. Use a magenta cartridge (P100). For emergency or nonroutine

operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, cartridge change schedules, and convenient, sanitary storage areas.

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

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid; lustrous metal or granular powder
Color: Silver-white, blue-tinged
Odor: Odorless
Vapor Pressure: 1 mm Hg at 741 °F (394 °C)
Formula Weight: 112.41
Density: 8.642 at 77 °F (25 °C)
Water Solubility: Insoluble
Other Solubilities: Dissolved by acids; ammonium nitrate solution
Boiling Point: 1409 °F (765 °C)
Melting Point: 609.8 °F (321 °C)
Refractive Index: 1.8 at 578 nm and 20 °C/D
Ionization Potential (eV): 8.99367

Section 10 - Stability and Reactivity

Stability: Cadmium is stable at room temperature in closed containers under normal storage and handling conditions. It slowly oxidizes in air to form cadmium oxide. Finely divided material is pyrophoric, i.e., it may ignite or explode spontaneously in air.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include acids (reacts readily with dilute nitric acid, slowly with hydrochloric acid); explodes on contact with hydrazoic acid; violent or explosive reaction when heated with ammonium nitrate; tellurium; zinc; ammonia; sulfur; selenium; nitryl fluoride; oxidizing agents; metals.

Conditions to Avoid: Avoid creation of dust clouds, contact with chemical incompatibles, heat, and sources of ignition.

Hazardous Decomposition Products: Thermal oxidative decomposition of cadmium can produce toxic fumes of cadmium and cadmium oxide.

Section 11 - Toxicological Information

Toxicity Data:*

Acute Dermal Effects:
Rabbit, subcutaneous, LD_{Lo}: 6 mg/kg

Acute Inhalation Effects:
Human, inhalation, LC_{Lo}: 39 mg/m^3/20 minutes produced cardiac changes; respiratory depression.
Rat, inhalation, LC_{50}: 25 mg/m^3/30 minutes produced dyspnea.

Acute Oral Effects:
Rat, oral, LD_{50}: 2330 mg/kg
Mouse, oral, LD_{50}: 890 mg/kg

Multiple Dose Toxicity Data:
Human, inhalation, TC_{Lo}: 88 µg/m^3/8.6 years produced proteinuria.
Rat, oral, 546 mg/kg administered for 26 weeks continuously produced toxic effects: changes in serum composition; transminases; weight loss or decreased weight gain.
Rat, oral, 1512 mg/kg administered for 48 weeks continuously produced toxic effects: changes to liver, kidneys, ureter and bladder.

Tumorigenic Effects:
Woman, inhalation, 129 µg/m^3/20 years, continuous produced toxic effects: carcinogenic by RTECS criteria; Lung, thorax or respiration - tumors.
Rat, subcutaneous, 3372 µg/kg produced toxic effects: carcinogenic by RTECS criteria, tumors at site of application.

Genetic Effects:
Mouse, micronucleus test, cell type - embryo: 6 µmol/L induced mutation.
Hamster, cytogenic analysis, cell type - ovary: 1 µmol/L induced mutation.

Reproductive Effects:
Rat, female, oral, 23 mg/kg administered on gestational days 1 - 22 produced specific developmental abnormalities - blood and lymphatic system (including spleen and marrow).
Rat, female, oral, 21.5 mg/kg administered to multigenerations produced toxic effects: Effects on fertility - preimplantation mortality; Effects on newborn - germ cell effects in offspring.
Rat, male, oral, 155 mg/kg administered 13 weeks prior to mating produced toxic effects: Effects on newborn - reduced weight gain and behavioral.

* See NIOSH, *RTECS* (EU9800000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Dreisena polymorpha*, zebra mussels, chronic LC_{50}: 130 mcg/L; *Rivulus marmoratus*, mangrove fish, LC_{50} in fresh water: 2.96 mg/L; Steelhead trout, LC_{50}: 0.0009 ppm for 96 hours; *Daphnia magna*, 0.1 ppm lethal.
Environmental Fate: Data not found.

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable federal, state, and local regulations.
Disposal Regulatory Requirements: Dispose of according to EPA regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Cadmium compounds
Shipping Symbols: -
Hazard Class: 6.1
ID No.: UN2570
Packing Group: III
Label: Keep away from food
Special Provisions (172.102): -

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger Aircraft/Rail: 100 kg
b) Cargo Aircraft Only: 200 kg

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: -

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33); RCRA Hazardous Waste Number: D006
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per (2) CWA, Sec. 307(a)
CERCLA Final Reportable Quantity (RQ): 10 lb (4.54 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
Toxic Substances Control Act (TSCA): Listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)
OSHA Specifically Regulated Substance (29 CFR 1910.1027)

Section 16 - Other Information

References: 1, 99, 124, 136, 149, 161, 176, 164, 198, 209, 216, 222, 225, 226, 227, 230, 233, 234

Prepared By ..... M. Adams, Ph.D/S Fleming, BS
Research Date 1999-3
Review Date 1999-7
Industrial Hygiene Review ..... R Everett Langford, Ph.D., CIH, CSP
Medical Review ..... T Thoburn, MD, MPH

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

Issue Date: 2000-07

Chromium
MSDS 83
CHR4520

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Chromium
CAS Number: 7440-47-3
Chemical Formula: Cr
Structural Chemical Formula: Cr
Synonyms: CHROM; CHROME; CHROMIUM; CHROMIUM METAL
General Use: Used in the manufacture of chrome-steel or chrome-nickel-steel alloys (stainless steel); for greatly increasing resistance and durability of metals; for chrome-plating of other metals.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
chromium	7440-47-3	> 99.5

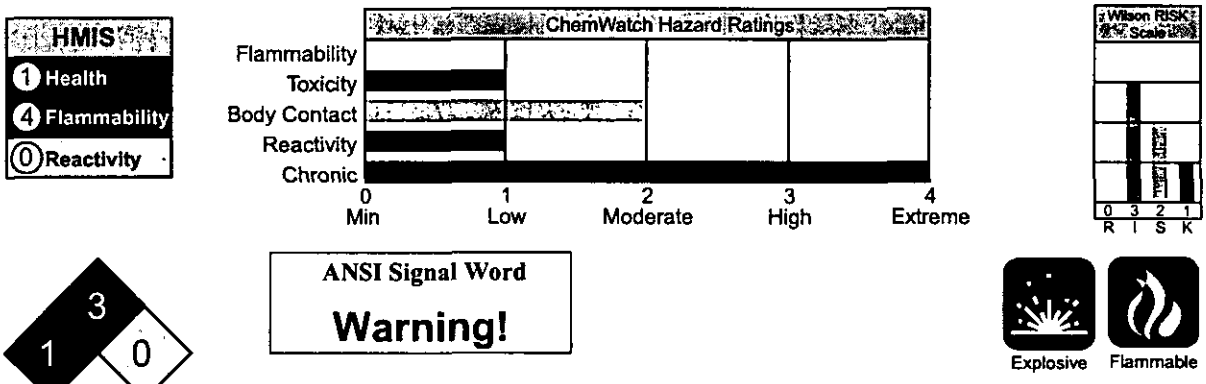
OSHA PEL
TWA: 1 mg/m^3; as Cr. Other Values: 0.1 mg/m^3; Clg Cr-VI as CrO_3.

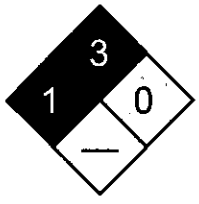
ACGIH TLV
TWA: 0.5 mg/m^3.

NIOSH REL
TWA: 0.5 mg/m^3; as Cr;Cr-II;Cr-III;Cr(VI)=.001.

IDLH Level
250 mg/m^3; as Cr.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Steel-gray, lustrous metal powder; odorless. Irritating to eyes/skin/respiratory tract. Chronic: exposure to chromium fumes can cause fibrosis of the lungs with decreased function. Flammable. Explosive in air.

Potential Health Effects

Primary Entry Routes: inhalation, skin absorption, ingestion
Target Organs: respiratory system
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.
Chrome fume is irritating to the respiratory tract and lungs.
Toxic effects result from over-exposure.
Asthmatic conditions may result as a consequence of the sensitizing action of chrome VI compounds.
Eye: The dust may produce eye discomfort and abrasive eye inflammation.
Skin: The material may be mildly discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.
Chrome fume, as the chrome VI oxide, is corrosive to the skin and may aggravate pre-existing skin conditions such as dermatitis and eczema.
As a potential skin sensitizer, the fume may cause dermatoses to appear suddenly and without warning. Absorption of chrome VI compounds through the skin can cause systemic poisoning effecting the kidneys and liver.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

Carcinogenicity: NTP - Listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems. The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

Chromium(III) is considered an essential trace nutrient serving as a component of the "glucose tolerance factor" and a cofactor for insulin action. High concentrations of chromium are also found in RNA. Trivalent chromium is the most common form found in nature.

Chronic inhalation of trivalent chromium compounds produces irritation of the bronchus and lungs, dystrophic changes to the liver and kidney, pulmonary edema, and adverse effects on macrophages. Intratracheal administration of chromium(III) oxide, in rats, increased the incidence of sarcomas, and tumors and reticulum cell sarcomas of the lung. There is inadequate evidence of carcinogenicity of chromium(III) compounds in experimental animals and humans (IARC).

Chronic exposure to hexavalent chromium compounds reportedly produces skin, eye and respiratory tract irritation, yellowing of the eyes and skin, allergic skin and respiratory reactions, diminished sense of smell and taste, blood disorders, liver and kidney damage, digestive disorders and lung damage. There is sufficient evidence of carcinogenicity of chromium(VI) compounds in experimental animals and humans to confirm these as Class 1 carcinogens (IARC).

Exposure to chromium during chrome production and in the chrome pigment industry is associated with cancer of the respiratory tract. A slight increase in gastrointestinal cancer following exposure to chromium compounds has also been reported. The greatest risk is attributed to exposure to acid- soluble, water-insoluble hexavalent chromium which occurs in roasting and refining processes. Animal studies support the idea that the most potent carcinogenic compounds are the slightly soluble hexavalent compounds.

The cells are more active in the uptake of the hexavalent forms compared to trivalent forms and this may explain the difference in occupational effect. It is the trivalent form, however, which is metabolically active and binds with nucleic acid within the cell suggesting that chromium mutagenesis first requires biotransformation of the hexavalent form by reduction.

Hexavalent chromes produce chronic ulceration of skin surfaces (quite independent of other hypersensitivity reactions exhibited by the skin).

Water-soluble chromium(VI) compounds come close to the top of any published "hit list" of contact allergens (eczematogens) producing positive results in 4 to 10% of tested individuals. On the other hand only chromium(III) compounds can bind to high molecular weight carriers such as proteins to form a complete allergen (such as a hapten). Chromium(VI) compounds cannot.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Seek medical attention if irritation or discomfort persist.

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

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

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

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

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

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

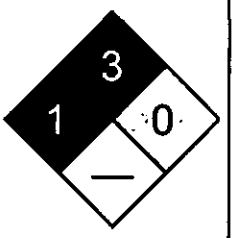
Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible Solid
Autoignition Temperature: 580 °C (cloud)
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.
General Fire Hazards/Hazardous Combustion Products: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Remove all ignition sources.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Clear area of personnel.
Contact fire department and tell them location and nature of hazard.
Control personal contact by using protective equipment.
Prevent, by any means available, spillage from entering drains or water ways.
Moderate hazard.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Avoid generating dust.
Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling.
Avoid physical damage to containers. Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Store in metal drums or safety cans.
Plastic container.
Metal can.
Metal drum.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Metal dusts must be collected at the source of generation as they are potentially explosive.
1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.

2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

Special ventilation requirements apply for processes which result in the generation of barium, chromium, lead, or nickel fume and in those processes which generate ozone.

The use of mechanical ventilation by local exhaust systems is required as a minimum in all circumstances (including outdoor work).

(In confined spaces always check that oxygen has not been depleted by excessive rusting of steel or snowflake corrosion of aluminum). Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

Personal Protective Clothing/Equipment

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

Hands/Feet: PVC gloves; Safety footwear.
Rubber gloves.

Respiratory Protection:

Exposure Range >1 to 10 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to <250 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 250 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)

Other: Overalls. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: A hard, brittle, lustrous, steel-grey metal which is very resistant to corrosion. Soluble in dilute sulphuric and hydrochloric acids. Welding flux grades typical sieve analysis (cumulative retention %):- 200 um 0, 150 um 10-40, 100 50-80, 75 um 80-95, 63 um 90-96, 43 um 97-100.

Physical State: Divided solid
Vapor Pressure (kPa): 0.13 at 1616 °C
Vapor Density (Air=1): 1.79
Formula Weight: 52.00
Specific Gravity (H_2O=1, at 4 °C): 7.2
Water Solubility: Insoluble in water
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 2642 °C (4788 °F)
Freezing/Melting Point Range: 1900 °C (3452 °F)
Volatile Component (% Vol): Nil
Decomposition Temperature (°C): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers, nitric oxide, potassium chlorate, sulfur dioxide, acids and strong alkalis.

Section 11 - Toxicological Information

No relevant toxicological data found at time of research.

See NIOSH, *RTECS* GB 4200000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
BCF: snails 1 $x10^6$
Biochemical Oxygen Demand (BOD): 62.5 lb/lb, 5 days

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options. Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: None
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 51/57

Material Name: Chrysene **CAS Number:** 218-01-9
Chemical Formula: $C_{18}H_{12}$
EINECS Number: 205-923-4
Synonyms: BENZO (A) PHENANTHRENE; BENZO[A|PHENANTHRENE; 1,2-BENZOPHENANTHRENE; BENZO(A)PHENANTHRENE; 1,2-BENZPHENANTHRENE; BENZ(A)PHENANTHRENE; CHRYSENE; COAL TAR PITCH VOLATILES: CHRYSENE; 1,2,5,6-DIBENZONAPHTHALENE
Derivation: Distilled from coal tar, coal tar pitch. A small amount is produced from the distillation or pyrolysis of many fats and oils. By heating hydrogen and acetylene. Chrysene is not produced commercially in the U.S. (except as a laboratory research chemical).
General Use: Used in organic synthesis; as a research chemical. Occurs in cigarette smoke.

Section 2 - Composition / Information on Ingredients

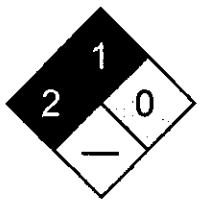
Name	CAS	%
No data found.		

OSHA PEL
TWA: 0.2 mg/m^3.

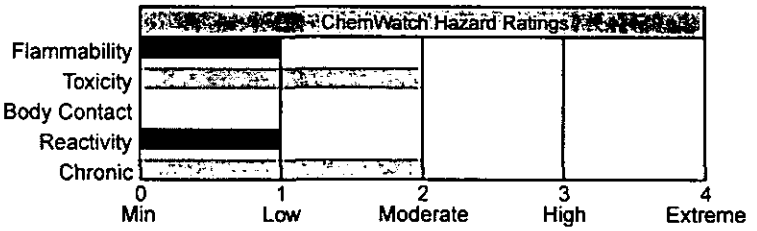
NIOSH REL
No data found.

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

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Chrysene exists as colorless to white crystals with reddish-blue fluorescence. This poycyclic aromatic hydrocarbon (PAH) is often present in mixtures of PAHs. May be irritating to skin, eyes, and respiratory system. It may be absorbed through the skin. Animal data indicate that chrysene may be cancer-causing in humans. Handle with care. Chrysene is combustible.

Potential Health Effects

Target Organs: Eyes, skin, respiratory system
Primary Entry Routes: Skin absorption
Acute Effects *There is no human evidence available for the acute health effects of chrysene alone. There is, however, considerable data indicating that it is carcinogenic in humans. Based on the chemical properties of chrysene, as a polynuclear aromatic hydrocarbon, the following acute effects may occur.*
Inhalation: May cause irritation.
Eye: . May cause irritation.
Skin: May cause irritation or be absorbed.
Ingestion: None reported.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Animal data indicate that chronic exposure to chrysene and other coal tar pitch volatiles probably causes cancer. May also cause respiratory, skin, or eye irritation; cough, bronchitis, photosensitivity, "coal tar warts" (precancerous lesions enhanced by UV light exposure), erythema (skin inflammation), dermal burns, acneiform lesions, hematuria (blood in urine). May alter genetic material. Exposure to PAH's is believed to cause leukoplakia (precancerous patches on the tongue), lip and oral cavity cancers, and bladder cancer.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

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

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

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

Note to Physicians: For high exposures, medical surveillance (skin, mouth, GI tract, respiratory system) may be necessary.

Section 5 - Fire-Fighting Measures

Flash Point: Combustible solid

Autoignition Temperature: None reported.

LEL: None reported.

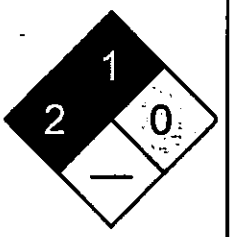
UEL: None reported.

Flammability Classification: Combustible solid

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

General Fire Hazards/Hazardous Combustion Products: Acrid smoke and fumes, including carbon monoxide and carbon dioxide.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Tag container as defective and return to supplier. Use spark-proof tools and explosion-proof equipment.

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills: Large spills of chrysene are unlikely. *Do not* release into sewers or waterways.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid dust inhalation and skin and eye contact. Use only with adequate ventilation to maintain concentrations at nonhazardous levels (see Sec. 2). Wear personal protective clothing and equipment to prevent contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid dust dispersion into the work area. Ventilate at the site of chemical release. To prevent static sparks, electrically ground and bond all containers and equipment. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (see Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the skin and lungs.

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

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Air purifying respirators may be adequate for handling small amounts of chrysene in a laboratory setting. For unlimited exposure ranges, wear a pressure-demand, full-face SCBA. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless to white rhombic plates with reddish-blue fluorescence.

Physical State: Solid

Vapor Pressure (kPa): 6.3 x10^{-7} mm Hg; 6.3 x10^{-9} mm Hg at 68 °F (20 °C)

Formula Weight: 228.28

Specific Gravity (H_2O=1, at 4 °C): 1.274 at 20 °C/4 °C

Refractive Index: 2610

Boiling Point: 838 °F (448 °C); sublimes easily in a vacuum

Freezing/Melting Point: 489 °F (254 °C) to 496 °F (258 °C)

Ionization Potential (eV): 7.59 +/- 0.2 eV

Water Solubility: Insoluble (0.0018 mg/kg)

Other Solubilities: Slightly soluble in 95% ethanol, acetone, carbon disulfide, ether, glacial acetic acid. Soluble in hot benzene, toluene.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Chrysene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid contact with chemical incompatibles, heat and ignition sources.

Storage Incompatibilities: Include strong oxidizers.

Hazardous Decomposition Products: Thermal oxidative decomposition of chrysene can produce acrid smoke and fumes, including carbon monoxide and carbon dioxide.

Section 11 - Toxicological Information

Acute Skin Effects:\
Mouse, skin: 192 µmol/kg produced DNA adducts.\
Mouse, skin, TD_{Lo}: 3600 µg/kg.\

Other Effects:\
Tumorgenicity, mouse, skin: 23 mg/kg; toxic effects: tumorigenic - neoplastic by RTECS criteria; skin and appendages - tumors.\
Human, lymphocyte: 6 µmol/L produced mutation.\
Mouse, intraperitoneal, LD_{50}: >320 mg/kg.\
Tumorigenic Effects: Mouse, skin, 3600 mg/kg for 30 weeks, intermittent; toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors.\
Hamster, intraperitoneal: 900 mg/24 hr induced sister chromatid exchange.\
Bacteria, *S typhimurium*: 5 mg/plate (-S9) produced mutation.

See NIOSH, *RTECS* GC0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to water, it will adsorb very strongly to sediments and particulate matter, but will not hydrolyze or appreciably evaporate. It will bioconcentrate in species which lack microsomal oxidase. Calculated BCF: 4,230. K_{ow} indicates bioaccumulation, which could cause food-chain contamination. It will not hydrolyze or appreciably evaporate from soils or surfaces. The estimated biodegradation half-life in soil is 7 years. The estimated half-life of any gas phase in the atmosphere is 1.25 hours as a result of reaction with photochemically produced hydroxyl radicals. It will be subject to near-surface, direct photolysis with a half-life of 4.4 hours computed for exposure to sunlight at mid-day in midsummer at latitude 40°N. If released to air, it will be subject to direct photolysis, although adsorption to particulates may affect the rate of this process. If released to soil it will be expected to adsorb very strongly to the soil and will not be expected to leach appreciably to groundwater.

Ecotoxicity: *Anabaena flos-aquae* (algae), 2 weeks, EC_{35} growth: +/- 0.002 mg/L. *Daphnia magna* (crustaceans), 2 hr, LC_{50}: 1.9 mg/L. *Rana pipiens* (amphibians), 24 hr, LC_{50}: >6.7 mg/L. *Neanthes arenaceodentata* (fishes), 96 hr, LC_{50}: >1 mg/L.

Henry's Law Constant: 9.4×10^{-6}

Octanol/Water Partition Coefficient: log K_{ow} = 5.61 to 5.91

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. One method is to dissolve or mix the material with a combustible solvent and burn in an incinerator equipped with an afterburner and scrubber. Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

Additional Shipping Information: *If in a quantity in one package which equals or exceeds the final reportable quantity (RQ) of 100 lb (45.4 kg)

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U050 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2000-07

Copper
MSDS 162
COP1000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Copper
CAS Number: 7440-50-8
Chemical Formula: Cu
Structural Chemical Formula: Cu
Synonyms: ALLBRI NATURAL COPPER; ANAC 110; ARWOOD COPPER; BRONZE POWDER; C.I. 77400; C.I. PIGMENT METAL 2; CDA 101; CDA 102; CDA 110; CDA 122; CE 1110; COPPER; COPPER BRONZE; COPPER M 1; COPPER METAL DUSTS; COPPER METAL FUMES; COPPER POWDER; COPPER SLAG-AIRBORNE; COPPER SLAG-MILLED; COPPER-AIRBORNE; COPPER,METALLIC POWDER; COPPER-MILLED; CU M3; CUPRUM; E 115 (METAL); EPA PESTICIDE CHEMICAL CODE 022501; 1721 GOLD; GOLD BRONZE; KAFAR COPPER; M 1; M 3; M 4; M1 (COPPER); M2 (COPPER); M3 (COPPER); M3R; M3S; M4 (COPPER); OFHC CU; RANEY COPPER
General Use: Manufacture of bronzes, brass, other copper alloys, electrical conductors, ammunition, copper salts, works of art, catalyst, oxygen scavenger.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
copper	7440-50-8	>99

OSHA PEL
TWA: 0.1 mg/m^3; as Cu, fume.

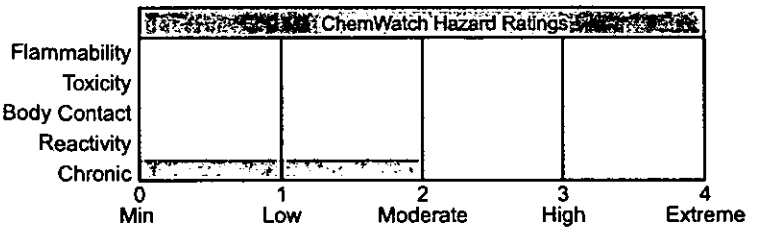
NIOSH REL
TWA: 1 mg/m^3.

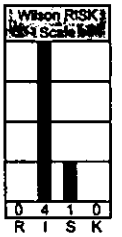
DFG (Germany) MAK
TWA: 0.1 mg/m^3.

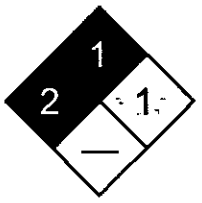
ACGIH TLV
TWA: 0.2 mg/m^3; as Cu; Inhalable.

IDLH Level
100 mg/m^3; as Cu.

Section 3 - Hazards Identification







Fire Diamond

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Red/brown-colored powder; odorless. Irritating. Also causes: skin discoloration; ingestion: nausea, vomiting, abdominal pain, diarrhea. Inhalation of copper fume: metal fume fever. Chronic: respiratory disease, dermatitis.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion
Target Organs: respiratory system, skin, eyes, liver, kidneys
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Copper poisoning following exposure to copper dusts and fume may result in headache, cold sweat and weak pulse. Capillary, kidney, liver and brain damage are the longer term manifestations of such poisoning. Inhalation of freshly formed metal oxide particles sized below 1.5 microns and generally between 0.02 to 0.05 microns may result in "metal fume fever". Symptoms may be delayed for up to 12 hours and begin with the sudden onset of thirst, and a sweet, metallic or foul taste in the mouth.

Other symptoms include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalized feeling of malaise. Mild to severe headache, nausea, occasional vomiting, fever or chills, exaggerated mental activity, profuse sweating, diarrhea, excessive urination and prostration may also occur. Tolerance to the fumes develops rapidly, but is quickly lost. All symptoms usually subside within 24-36 hours following removal from exposure.

Nasal ulcerations with resultant nose-bleed may occur following inhalation of fine dusts.

Eye: Particulate/dust is regarded as discomforting and abrasive to the eyes.

Skin: The material may be slightly discomforting and abrasive to the skin.

Ingestion: The material may be mildly discomforting to the gastrointestinal tract if swallowed in large quantity. Large oral doses may cause nausea, vomiting, abdominal pain, metallic taste and diarrhea. If vomiting does not occur immediately, systematic copper poisoning may occur; capillary damage, headache, cold sweat, weak pulse, kidney and liver damage may be the result of poisoning.

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

Chronic Effects: Chronic exposure to copper dusts may result in runny nose, irritation of mucous membranes and atrophic changes with resultant dementia.

Pre-existing skin, kidney, liver and pulmonary disorders may be aggravated by exposure.

Chronic copper poisoning is rarely recognized in man although in one instance, at least, symptoms more commonly associated with exposures to mercury, namely infantile acrodynia (pink disease), have been described.

Tissue damage of mucous membranes may follow chronic dust exposure.

A hazardous situation is exposure of a worker with the rare hereditary condition (Wilson's disease or hereditary hepatolenticular degeneration) to copper exposure which may cause liver, kidney, CNS, bone and sight damage and is potentially lethal.

Hemolytic anemia (a result of red-blood cell damage) is common in cows and sheep poisoned by copper derivatives.

Overdosing of copper feed supplements has resulted in pigmentary cirrhosis of the liver.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

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

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

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

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

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

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: Copper, magnesium, aluminum, antimony, iron, manganese, nickel (and their compounds) in welding, galvanizing or smelting operations all give rise to thermally produced particulates of smaller dimension than might be produced if the metals are divided mechanically. Where insufficient ventilation or respiratory protection is available these particulates may produce "metal fume fever" in the worker.

1.Onset occurs in 4-6 hours generally on the evening following exposure.

Tolerance develops in workers but may be lost over the weekend. (Monday Morning Fever).

2.Pulmonary function tests may indicate reduced lung volumes, small airway obstruction and decreased carbon monoxide diffusing capacity but these abnormalities resolve after several months.

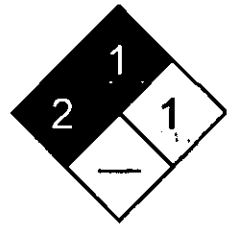
3.Although mildly elevated urinary levels of heavy metal may occur they do not correlate with clinical effects.

4.The general approach to treatment is recognition of the disease, supportive care and prevention of exposure.

5.Seriously symptomatic patients should receive chest x-rays, have arterial blood gases determined and be observed for the development of tracheobronchitis and pulmonary edema.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible, except as a powder
Autoignition Temperature: Not applicable
Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.
General Fire Hazards/Hazardous Combustion Products: Does not burn.



Fire Diamond

Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.
Fire Incompatibility: Avoid contact with acetylene, ammonium nitrate, barium bromate, chlorate and iodate, bromates, phosphorus, potassium chlorate, potassium iodate, potassium peroxide, sodium azide, sodium chlorate and iodate, sodium peroxide, sulfur and chlorates.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Cool fire-exposed containers with water spray from a protected location.
Do not approach containers suspected to be hot.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Control personal contact by using protective equipment and dust respirator.
Prevent spillage from entering drains, sewers or waterways.
Avoid generating dust. Sweep, shovel up. Recover product wherever possible.
Put residues in labeled plastic bags or other containers for disposal.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling.
Avoid physical damage to containers. Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Glass container.
Plastic drum.
Polyethylene or polypropylene container.
Metal can.
Metal drum.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment

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

Hands/Feet: No special equipment needed when handling small quantities.
OTHERWISE: Wear chemical protective gloves, eg. PVC.

Respiratory Protection:
Exposure Range >0.1 to 1 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1 to 10 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >10 to 100 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >100 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)
Note: as a fume; if exposure is as a dust, respirator recommendations are different

Other: No special equipment needed when handling small quantities.
OTHERWISE: Overalls. Barrier cream. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Reddish metallic solid with high electrical conductivity. Odorless.

Physical State: Divided solid
Vapor Pressure (kPa): 0.13 at 1628 °C
Formula Weight: 63.5
Specific Gravity (H_2O=1, at 4 °C): 8.94
Water Solubility: Insoluble in water
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 2595 °C (4703 °F)
Freezing/Melting Point Range: 1083 °C (1981.4 °F)
Volatile Component (% Vol): Not applicable
Decomposition Temperature (°C): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with acetylene, ammonium nitrate, bromates, chlorates, chlorine, chlorine plus oxygen difluoride, chlorine trifluoride, ethylene oxide, fluorine, hydrazine, mononitrate, hydrozoic acid, hydrogen peroxide, hydrogen sulfide, iodates, lead azide, phosphorus, nitric acid, potassium peroxide, sodium azide, sodium peroxide, sulfur plus chlorates, and 1-bromo-2-propylene.

Section 11 - Toxicological Information

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

TOXICITY
Oral (human) TD_{Lo}: 0.12 mg/kg

IRRITATION
Nil Reported

See NIOSH, *RTECS* GL 5325000, for additional data.

Section 12 - Ecological Information

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

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options. Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NONE
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Material Safety Data Sheet Collection

Genium group inc.
1171 RiverFront Center Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2005-05

Copper Sulfate
COP9000

Section 1 - Chemical Product and Company Identification 47 / 60

Material Name: Copper Sulfate
CAS Number: 7758-98-7
Chemical Formula: CuO_4S; $CuH_{10}O_9S$
Structured Chemical Formula: $CuSO_4$; $CuSO_4 \cdot 5H_2O$
EINECS Number: 231-847-6
ACX Number: X1002517-9
Synonyms: ALL CLEAR ROOT DESTROYER; AQUA MAID PERMANENT ALGAECIDE; AQUATRONICS SNAIL-A-CIDE DRI-PAC SNAIL POWDER; BCS COPPER FUNGICIDE; BLUE COPPER; BLUE COPPER AS; BLUE COPPERAS; BLUE STONE; BLUE VICKING; BLUE VITRIOL; BLUESTONE; BONIDE ROOT DESTROYER; CALCANTHITE; COPPER MONOSULFATE; COPPER SULFATE; COPPER SULFATE (1:1); COPPER(2+) SULFATE; COPPER(2+) SULFATE (1:1); COPPER SULFATE (CUSO4) PENTAHYDRATE; COPPER SULFATE PENTAHYDRATE; COPPER(2+) SULFATE PENTAHYDRATE; COPPER SULFATE POWDER; COPPER SULPHATE; COPPER(II) SULFATE; COPPER(II) SULFATE PENTAHYDRATE (1:1:5); CP BASIC SULFATE; CSP; CUPRIC SULFATE; CUPRIC SULFATE ANHYDROUS; CUPRIC SULFATE,PENTAHYDRATE; CUPRIC SULPHATE; GRANULAR CRYSTALS COPPER SULFATE; GRIFFIN SUPER CU; INCRACIDE 10A; INCRACIDE E 51; KILCOP 53; KOBASIC; KUPFERSULFAT; KUPFERSULFAT-PENTAHYDRAT; KUPFERVITRIOL; PHELPS TRIANGLE BRAND COPPER SULFATE; PHYTO-BORDEAUX; ROMAN VITRIOL; SA-50 BRAND COPPER SULFATE GRANULAR CRYSTALS; SALZBURG VITRIOL; SNOW CRYSTAL COPPER SULFATE; SULFATE DE CUIVRE; SULFURIC ACID COPPER(2+) SALT (1:1),PENTAHYDRATE; SULFURIC ACID,COPPER(2+) SALT (1:1); SULFURIC ACID,COPPER(2+) SALT,PENTAHYDRATE; TNCS 53; TOBACCO STATES BRAND COPPER SULFATE; TRIANGLE; TRINAGLE
Derivation: Occurs in nature as the mineral hydrocyanite. Produced commercially by reacting dilute sulfuric acid with copper or cupric oxide (often as oxide ores) in large quantities with evaporation and subsequent crystallization.
General Use: The anhydrous salt is used as a dehydrating agent (especially for alcohols) and as a fungicide. The pentahydrate has a wider range of uses, including use as a fungicide, algicide, bactericide, herbicide, food and fertilizer additive, pigment for paints and varnishes, reagent toner in photography, flotation agent, battery electrolyte; in preparation of azo dyes and other copper compounds, preserving hides and tanning leather, in preserving wood, electroplating solutions, petroleum refining, pyrotechnic compositions, water-resistant adhesives for wood, and in anti-rusting compositions for radiator and heating systems.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Copper sulfate		ca 100% wt

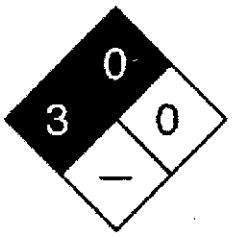
OSHA PEL

NIOSH REL

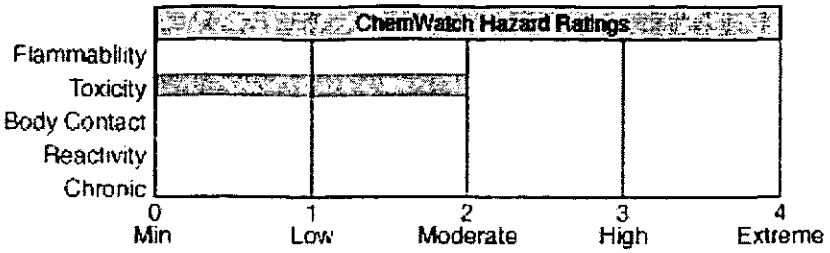
DFG (Germany) MAK
TWA: 1 mg/m^3; PEAK: 2 mg/m^3; as Cu, measured as inhalable fraction of the aerosol, substances with systemic effects, onset of effect within 2 hours.

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Warning!

♦♦♦♦♦ Emergency Overview ♦♦♦♦♦

Grayish-white to greenish-white crystals/powder, or blue crystals/powder. Severely irritating to eyes/skin/respiratory tract. Other Acute Effects: metallic taste, nausea, vomiting, damage to blood/kidneys.

Potential Health Effects

Target Organs: Eyes, skin, repsiratory tract, gastrointestinal tract, blood, kidneys, liver.

Primary Entry Routes: Inhalation, skin and eye contact, ingestion.

Acute Effects

Inhalation: Irritation of the respiratory tract. Systemic symptoms (as per ingestion) may also occur if sufficient amounts are absorbed through the mucous membranes of the respiratory tract.

Eye: Severe irritation may occur with clouding of the cornea and conjunctivitis.

Skin: Irritation with itching and eczema may occur.

Ingestion: Gastritis, ulceration of the gastrointestinal tract, diarrhea, nausea and vomiting, red blood cell hemolysis (leading to anemia), hypertension leading to shock, kidney tubule damage (suppression of urine followed by jaundice), and possible coma. Ingestion of as little as 5.3 mg has resulted in vomiting. Ingestion of 50 g, produced cyanosis, suppressed urination, anemia, severe intravascular hemolysis, and methemoglobinemia with death resulting in 16 hours. The lethal dose of copper sulfate for adults appears to vary widely from < 1 gram to several ounces.

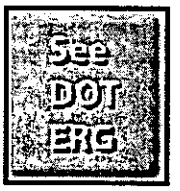
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Persons with Wilson's disease (inability to metabolize copper) or those with glucose-6-phosphate dehydrogenase deficiency are at increased risk of developing hemolytic anemia from exposure to copper or its salts (including copper sulfate).

Chronic Effects:

Liver degeneration will occur in persons with Wilson's disease. Mutation data has been reported.

Section 4 - First Aid Measures



Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.

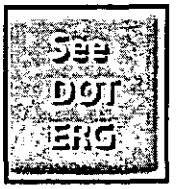
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

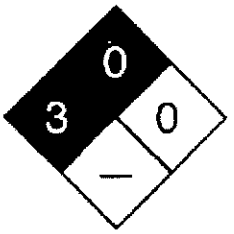
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

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

Note to Physicians: Treatment is symptomatic and supportive. Chelation therapy (dimercaprol/penicillamine) can be effective if performed shortly after ingestion.

Section 5 - Fire-Fighting Measures

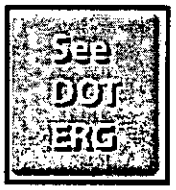




Fire Diamond

Flash Point: Noncombustible
Autoignition Temperature: Noncombustible
LEL: None reported.
UEL: None reported.
Flammability Classification: Noncombustible solid
Extinguishing Media: Use agents suitable for surrounding area.
General Fire Hazards/Hazardous Combustion Products: Carbon and sulfur oxide(s).
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures



Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against inhalation and skin/eye contact.
Small Spills: Carefully scoop up or vacuum (with appropriate filter) and place in suitable container.
Large Spills: Flush with water to containment area for later disposal. *Do not* release into sewers or waterways. Damp mop with dilute sodium bicarbonate solution.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use only with sufficient ventilation to prevent airborne hazards and wear appropriate PPE.
Never eat, drink, or smoke in work areas. Practice good personal hygiene after using copper sulfate, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.
Recommended Storage Methods: Store in tightly closed containers (hygroscopic) in a cool, dry, well-ventilated area away from incompatibles (Sec. 10). *Do not* store in iron or galvanized iron containers.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where possible, enclose processes to prevent dust dispersion into work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the blood and kidneys.
Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For <= 5 mg/m^3, wear any dust or mist respirator. For <= 10 mg/m^3, wear any dust or mist respirator except single-use and quarter-mask respirators or any supplied-air respirator. For <= 25 mg/m^3, wear any supplied-air respirator operated in continuous-flow mode or any powered, air-purifying respirator with a dust and mist filter. For <= 50 mg/m^3, wear any air-purifying, full facepiece respirator with a high-efficiency particulate filter; any powered, air-purifying respirator with a high-efficiency particulate filter, any SCBA with a full facepiece, or any supplied-air respirator with a full facepiece. For <= 100 mg/m^3, wear any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove copper sulfate from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Grayish-white to greenish-white crystals or powder (anhydrous), blue crystals or powder (pentahydrate); metallic taste.

Physical State: Solid
Formula Weight: 159.60
Density: 3.6 g/cm^3 (*anhydrous*), 2.284 g/cm^3 (*pentahydrate*)
Refractive Index: 1.733, 1.724, 1.739

Boiling Point: 392 °F/200 °C (slight decomposition); > 1202 °F/560 °C (decomposition to cupric oxide)
Water Solubility: 14.3 g/100 cc at 32 °F (0 °C), 75.4 g/100 cc at 212 °F (100 °C)
Other Solubilities: Slightly soluble in alcohol and glycerol. Soluble (1.04 g/100 cc) in methanol at 64.4 °F (18 °C).

Section 10 - Stability and Reactivity

Stability / Polymerization / Conditions to Avoid: Copper sulfate is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to incompatibles.
Storage Incompatibilities: Hydroxylamine (*ignites*), magnesium (*evolves hydrogen gas*), ammonia (or other caustic) + acetylene (*explodes*), sodium hypobromite, or nitromethane. Strongly corrosive to iron or galvanized iron.
Hazardous Decomposition Products: Thermal oxidative decomposition of copper sulfate can produce carbon and sulfur oxide(s).

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 300 mg/kg.

Human, oral, LD_{Lo}: 50 mg/kg caused somnolence, changes in kidney tubules (acute kidney failure and necrosis), and hemorrhage.

Human, oral, TD_{Lo}: 11 mg/kg caused gastritis, hypermotility, diarrhea, and nausea or vomiting.

Other Effects:

Rat, oral: 915 mg/kg administered intermittently for 1 year caused changes in the coronary artery and serum composition.

Rat, oral: 157 mg/kg administered intermittently for 6 weeks caused changes in adrenal weight, weight loss or decreased weight gain, and affected dehydrogenase levels.

Genetic Effects - Rat, liver cell: 1 mmol/L caused DNA damage.

Mouse, intravenous: 3200 •g/kg administered on the 8th day of pregnancy caused fetotoxicity and specific developmental abnomalities of the central nervous system and cardiovascular system.

See *RTECS* GL8800000 for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, copper sulfate may leach to groundwater, be partly oxidized, or bind to humic materials, clay, or hydrous oxides of iron and manganese. In water, it will bind to carbonates as well as humic materials, clay, and hydrous oxides of iron and manganese. Copper is accumulated by plants and animals, but it does not appear to biomagnify from plants to animals. This lack of biomagnification appears common with heavy metals. In air, copper aerosols (in general) have a residence time of 2 to 10 days in an unpolluted atmosphere and 0.1 to > 4 days in polluted, urban areas.
Ecotoxicity: American eel (*Anguilla rostrata*), LC_{50} = 3.20 mg/L/96 hr; Coho salmon (*Oncorhynchus kistuch*), LC_{50} = 286 mg/L/96 hr; rainbow trout, TL_m = 3.8 ppm/24 hr

Section 13 - Disposal Considerations

Disposal:
Add slowly to an excess of water, stir in soda ash, let stand 24 hr, decant liquid into new container and neutralize with 6 M HCl. Flush to drain with excess water. Landfill sludge. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

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

Shipping Name and Description: Copper based pesticides, solid, toxic
ID: UN2775
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7, IP1
Packaging:
Exceptions: None
Non-bulk: 211
Bulk: 242
Quantity Limitations:
Passenger aircraft/rail: 5 kg
Cargo aircraft only: 50 kg
Vessel Stowage:
Location: A
Other: 40

Shipping Name and Description: Copper based pesticides, solid, toxic
ID: UN2775
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging:
Exceptions: None
Non-bulk: 212
Bulk: 242
Quantity Limitations:
Passenger aircraft/rail: 25 kg
Cargo aircraft only: 100 kg
Vessel Stowage:
Location: A
Other:

Shipping Name and Description: Copper based pesticides, solid, toxic
ID: UN2775
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging:
Exceptions: 153
Non-bulk: 213
Bulk: 240
Quantity Limitations:
Passenger aircraft/rail: 100 kg
Cargo aircraft only: 200 kg
Vessel Stowage:
Location: A
Other:

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed

CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 10 lb (4.535 kg)

SARA 40 CFR 372.65: Listed as Compound

SARA EHS 40 CFR 355: Not listed

TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 56b/ 57

Material Name: Dibenzofuran **CAS Number:** 132-64-9
Chemical Formula: $C_{12}H_8O$
EINECS Number: 205-071-3
Synonyms: (1,1'-BIPHENYL)-2,2'-DIYL OXIDE; 2,2'-BIPHENYLENE OXIDE; 2,2'-BIPHENYLYLENE OXIDE; DIBENZO(B,D)FURAN; DIBENZOFURAN; DIBENZOL(B,D)FURAN; DIPHENYLENE OXIDE
General Use: Intermediate. Heterocyclic aromatic hydrocarbon.

Section 2 - Composition / Information on Ingredients

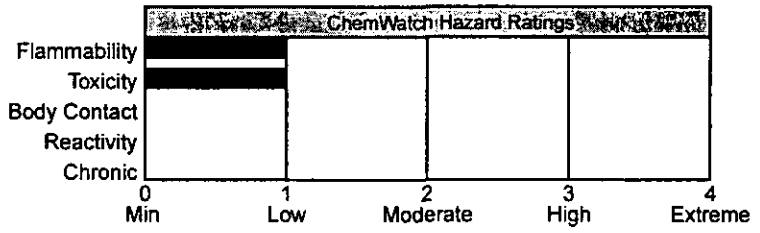
Name	CAS	%
dibenzofuran	132-64-9	>98

OSHA PEL
No data found.

NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, crystalline solid. May cause irritation. Other Acute Effects: may be harmful by inhalation, ingestion, or skin absorption. Will burn. Extinguishing agents: water spray, carbon dioxide, dry chemical powder, or appropriate foam.

Potential Health Effects

Target Organs: No data found.
Primary Entry Routes: skin contact/absorption and inhalation of generated dust
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract.
Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to windburn), temporary impairment of vision and/ or other transient eye damage/ ulceration.
Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.
Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Chronic Effects: The so-called polycyclic aromatic hydrocarbons (PAHs) comprise a large family; some members occur in coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified, in animal studies, as amongst the most highly active carcinogens.
Administration of PAHs to Rhesus monkey on the other hand has not yet proved successful in yielding tumors and there is inadequate date to support the proposition that individual PAHs produce cancer in humans. There are however a number of epidemiology and mortality studies that show increased incidence of cancer in humans exposed to mixtures of PAHs. Evidence exists of lung and genito-urinary cancer mortality amongst coke-oven workers and skin tumors in

workers exposed to creosote. Exposures to other chemical mixtures containing PAHs such as cigarette smoke, coal tar, coal tar pitch and bitumens, have been associated with increased incidences of lung cancer in humans.

Section 4 - First Aid Measures

Inhalation: • If dust is inhaled, remove to fresh air.
• Encourage patient to blow nose to ensure clear breathing passages.
• Rinse mouth with water. Consider drinking water to remove dust from throat.
• Seek medical attention if irritation or discomfort persist.
Eye Contact: If this product comes in contact with the eyes:
• Immediately hold the eyes open and flush with fresh running water.
• Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
• Seek medical attention if pain persists or recurs.
• Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: If product comes in contact with the skin:
• Immediately remove all contaminated clothing, including footwear (after rinsing with water).
• Wash affected areas thoroughly with water (and soap if available).
• Seek medical attention in event of irritation.
Ingestion: Rinse mouth out with plenty of water. Seek medical attention if irritation or discomfort persist.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: 130 °C
Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
• Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, i.e., flame or spark, will cause fire or explosion. Dust clouds generated by the fine grinding of the solid are a particular hazard; accumulations of fine dust may burn rapidly and fiercely if ignited
• Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
• Build-up of electrostatic charge may be prevented by bonding and grounding.
• Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting. Combustion products include carbon monoxide (CO).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: • Use water delivered as a fine spray to control fire and cool adjacent area.
• Do not approach containers suspected to be hot.
• Cool fire-exposed containers with water spray from a protected location.
• If safe to do so, remove containers from path of fire.
• Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: • Clean up all spills immediately.
• Avoid contact with skin and eyes.
• Wear impervious gloves and safety glasses.
• Use dry clean up procedures and avoid generating dust.
• Vacuum up or sweep up.
• Place spilled material in clean, dry, sealable, labeled container.
Large Spills: • Clear area of personnel and move upwind.
• Contact fire department and tell them location and nature of hazard.
• Control personal contact by using protective equipment and dust respirator.
• Prevent spillage from entering drains, sewers or waterways.
• Avoid generating dust.
• Sweep, shovel up. Recover product wherever possible.
• Put residues in labeled plastic bags or other containers for disposal.
• If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Limit all unnecessary personal contact.

- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- When handling, do not eat, drink or smoke.
- Always wash hands with soap and water after handling.
- Avoid physical damage to containers.
- Observe manufacturer's storage and handling recommendations.

Recommended Storage Methods: Polyethylene or polypropylene container. Plastic carboy. Plastic drum. Polyliner drum. Packing as recommended by manufacturer. Check that all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

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

Hands/Feet: Wear general protective gloves, e.g. light weight rubber gloves.

Other: Overalls; impervious protective clothing.

Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Tan powder.

Physical State: white, crystalline solid

Vapor Pressure (kPa): negligible

Vapor Density (Air=1): 5.8 Air=1

Formula Weight: 168.19

Specific Gravity (H_2O=1, at 4 °C): 1.0886 at 99 °C/4 °C

Evaporation Rate: not applicable

pH: not applicable

pH (1% Solution): not applicable

Boiling Point: 287 °C (549 °F) at 760 mm Hg

Freezing/Melting Point: 86 °C (186.8 °F) to 87 °C (188.6 °F)

Volatile Component (% Vol): negligible

Water Solubility: < 1 mg/mL at 20 °C

Section 10 - Stability and Reactivity

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

Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

No significant acute toxicological data identified in literature search.

See NIOSH, *RTECS* HP4430000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it will exist primarily in the gas-phase where it will degrade relatively rapidly by reaction with photochemically produced hydroxyl radicals (estimated half-life of 11.3 hr in average air). A small percentage released to air will exist in the particulate phase which may be relatively persistent to atmospheric degradation. Physical removal from air can occur by both wet and dry deposition. If released to water, it may partition significantly from the water column to sediments and suspended material. Volatilization from the water column may be important; however, sorption to sediment may diminish the potential importance of volatilization. If released to soil, it is not expected to leach significantly in most soil types. Biological screening studies have shown that it is biodegraded readily by adapted microbes in the presence of sufficient oxygen. However, in various groundwaters or aquatic sediments where oxygen is limited or lacking, biodegradation may occur very slowly resulting in long periods of persistence.

Ecotoxicity: No data found.

Henry's Law Constant: estimated at 9.73×10^{-5}

BCF: fish 947

Octanol/Water Partition Coefficient: $\log K_{ow} = 4.12$

Soil Sorption Partition Coefficient: $K_{oc} = 4600$ to 6350

Section 13 - Disposal Considerations

Disposal: • Consult manufacturer for recycling options and recycle where possible.
- Follow applicable local, state, and federal regulations.
- Incinerate residue at an approved site.

• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: No data found.

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CAA Section 112 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 55/ 57

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

Section 2 - Composition / Information on Ingredients

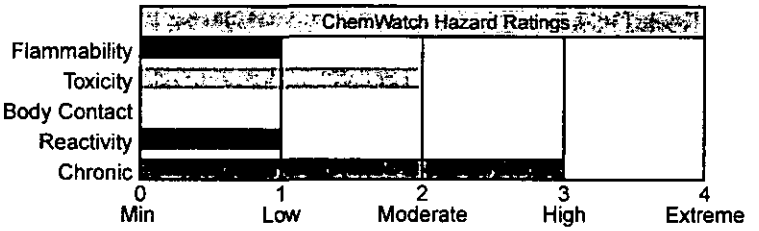
Name	CAS	%
dibenz[a,h]anthracene	53-70-3	>98

OSHA PEL
No data found.

NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Target Organs: respiratory system, liver
Primary Entry Routes: accidental skin and eye contact, inhalation of generated dusts
Acute Effects

Inhalation: The dust is harmful and discomforting to the upper respiratory tract. Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Eye: The dust may be discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/ or other transient eye damage/ ulceration.

Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material. Toxic effects may result from skin absorption.

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

Carcinogenicity: NTP - Listed; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: The so-called polycyclic aromatic hydrocarbons (PAHs) comprise a large family; some members occur in coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified, in animal studies, as amongst the most highly active carcinogens. Rodent species are sensitive to some PAHs with skin application producing cancerous growths. Injection produces soft tissue tumors (sarcomas) in rats and mice.

Administration of PAHs to Rhesus monkey on the other hand has not yet proved successful in yielding tumors and there is inadequate date to support the proposition that individual PAHs produce cancer in humans. There are however a number of epidemiology and mortality studies that show increased incidence of cancer in humans exposed to mixtures of PAHs. Evidence exists of lung and genito-urinary cancer mortality amongst coke-oven workers and skin tumors in workers exposed to creosote. Exposures to other chemical mixtures containing PAHs such as cigarette smoke, coal tar, coal tar pitch and bitumens, have been associated with increased incidences of lung cancer in humans.

Section 4 - First Aid Measures

Inhalation: • If dust is inhaled, remove to fresh air.
• Encourage patient to blow nose to ensure clear breathing passages.
• Rinse mouth with water. Consider drinking water to remove dust from throat.
• Seek medical attention if irritation or discomfort persist.
• If fumes or combustion products are inhaled, remove to fresh air.
• Lay patient down. Keep warm and rested.
• Other measures are usually unnecessary.
Eye Contact: • Immediately hold the eyes open and flush with fresh running water.
• Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
• Seek medical attention if pain persists or recurs.
• Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: • Immediately remove all contaminated clothing, including footwear (after rinsing with water).
• Wash affected areas thoroughly with water (and soap if available).
• Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center. If more than 15 minutes from a hospital:
• INDUCE vomiting with IPECAC SYRUP, or fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. NOTE: Wear a protective glove when inducing vomiting by mechanical means.
• SEEK MEDICAL ATTENTION WITHOUT DELAY.
• In the meantime, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
• If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided.
• If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: Not available; probably combustible
Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
• Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, e.g., flame or spark, will cause fire or explosion.
• Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
• Build-up of electrostatic charge may be prevented by bonding and grounding.
• Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e., nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves for fire only.
• Prevent, by any means available, spillage from entering drains or waterways.
• Use fire fighting procedures suitable for surrounding fire.
• Do not approach containers suspected to be hot.
• Cool fire-exposed containers with water spray from a protected location.
• If safe to do so, remove containers from path of fire.
• Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: • Clean up all spills immediately.
• Avoid contact with skin and eyes.
• Wear protective clothing, gloves, safety glasses and dust respirator.
• Use dry clean up procedures and avoid generating dust.
• Vacuum up or sweep up.
• Place in clean drum then flush area with water.
Large Spills: • Clear area of personnel and move upwind.
• Contact fire department and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves.
• Prevent, by any means available, spillage from entering drains or waterways.
• No smoking, bare lights or ignition sources.
• Increase ventilation.
• Stop leak if safe to do so.
• Water spray or fog may be used to disperse/absorb vapor.
• Contain or absorb spill with sand, earth or vermiculite.
• Collect recoverable product into labeled containers for recycling.
• Collect solid residues and seal in labeled drums for disposal.
• Wash area and prevent runoff into drains.
• After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
• If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid all personal contact, including inhalation.
• Wear protective clothing when risk of overexposure occurs.
• Use in a well-ventilated area.
• Prevent concentration in hollows and sumps.
• DO NOT enter confined spaces until atmosphere has been checked.
• Do not allow material to contact humans, exposed food or food utensils.
• Avoid smoking, bare lights or ignition sources.
• When handling, DO NOT eat, drink or smoke.
• Avoid contact with incompatible materials.
• Keep containers securely sealed when not in used.
• Avoid physical damage to containers.
• Always wash hands with soap and water after handling.
• Working clothes should be laundered separately. Launder contaminated clothing before reuse.
• Follow good occupational work practices.
• Observe manufacturer's storage/handling recommendations.
• Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Glass container. Plastic container. Metal can. Metal drum. Check that all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required. If risk of overexposure exists, wear NIOSH-approved respirator. Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields or chemical goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, e.g. PVC. Wear safety footwear.
Other: • Overalls.
• PVC Apron.
• PVC protective suit may be required if exposure severe.
• Eyewash unit.
• Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Light-yellow crystalline powder. Soluble in petroleum ether, benzene, toluene, xylene, oils and cyclohexanane.

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

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

No significant acute toxicological data identified in literature search.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

See NIOSH, *RTECS* HN2625000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Release to the environment is quite general since it is a ubiquitous product of incomplete combustion. It is largely associated with particulate matter, soils, and sediments. Its presence in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long distance transport. If it is released to soils it will be expected to adsorb very strongly to the soils and will not be expected to leach to the groundwater, hydrolyze or evaporate from soils or surfaces. It will be subject to biodegradation in soils with reported half-lives of 18 and 21 days. If it is released to water it will be expected to adsorb very strongly to sediments and particulate matter and to bioconcentrate in aquatic organisms which lack microsomal oxidase (this enzyme enables the rapid metabolism of certain polycyclic aromatic hydrocarbons). Based on limited data from laboratory screening tests using settled domestic wastewater and activated sludge, it may be subject to biodegradation in natural waters. Since it absorbs solar radiation strongly, it may be subject to direct photolysis in natural waters. However, adsorption may significantly retard photolysis as the photosensitivity of polyaromatic hydrocarbons is strongly dependent upon the nature of the surface upon which the compound is adsorbed. It will not hydrolyze and should not evaporate from water. If released to the atmosphere it will likely be associated with particulate matter and may be subject to moderately long range transport, depending mainly on the particle size distribution and climatic conditions which will determine the rates of wet and dry deposition. Its presence in areas remote from primary sources demonstrates the potential for this long range transport as well as it's considerable stability in the air. It may be subject to direct photolysis in the atmosphere; however, adsorption may significantly retard photolysis as the photosensitivity of polyaromatic hydrocarbons is strongly dependent upon the nature of the surface upon which the compound is adsorbed. The estimated vapor phase half-life in the atmosphere is 1.00 day as a result of reaction with photochemically produced hydroxyl radicals.
Ecotoxicity: TL_m Neanthes arenaceodentata > 1 ppm/96 hr at 22 °C in a static bioassay
Henry's Law Constant: calculated at 7 x10^{-8}
BCF: daphnia manga 652
Octanol/Water Partition Coefficient: log K_{ow} = 6.50
Soil Sorption Partition Coefficient: K_{oc} = sediments 8.05392 x10^5 to 3.059425 x10^6

Section 13 - Disposal Considerations

Disposal: • Recycle wherever possible or consult manufacturer for recycling options.
• Follow applicable local, state, and federal regulations.
• Bury residue in an authorized landfill.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U063 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 53/57

Material Name: Fluoranthene **CAS Number:** 206-44-0
Chemical Formula: $C_{16}H_{10}$
EINECS Number: 205-912-4
Synonyms: 1,2-BENZACENAPHTHENE; BENZENE,1,2-(1,8-NAPHTHALENEDIYL)-; BENZENE,1,2-(1,8-NAPHTHYLENE)-; BENZO (J,K) FLUORENE; BENZO(J,K)FLUORENE; BENZO(JK)FLUORENE; FLUORANTHENE; IDRYL; 1,2-(1,8-NAPHTHALENE)BENZENE; 1,2-(1,8-NAPHTHALENEDIYL)BENZENE; 1,2-(1,8-NAPHTHYLENE)BENZENE
Derivation: Fluoranthene is derived from coal tar and from the pyrolytic processing of organic raw materials such as coal or petroleum at high temperatures.
General Use: Fluoranthene is a constituent of coal tar and petroleum derived asphalt used as a lining material to protect the interior of steel and ductile-iron potable water pipes and storage tanks; used as a research chemical and medication.

Section 2 - Composition / Information on Ingredients

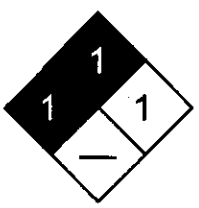
Name	CAS	%
Fluoranthene	206-44-0	ca 98% wt

OSHA PEL
No data found.

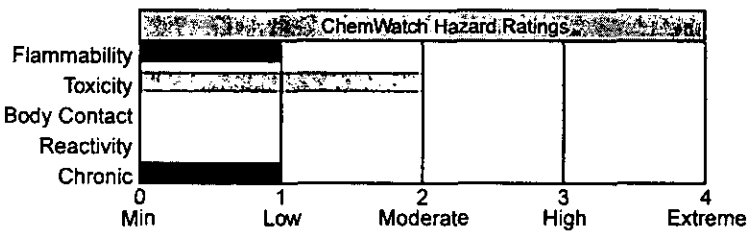
NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Fluoranthene is a colorless to pale yellow solid. It is irritating to the skin, eyes, and respiratory tract. Fluoranthene is combustible. Mutagenic and tumorigenic data exist. Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer.

Potential Health Effects

Target Organs: Eyes, skin, and respiratory system
Primary Entry Routes: Inhalation, skin/eye contact, ingestion
Acute Effects Note: In general, polynuclear aromatic hydrocarbons (PAH's) have a low order of acute toxicity in humans. The following effects from exposure are based on analogy to phenol and coal tar.
Inhalation: Causes irritation of the mucous membranes and upper respiratory tract.
Eye: Contact causes eye irritation and burning.
Skin: Contact causes skin irritation and burning.
Ingestion: Causes nausea, tachycardia, cardiac arrhythmias, pulmonary edema, and respiratory arrest.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: Persons with existing skin disorders may be more susceptible to the effects of coal tar pitches.

Chronic Effects: Cough and bronchitis, photosensitivity of the eyes and skin, coal tar warts, erythema, and acneiform lesions, leukoplakia, mild hepatotoxicity, and hematuria. Laboratory experiments have shown mutagenic and tumorigenic effects. Some PAH's have been associated with kidney, skin, bladder, lung, and gastrointestinal cancers. PAH's may cross the placenta and are excreted in breast milk in animals.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, lacrimation, or photophobia persist.

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

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

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

Note to Physicians: Monitor arterial blood gases, pulmonary function, and chest x-ray for patients with significant exposure. If cough or difficulty breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If bronchospasm and wheezing occur, consider treatment with inhaled sympathomimetic agents. Inhalation exposure to PAH's may be complicated by exposure to other substances which produce acute respiratory and systemic effects. Treat according to clinical presentation and exposure history. Treat dermal irritation or burns with standard topical therapy. Patients developing dermal hypersensitivity may require treatment with systemic or topical corticosteroids or antihistamines.

Section 5 - Fire-Fighting Measures

Flash Point: Data not found.

Autoignition Temperature: Data not found.

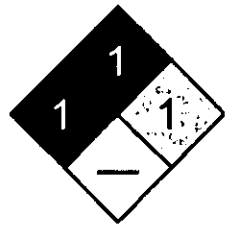
LEL: Data not found.

UEL: Data not found.

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

General Fire Hazards/Hazardous Combustion Products: Emits toxic fumes of carbon monoxide and carbon dioxide.

Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Cleanup personnel should protect against exposure (Sec. 8).

Small Spills: If in solid form, *do not* sweep! Spills of hot coal tar may be covered with sand. Carefully scoop up or vacuum (with a HEPA filter).

Large Spills: For large spills, dike far ahead of spill for later disposal. *Do not* release into sewers or waterways.

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

Section 7 - Handling and Storage

Handling Precautions: Wear personal protective clothing and equipment to prevent vapor inhalation and contact with skin or eyes (Sec. 8). To prevent skin absorption of coal tar products, *do not* use solvents to clean hands. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from heat, light, ignition sources, and incompatibles. Control storage conditions to prevent overheating and pressure buildup in containers of coal tar products. Design and operate transfer and storage systems to prevent blockage by condensed coal tar products.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor dispersion into the work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with this material. Train in work practices which minimize exposure. Institute a complete respiratory protection program which includes regular training, maintenance, inspection, cleaning, and evaluation. Make available to employees exposed to coal tar pitch volatiles a complete history and physical examination with emphasis on the oral cavity, respiratory tract, bladder, and kidneys. Examine the skin for evidence of chronic disorders, for premalignant and malignant lesions, and evidence of hyperpigmentation or photosensitivity. Obtain a urinalysis including specific gravity, albumin, glucose, and a microscopic examination of centrifuged sediment, as well as a test for red blood cells. Also perform a complete blood count to search for leukemia and aplastic anemia. Employees having 5 or more years of exposure or who are 45 years of age or older should have a urinary cytology exam. Employees having 10 or more years of exposure or who are 45 year of age or older should have a sputum cytology examination, a 14" x 17" chest roentgenogram, and periodic measure of FVC and FEV (1 sec).

Personal Protective Clothing/Equipment: Wear chemically protective gloves, aprons, and gauntlets to prevent any skin contact. Employees handling drums, cans, or other large containers of coal tar products shall wear impervious shoes or boots with safety toe caps. Protect leather safety shoes with impervious coverings such as rubbers. Wear cup type or rubber-framed chemical safety goggles with a full length, plastic face shield (20 cm min.), per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not protective eye devices. Appropriate eye protection must be worn instead of contact lenses. *Do not* wear contacts while working with fluoranthene.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For exposure to concentrations <= 2 mg/m^3, wear a chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high efficiency filter or any supplied-air respirator or any SCBA; for exposure to concentrations <= 10 mg/m^3, wear a chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high efficiency filter, or a gas mask with a chin style or a front- or back- mounted organic vapor canister and with a full facepiece and a fume or high efficiency filter, or any supplied-air respirator with a full facepiece, helmet, or hood or any SCBA with a full facepiece; for exposure to concentrations <= 200 mg/m^3, wear a type C supplied-air respirator operated in pressure-demand or other positive-pressure or continuous flow mode, or a powered air- purifying respirator with an organic vapor cartridge and a high efficiency particulate filter; for exposure to concentrations <= 400 mg/m^3 , wear a type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure mode, or with a full facepiece, helmet, or hood operated in continuous flow mode. For exposure to concentrations >= 400 mg/m^3 or for emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes and place in a closed container in the change room. Launder daily before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless to pale yellow
Physical State: Solid; needles or plates from alcohol
Vapor Pressure (kPa): 0.01 mm Hg at 68 °F (20 °C)
Formula Weight: 202.2
Density: 1.252 g/mL at 0°C/4°C
Specific Gravity (H_2O=1, at 4 °C): 1.252
Boiling Point: 707 °F (375 °C)
Freezing/Melting Point: 230 °F (110 °C)
Ionization Potential (eV): 7.95 +/- 0.3 eV
Water Solubility: Insoluble; 0.20 to 0.26 mg/L
Other Solubilities: Soluble in acetic acid, benzene, carbon disulfide, chloroform, and ether; at 72 °F (22 °C): 5-10 mg/mL 95% ethanol, >= 100 mg/mL acetone, and >= 100 mg/mL DMSO

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Fluoranthene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid contact with chemical incompatibles, heat, and sources of ignition.

Storage Incompatibilities: Include strong oxidizing agents.

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

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 2 g/kg.
Acute Skin Effects:
Rabbit, skin, LD_{50}: 3180 mg/kg.
Other Effects:
Multiple Dose Toxicity Effects: Rat, oral, 67500 mg/kg administered for 90 days intermittently produced toxic effects: kidney, ureter, and bladder - changes in tubules (including acute renal failure, acute tubular necrosis); blood - normocytic anemia, changes in leukocyte (WBC) count.
Genetic Effects: Bacteria, *S Typhimurium*, 5 µg/plate (-S9) induced mutations in microorganisms.
Human, lymphocyte, 2 µmol/L induced mutations in mammalian somatic cells.
Hamster, ovary, 9 mg/L induced sister chromatid exchange.
Rat, embryo, 50 mg/L induced morphological transformation.
Mouse, skin, 280 mg/kg administered for 58 weeks intermittently produced toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors; tumorigenic - tumors at site of application.

See NIOSH, *RTECS* LL4025000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Fluoranthene degrades slowly in soil. When released to water, fluoranthene is expected to bioconcentrate into aquatic organisms. In the unadsorbed state it will degrade by photolysis. It appears to be stable in sediment for decades or more. Biodegradation in a few years in the presence of acclimated organisms is expected to occur. Fluoranthene released in the atmosphere will photodegrade in the free state. Fluoranthene will rapidly become adsorbed to sediment and particulate matter in the water column. Fluoranthene adsorbs strongly to soil. It is expected to remain in the upper layers of soil. However, it has been detected in groundwater samples, which demonstrates that it can be transported there by some other process. log K_{ow}: 4.90
Ecotoxicity: *Lepomis macrochirus*/ LC_{50}: 4.0 mg/L/96 hr
BCF: 2.58 (rainbow trout)
Soil Sorption Partition Coefficient: $K_{OC} = 6.6x10^4$

Section 13 - Disposal Considerations

Disposal: Fluoranthene is a good candidate for disposal by rotary kiln or fluidized bed forms of incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Not specifically listed.

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U120 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 56b/ 57

Material Name: Indeno[1,2,3-cd]pyrene **CAS Number:** 193-39-5
Chemical Formula: $C_{22}H_{12}$
EINECS Number: 205-893-2
Synonyms: IDENO(1,2,3-CD)PYRENE; INDENO(1,2,3-C,D) PYRENE; INDENO(1,2,3-CD)PYRENE; INDENO[1,2,3-CD]PYRENE; INDENO(1,2,3-C,D)PYRENE; INDENOPYRENE; IP; 1,10-(1,2-PHENYLENE)PYRENE; 1,10-(O-PHENYLENE)PYRENE; 1,10-(ORTHO-PHENYLENE)PYRENE; 2,3-O-PHENYLENEPYRENE; 2,3-ORTHO-PHENYLENEPYRENE; 2,3-PHENYLENEPYRENE; O-PHENYLENEPYRENE; ORTHO-PHENYLENEPYRENE
General Use: Laboratory standard used in cancer research. Found in automotive and diesel exhaust, cigarette smoke condensate, benzene and pyrene pyrolysis products, soot, coal tar and coal tar pitch and petroleum asphalt.

Section 2 - Composition / Information on Ingredients

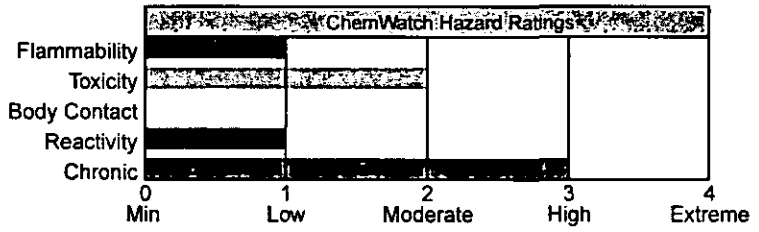
Name	CAS	%
indeno[1,2,3-cd]pyrene	193-39-5	>98

OSHA PEL
No data found.

NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



☆☆☆☆☆ Emergency Overview ☆☆☆☆☆
Yellow plates or needles. May cause irritation to eyes/skin. Other Acute Effects: may be harmful by inhalation, ingestion, or skin absorption.

Potential Health Effects

Target Organs: No data found.
Primary Entry Routes: accidental skin and eye contact and inhalation of generated dusts
Acute Effects
Inhalation: The dust is harmful and discomforting to the upper respiratory tract.
Persons with impaired respiratory function, airway diseases, or conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Eye: The dust may be discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to windburn), temporary impairment of vision and/ or other transient eye damage/ ulceration.
Skin: The material may be mildly discomforting to the skin. Open cuts and abraded or irritated skin should not be exposed to this material.
Toxic effects may result from skin absorption.
Ingestion: The solid/dust is discomforting to the gastrointestinal tract and harmful if swallowed.
Considered an unlikely route of entry in commercial/industrial environments.
Carcinogenicity: NTP - Listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.
Chronic Effects: The so-called polycyclic aromatic hydrocarbons (PAHs) comprise a large family; some members occur in coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified, in animal studies, as amongst the most highly active carcinogens.

Section 4 - First Aid Measures

Inhalation: • If dust is inhaled, remove to fresh air.
• Encourage patient to blow nose to ensure clear breathing passages.
• Rinse mouth with water. Consider drinking water to remove dust from throat.
• Seek medical attention if irritation or discomfort persist.
• If fumes or combustion products are inhaled, remove to fresh air.
• Lay patient down. Keep warm and rested.
• Other measures are usually unnecessary.
Eye Contact: If this product comes in contact with the eyes:
• Immediately hold the eyes open and flush with fresh running water.
• Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
• Seek medical attention if pain persists or recurs.
• Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: If product comes in contact with the skin:
• Immediately remove all contaminated clothing, including footwear (after rinsing with water).
• Wash affected areas thoroughly with water (and soap if available).
• Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center. If swallowed, and if more than 15 minutes from a hospital:
• Induce vomiting with Ipecac syrup, or fingers down the back of the throat, only if conscious. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. Note: Wear a protective glove when inducing vomiting by mechanical means.
• Seek medical attention without delay.
• In the meantime, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
• If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided. Further action will be the responsibility of the medical specialist.
• If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Extinguishing Media: Foam. Dry chemical powder. BCF (where regulations permit). Carbon dioxide. Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: • Solid which exhibits difficult combustion or is difficult to ignite.
• Avoid generating dust, particularly clouds of dust in a confined or unventilated space, as dust may form an explosive mixture with air and any source of ignition, i.e., flame or spark, will cause fire or explosion. Dust clouds generated by the fine grinding of the solid are a particular hazard; accumulations of fine dust may burn rapidly and fiercely if ignited
• Dry dust can also be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport.
• Build-up of electrostatic charge may be prevented by bonding and grounding.
• Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e., nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: • Contact fire department and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves for fire only.
• Prevent, by any means available, spillage from entering drains or waterways.
• Use fire fighting procedures suitable for surrounding fire.
• Do not approach containers suspected to be hot.
• Cool fire-exposed containers with water spray from a protected location.
• If safe to do so, remove containers from path of fire.
• Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: • Clean up all spills immediately.
• Avoid contact with skin and eyes.
• Wear protective clothing, gloves, safety glasses and dust respirator.
• Use dry clean up procedures and avoid generating dust.
• Vacuum up or sweep up.

• Place in clean drum then flush area with water.
Large Spills: • Clear area of personnel and move upwind.
• Contact fire department and tell them location and nature of hazard.
• Wear breathing apparatus plus protective gloves.
• Prevent, by any means available, spillage from entering drains or waterways.
• No smoking, bare lights or ignition sources.
• Increase ventilation.
• Stop leak if safe to do so.
• Water spray or fog may be used to disperse/absorb vapor.
• Contain or absorb spill with sand, earth or vermiculite.
• Collect recoverable product into labeled containers for recycling.
• Collect solid residues and seal in labeled drums for disposal.
• Wash area and prevent runoff into drains.
• After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
• If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid all personal contact, including inhalation.
• Wear protective clothing when risk of overexposure occurs.
• Use in a well-ventilated area.
• Prevent concentration in hollows and sumps.
• Do not enter confined spaces until atmosphere has been checked.
• Do not allow material to contact humans, exposed food or food utensils.
• Avoid smoking, bare lights or ignition sources.
• When handling, do not eat, drink or smoke.
• Avoid contact with incompatible materials.
• Keep containers securely sealed when not in used.
• Avoid physical damage to containers.
• Always wash hands with soap and water after handling.
• Work clothes should be laundered separately. Launder contaminated clothing before reuse.
• Observe manufacturer's storage/handling recommendations.
• Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Glass container. Plastic container. Metal can. Metal drum. Packing as recommended by manufacturer. Check that all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Supplied-air type respirator may be required in special circumstances. An approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields. Chemical goggles. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, e.g. PVC. Wear safety footwear.
Other: • Overalls.
• PVC Apron.
• PVC protective suit may be required if exposure severe.
• Eyewash unit.
• Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Off-white powder.
Physical State: yellow plates or needles
Vapor Pressure (kPa): 1.0×10^{-1} mm Hg
Vapor Density (Air=1): not applicable
Formula Weight: 276.34
Evaporation Rate: not applicable
pH: not applicable
pH (1% Solution): not applicable
Boiling Point: 530 °C (986 °F)
Freezing/Melting Point: 162.5 °C (324.5 °F) to 164 °C (327.2 °F)
Volatile Component (% Vol): negligible
Water Solubility: 0.062 mg/L water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Substance has been shown to be mutagenic in at least one assay, or belongs to a family of chemicals producing damage or change to cellular DNA.

See NIOSH, *RTECS* NK9300000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil it will sorb strongly (estimated K_{oc} = 20,146) and hence is not expected to leach. No information was found about volatilization from, hydrolysis in, or biodegradation in soil. Released to water it will sorb strongly to suspended particulate matter, biota and sediments. Although there is a high potential to bioconcentrate in most aquatic organisms, it may not in fish since fish contain microsomal oxidase, which allows polyaromatic hydrocarbons to be metabolized. No information was found about volatilization, photolysis, hydrolysis, or biodegradation in water. It will probably be persistent in the aquatic environment and concentrate in sediments. Almost all released to the atmosphere will be sorbed to particulate matter; thus its atmospheric fate will primarily depend on physical processes such as dry and wet deposition. However, a computer-estimated half-life in the vapor phase is about 20 hours due to reaction with photochemically produced hydroxyl radicals.
Ecotoxicity: No data found.
Henry's Law Constant: 5.89×10^{-10}
BCF: *estimated at* 5.9407×10^{4}
Octanol/Water Partition Coefficient: $\log K_{ow} = 6.584$
Soil Sorption Partition Coefficient: $K_{oc} = 2.0146 \times 10^{6}$

Section 13 - Disposal Considerations

Disposal: • Recycle wherever possible or consult manufacturer for recycling options.
• Follow applicable local, state, and federal regulations.
• Bury residue in an authorized landfill.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U137 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2000-07

Lead
MSDS 713
LEA1000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Lead **CAS Number:** 7439-92-1
Chemical Formula: Pb
Structural Chemical Formula: Pb
Synonyms: C.I. 77575; C.I. PIGMENT METAL 4; GLOVER; KS-4; LEAD; LEAD FLAKE; LEAD INORGANIC; LEAD METAL; LEAD S2; LEAD SZ; OLOW; OMAHA & GRANT; PB-S 100; PLUMBUM
General Use: Used as a construction material in chemical reaction equipment (tank piping,etc.); manufacture of tetraethyl lead; pigments for paints.
Used in pottery glazes, glass, ceramics, bearing metal and alloys, solder and other lead alloys.
Also used in metallurgy of steel and other metals, cable sheathing, storage batteries, radiation shielding and ammunition.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
lead	7439-92-1	>99

OSHA PEL
STEL: 0.05 mg/m^3; as Pb inorganic.

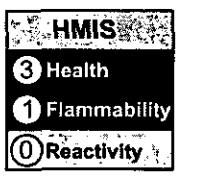
ACGIH TLV
TWA: 0.05 mg/m^3.

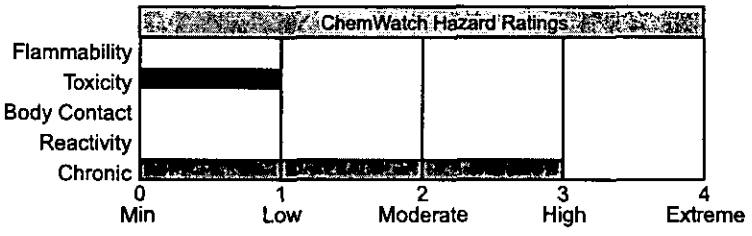
NIOSH REL
TWA: 0.1 mg/m^3.

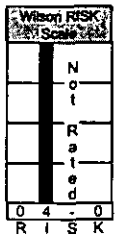
IDLH Level
100 mg/m^3; as Pb.

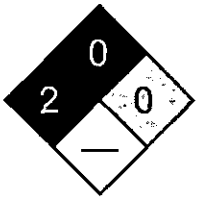
DFG (Germany) MAK
TWA: 0.1 mg/m^3.

Section 3 - Hazards Identification









Fire Diamond

ANSI Signal Word
Danger!


Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Bluish-white, silvery, or gray metal. Cumulative poison. Repeated low exposures causes: severe neurological effects, blood/kidney damage. Possible cancer hazard. Reproductive damage (sterility, decreased fertility) and developmental damage to fetus.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion
Target Organs: blood, central nervous system (CNS), peripheral nervous system, kidneys, gastrointestinal (GI) tract
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.
Eye: The dust may be discomforting to the eyes.
Skin: The material may be mildly discomforting to the skin.
Prolonged exposure may cause skin reactions.
Skin absorption is not considered a significant route of exposure.
Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed.
In rats intestinal lead absorption is bidirectional and does not follow a linear relationship with oral dose.

Acute effects of exposure are generally minor because of its relative insolubility and physical form. Unusual instances of exposure have been reported in inadequately ventilated indoor firing ranges (as fume), in the application of surma, a mascara-like cosmetic agent, to the conjunctival surfaces in Asian countries and in lead-smelting and associated occupations.

In humans lead metabolism fits into a three compartment model. The first compartment in which lead has a half-life of about 35 days includes the blood; it receives blood from the gut and delivers some of it to the urine and communicates with the other two pools. The second compartment in which lead has a similar half-life includes the soft tissues which contain about half the blood level; they share lead with hair, nails, sweat, saliva, bile and other digestive secretions. The skeleton is the third compartment and contains the vast bulk of the total body burden, possesses a very long half-life and demonstrates a difference between the dense and less dense components to bind lead.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: Symptoms of exposure include headache, fatigue, sleep disturbances, abdominal pains and decreased appetite. Overexposure to lead in the form of dust has toxic effects on the lungs and kidneys and on the nervous system resulting in mental disturbances and anemia.

Skin absorption is not considered to be a significant route of exposure.

Worker exposure to lead must be kept to a minimum, especially in cases where lead is worked at temperatures whereby lead vapors are evolved e.g. metal refining.

Lead is an accumulative poison and exposure even to small amounts can raise the body's content to toxic levels.

Potential adverse effects on the offspring of pregnant workers have been cited in the literature.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

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

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

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

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

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water.

Seek medical attention if irritation or discomfort persist.

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

Note to Physicians: 1.Gastric acids solubilize lead and its salts and lead absorption occurs in the small bowel.

2.Particles of less than 1um diameter are substantially absorbed by the alveoli following inhalation.

3.Lead is distributed to the red blood cells and has a half-life of 35 days.

It is subsequently redistributed to soft tissue & bone-stores or eliminated.The kidney accounts for 75% of daily lead loss; integumentary and alimentary losses account for the remainder.

4.Neurasthenic symptoms are the most common symptoms of intoxication.

Lead toxicity produces a classic motor neuropathy.

Acute encephalopathy appears infrequently in adults.

Diazepam is the best drug for seizures.

5.Whole-blood lead is the best measure of recent exposure; free erythrocyte protoporphyrin (FEP) provides the best screening for chronic exposure. Obvious clinical symptoms occur in adults when whole-blood lead exceeds 80 ug/dL.

6.British Anti-Lewisite is an effective antidote and enhances fecal and urinary excretion of lead. The onset of action of BAL is about 30 minutes and most of the chelated metal complex is excreted in 4-6 hours, primarily in the bile.

Adverse reaction appears in up to 50% of patients given BAL in doses exceeding 5 mg/kg. CaNa2EDTA has also been used alone or in concert with BAL as an antidote.

D-penacillamine is the usual oral agent for mobilization of bone lead; its use in the treatment of lead poisoning remains investigational.

2-3-dimercapto-1-propanesulfonic acid (DMPS) and dimercaptosuccinic acid (DMSA) are water soluble analogues of BAL and their effectiveness is undergoing review.

As a rule, stop BAL if lead decreases below 50 ug/dL; stop CaNa2EDTA if blood lead decreases below 40 ug/dL or urinary lead drops below 2 mg/24 hrs.

BIOLOGICAL EXPOSURE INDEX - BEI

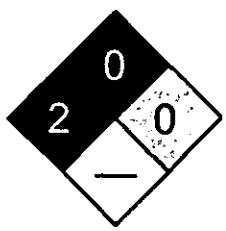
These represent the determinants observed in specimens collected from a healthy worker who has been exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Lead in blood	50 ug/100 mL	Not Critical	B
Lead in urine	150 ug/gm creatinine	Not critical	B
Zinc Protoporphyrin in blood	250 ug/100 mL erythrocytes OR 100 ug/100 mL blood	After 1 month exposure	B

B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: Not available; probably noncombustible
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: There is no restriction on the type of extinguisher which may be used.
General Fire Hazards/Hazardous Combustion Products: Noncombustible.
Not considered to be a significant fire risk; however, containers may burn.
Moderate fire hazard, in the form of dust, when exposed to heat or flames.
Decomposition products may include toxic lead dust and lead oxide fumes.



Fire Diamond

Fire Incompatibility: Incompatible with strong acids, oxidants, ammonium nitrate, chlorine trifluoride and sodium azide.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Use fire fighting procedures suitable for surrounding area.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
If safe to do so, remove containers from path of fire.
Cool fire-exposed containers with water spray from a protected location.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective clothing, gloves, safety glasses and dust respirator.
Use dry clean-up procedures and avoid generating dust.
Vacuum up.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Control personal contact by using protective equipment and dust respirator.
Prevent spillage from entering drains, sewers or waterways.
Recover product wherever possible. Avoid generating dust. Sweep / shovel up.
If required, wet with water to prevent dusting.
Put residues in labeled plastic bags or other containers for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.

Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved dust respirator.
Correct fit is essential to obtain adequate protection.

Personal Protective Clothing/Equipment

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

Hands/Feet: Impervious gloves; rubber gloves.
Rubber boots.
Protective footwear.

Respiratory Protection:
Exposure Range >0.05 to 0.5 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >0.5 to 2.5 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >2.5 to 50 mg/m^3: Powered Air Purifying Respirator, Half or Full Facepiece or Hood
Exposure Range >50 to 100 mg/m^3: Supplied Air Respirator with Full Facepiece, Hood, Helmet, or Suit, operated in a Positive Pressure Mode
Exposure Range >100 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)
Note: (29CFR 1910.1025) for general industry

Other: Overalls. Eyewash unit. Skin cleansing cream.
Provide adequate ventilation in warehouse or closed storage areas.
General and local exhaust ventilation usually required to maintain airborne dust levels to safety levels.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Bluish-white, silvery-gray metal. Malleable, lustrous when freshly cut and tarnishes when exposed to air. Reacts with strong acids like nitric acid, sulphuric or hydrochloric acid. Attacked by water in presence of oxygen. Poor electrical conductor. Lead fumes are formed at temperatures above 500-700 °C.

Physical State: Divided solid
Vapor Pressure (kPa): 0.24 at 1000 °C
Vapor Density (Air=1): Not applicable
Formula Weight: 207.19
Specific Gravity (H_2O=1, at 4 °C): 11.34
Water Solubility: Insoluble in water
Evaporation Rate: Not applicable

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 1740 °C (3164 °F)
Freezing/Melting Point Range: 327.4 °C (621.32 °F)
Volatile Component (% Vol): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Hazardous polymerization will not occur. Stable under normal storage conditions.
Storage Incompatibilities: Avoid storage with strong acids, oxidants, ammonium nitrate, chlorine trifluoride and sodium azide.

Section 11 - Toxicological Information

TOXICITY
Oral (woman) TD_{Lo}: 450 mg/kg/6 years
Inhalation (human) TC_{Lo}: 0.01 mg/m^3

IRRITATION
Nil Reported

WARNING: Lead is a cumulative poison and has the potential to cause abortion and intellectual impairment to unborn children of pregnant workers.

See NIOSH, *RTECS* OF 7525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released or deposited on soil, it will be retained in the upper 2-5 cm of soil, especially soils with at least 5% organic matter or a pH 5 or above. Leaching is not important under normal conditions although there is some evidence to suggest that it is taken up by some plants. Generally, the uptake from soil into plants is not significant. It is expected to slowly undergo speciation to the more insoluble sulfate, sulfide, oxide, and phosphate salts. It enters water from atmospheric fallout, runoff or wastewater; little is transferred from natural ores. It is a stable metal and adherent films of protective insoluble salts form that protect the metal from further corrosion. That which dissolves tends to form ligands. It is effectively removed from the water column to the sediment by adsorption to organic matter and clay minerals, precipitation as insoluble salt (the carbonate or sulfate, sulfide), and reaction with hydrous iron and manganese oxide. Under most circumstances, adsorption predominates. It does not appear to bioconcentrate significantly in fish but does in some shellfish such as mussels. When released to the atmosphere, it will generally be in dust or adsorbed to particulate matter and subject to gravitational settling and be transformed to the oxide and carbonate.

Ecotoxicity: LC_{50} Japanese quail (Coturnix japonica), males or females, 14 days old, oral (5-day ad libitum in diet) >5,000 ppm; at 1000, 2236 & 5000 onset of toxic signs began at 7, 7 & 7 days and remissed at 11, 11 & 12 days, respectively, no mortality was observed; control references were dieldrin & dicrotophos; corn oil diluent was added to diet at ratio of 2:98 by wt; (extreme concentrations: 1,000-5,000 ppm)

BCF: freshwater fish 1.38 to 1.65

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NONE
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 44/57

Material Name: Mercury **CAS Number:** 7439-97-6
Chemical Formula: Hg
EINECS Number: 231-106-7
Synonyms: COLLOIDAL MERCURY; HYDRARGYRUM; KWIK; LIQUID SILVER; MERCURE; MERCURIO; MERCURY; MERCURY (ELEMENTAL); MERCURY METAL: COLLOIDAL MERCURY; MERCURY,METALLIC; METALLIC MERCURY; QUECKSILBER; QUICK SILVER; QUICKSILVER; QUICKSILVER SYNONYMS OF; RTEC
Derivation: Obtained by roasting cinnabar (mercury sulfide) and purified by distillation, or as a by-product of gold mining.
General Use: Used in agricultural poisons, anti-fouling paint, dental amalgams, mining amalgamation (to remove gold and other metals from ore), thermometers, barometers, dry cell batteries, chlorine and caustic soda production, electrical apparatus, and as a neutron absorber in nuclear power plants.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Mercury		ca 100% wt

OSHA PEL
Ceiling: 0.1 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 0.05 mg/m^3; STEL: 0.1 mg/m^3.

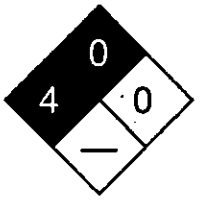
ACGIH TLV
TWA: 0.025 mg/m^3; skin.

NIOSH REL
TWA: 0.05 mg/m^3; Ceiling: 0.1 mg/m^3; skin, as Hg vapor.

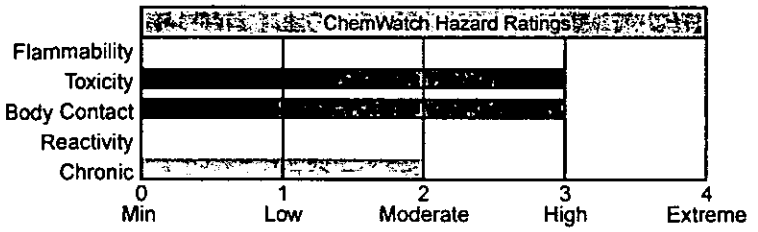
IDLH Level
10 mg/m^3; as Hg.

DFG (Germany) MAK
TWA: 0.1 mg/m^3; danger of sensitization of the skin, substances with systemic effects, onset of effect greater than 2 hours, half-life greater than shift length, strongly cumulative.

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word
Danger!


Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Mercury exists as a heavy, odorless, silver-white liquid metal. It is highly toxic by both acute and chronic exposure. Exposure can cause corrosion of the eyes, skin, and respiratory tract and may result in irreversible nervous system damage. It readily forms amalgamations with most metals except iron.

Potential Health Effects

Target Organs: Central nervous system, eyes, skin, respiratory system, liver, kidneys.
Primary Entry Routes: Inhalation, eye and skin contact/absorption.

Acute Effects The onset of signs and symptoms usually is prompt, but may be delayed up to 12 hr.

Systemic Effects by all routes: Nausea, vomiting, abdominal pain, diarrhea, excessive salivation, sweating, headache, giddiness, vertigo (dizziness), weakne ss, blurring or dimness of vision, miosis or mydiasis (dilatation of the pupils), tearing, bradycardia (slow heart beat), tachycardia (fast heart beat), cardiac irregularities (arrhythmias, compl ete heart block), loss of muscle coordination, slurred speech, muscle twitching (particularly tongue and eyelids), generalized profound weakness, confusion, disorientation, drowsiness, difficulty in breathing, excessive secretion of saliva and mucus, cyanosis, rales, high blood pressure, random jerky movements, incontinence, convulsions, coma, and death due to respiratory paralysis.

Inhalation: Exposure to high vapor concentrations can cause severe respiratory damage. Other symptoms include wakefulness, muscle weakness, anorexia, headache, ringing in the ear, headache, diarrhea, liver changes, fever, gingivitis, chest pain, difficulty breathing, cough, inflammation of the mouth (stomatitis), salivation, bronchitis, and pneumonitis. Acrodynia (pink or Swifts disease), characterized by redness and peeling of the skin on the toes and fingers, was commonly seen in children in the 1950s and is still *infrequently* seen in workers.

Eye: Irritation and corrosion.

Skin: Skin can become severely irritated if allowed to remain in contact with mercury. Skin absorption will occur at 2.2% of the rate of absorption through the lungs.

Ingestion: Mercury generally passes through the digestive tract uneventfully. However, large amounts may get caught up in the intestine and require surgical removal. If an abscess or other perforation is present along the digestive tract, absorption into the blood stream with subsequent mercury poisoning is possible.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Central nervous system disorders.

Chronic Effects: Chronic exposure appears more common than acute and is primarily associated with central nervous system damage which can be permanent (ex. paresthesia of the hands, lips, feet). Early signs of toxicity include weakness, fatigue, anorexia, weight loss, and gastrointestinal disturbances. If exposure levels are high, characteristic tremors of the fingers, eyelids, and lips occur with progression to generalized tremors of the entire body. Psychic disorders are noticeable and characterized by behavior and personality changes, increased excitability, memory loss, insomnia, and depression. In severe cases, delirium and hallucinations may occur. Kidney damage is observed with oliguria (decreased urine output) progressing to anuria (urine cessation) and may require dialysis. The cornea and lens of the eyes may take on a brownish discoloration and the extraocular muscles may be damaged. This syndrome has been termed *Asthenic-Vegetative Syndrome* or *Micromercurialism.* Chronic symptoms occur increasingly with exposures to 0.1 mg/m^3 or higher. *Mutation:* Aneuploidy and other chromosomal aberrations have been observed in the lymphocytes from whole blood cultures in workers exposed to mercury. *Reproductive:* Mercury has been detected in stillborn babies of women treated with mercury for syphilis. In a study of six men acutely exposed (occupationally) to mercury levels as high as 44 mg/m^3, all suffered impaired sexual function. Repeated skin contact may cause allergic dermatitis in some individuals.

Note: Spilled mercury will release sufficient vapor over time to produce chronic poisoning.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water and then wash exposed area with soap. For reddened or blistered skin, consult a physician.

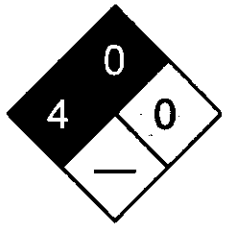
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. In general, mercury will pass through the digestive tract uneventfully.

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

Note to Physicians: BEI: *blood* (15 µg/L), *urine*: (35 µg/g creatinine). Extremely high urine levels of 0.5 to 0.85 mg Hg/L are indicative of polyneuropathy. 0.4 to 22 µg/L is reported to be the human lethal blood level. Obtain urinalysis including at a minimum: albumin, glucose, and a microscopic examination of centrifuged sediment. Use BAL or 2, 3-dimercaptosuccinic acid as chelators. *Do not* use calcium sodium EDTA because of nephrotoxicity. An electromyograph may determine extent of nerve dysfunction. It has been noted that exposure to mercury may predispose persons to development of carpal tunnel syndrome.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Nonflammable
LEL: None reported.
UEL: None reported.
Extinguishing Media: Use agents suitable for surrounding fire.
General Fire Hazards/Hazardous Combustion Products: Toxic mercury vapor and mercuric oxide.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Keep a mercury spill kit readily available in areas where mercury is used. Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind.
Small Spills: Small and Large Spills: Follow instructions on mercury spill kit. Most kits come with an aspiration-driven vacuum trap with a mercury "sweeper" (copper or copper-plated brush). Wash spill area with a dilute calcium sulfide or nitric acid solution. If spill cannot be taken up readily, dust the top of the spill with flowers of sulfur or preferably, calcium polysulfide. This will produce a surface coating of mercury sulfide which will reduce mercury vapor dispersion into the air.
Large Spills: No data found.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use appropriate PPE when working with mercury. *Do not* use on porous work surfaces (wood, unsealed concrete, etc.) to prevent spills from lodging in cracks.
Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.
Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat and incompatibles (Sec. 10). Store on non- porous floors and wash them regularly with a dilute calcium sulfide solution. Because mercury will form amalgamations with most metals except iron, metal shelves should be painted with a sufficiently thick coating to prevent this from happening.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Wherever possible, enclose processes to prevent mercury vapor dispersion into work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.
Administrative Controls: Consider pre-placement and periodic medical exams of exposed workers with emphasis on the skin, eyes, central nervous system, liver, and kidneys.
Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets made of butyl rubber, nitrile rubber, fluorocarbon rubber, neoprene rubber, polyvinyl chloride, chlorinated polyethylene, or polycarbonate to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For <= 0.5 mg/m^3, use any chemical cartridge respirator with cartridges providing protection against mercury and equipped with an ESLI (end of service life indicator), any SCBA, or any SAR (supplied-air respirator). For <= 1.25 mg/m^3, use any SAR operated in continuous-flow mode, any PAPR (powered, air-purifying respirator) with an ESLI. For <= 2.5 mg/m^3, use any SCBA or SAR with a full facepiece, any SAR with a tight-fitting facepiece and operated in continuous-flow mode, or any chemical cartridge respirator with a full facepiece, chemical cartridges providing protection against mercury, and equipped with an ESLI. For <=28 mg/m^3, use any SAR operated in pressure- demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA with full facepiece and operated in pressure-demand or other positive pressure mode. *Warning! Air- purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Silvery-white, odorless.
Physical State: Liquid metal
Vapor Pressure (kPa): 0.0018 mm Hg at 77 °F (25 °C)
Formula Weight: 200.59
Density: 13.534 g/cm^3 at 77 °F (25 °C)
Boiling Point: 674.09 °F (356.72 °C)
Freezing/Melting Point: -37.97 °F (-38.87 °C)
Viscosity: 15.5 mP at 77 °F (25 °C)
Surface Tension: 484 dyne/cm at 77 °F (25 °C)
Critical Temperature: 2664 °F (1462 °C)
Critical Pressure: 1587 atm
Water Solubility: 0.28 µmol/L at 77 °F (25 °C)
Other Solubilities: Soluble in boiling sulfuric acid, nitric acid (reacts); slightly in lipids, and 2.7 mg/L in pentane. Insoluble in alcohol, ether, cold sulfuric acid, hydrogen bromide, and hydrogen iodide.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Mercury does not tarnish at ordinary temperatures but when heated to near its boiling point, it slowly oxidizes to mercuric oxide. Hazardous polymerization does not occur. Exposure to high temperatures, metal surfaces or incompatibles.
Storage Incompatibilities: Mercury forms alloys (amalgamates) with most metals except iron. It is incompatible with oxidizers such as bromine, 3-bromopropyne, methylsilane + oxygen, chlorine, chlorine dioxide, nitric acid, or peroxyformic acid; tetracarbonyl nickel + oxygen, alkynes + silver perchlorate, ethylene oxide, acetylenic compounds (explosive), ammonia (explosive), boron phosphodiiodide, methyl azide, nitromethane, and ground sodium carbide.
Hazardous Decomposition Products: Thermal oxidative decomposition of mercury can produce mercuric oxide.

Section 11 - Toxicological Information

Acute Oral Effects:
Man, oral, TD_{Lo}: 43 mg/kg caused tremor and jaundice or other liver changes.
Acute Inhalation Effects:
Woman, inhalation, TC_{Lo}: 150 µg/m^3/46 days caused anorexia, diarrhea, and wakefulness.
Man, inhalation, TC_{Lo}: 44300 µg/m^3/8 hr caused muscle weakness, liver changes, and increased body temperature.
Acute Skin Effects:
Man, skin, TD_{Lo}: 129 mg/kg for 5 continuous hours caused ringing in the ears, headache, and allergic dermatitis.
Other Effects:
Rat, inhalation: 1 mg/m^3/ 24 hr for 5 continuous weeks caused proteinuria.
Rat, inhalation: 890 ng/m^3/24 hr for 16 weeks prior to mating had an effect on spermatogenesis.

See NIOSH, *RTECS* OV4550000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Mercury is expected to volatilize rapidly when deposited on soil surfaces. Once in the air, it can be transported long distances before being redeposited on soil or in water. In water, mercury appears to bind to particulates where it eventually becomes deposited on the bed sediment. In general, mercury entering the environment can be deposited and revolatilized several times.
Ecotoxicity: Catfish, LC_{50} = 0.35 mg/L/96 hr; mollusk (*Modiolus carvalhoi*), LC_{50} = 0.19 ppm/96 hr: tadpole (*Rana hexadactyla*), LC_{50} = 0.051 ppm/96 hr. Mercury is transformed to methyl mercury by bacteria in the environment and undergoes bioaccumulation readily. BCF for freshwater fish = 63,000; for saltwater fish = 10,000; and for marine and freshwater invertebrates = 100,000.

Section 13 - Disposal Considerations

Disposal: Incineration is *not* an appropriate disposal method. Wastewater may be treated by addition of chlorine to oxidize the mercury to its ionic state. The water can then be passed through an absorbent (an activated charcoal concentrate with a sulfur coating or peanut shell charcoal) to collect the ionic mercury, followed by distillation to recover the mercury. Sodium borohydride, a reducing agent, can be used to precipitate mercury from waste solutions. Bioremediation, using *Pseudomonas putida*, has also been suggested. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Mercury
Hazard Class: 8
ID No.: UN2809
Packing Group: III
Label: Corrosive

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U151 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a), per CAA Section 112 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 50/57

Material Name: Naphthalene **CAS Number:** 91-20-3
Chemical Formula: $C_{10}H_8$
EINECS Number: 202-049-5
Synonyms: ALBOCARBON; CAMPHOR TAR; DEZODORATOR; FAULDING NAPHTHALENE FLAKES; MIGHTY 150; MIGHTY RD1; MOTH BALLS; MOTH FLAKES; MOTHBALLS; NAFTALEN; NAPHTHALENE; NAPHTHALIN; NAPHTHALINE; NAPHTHENE; TAR CAMPHOR; WHITE TAR
Derivation: From coal tar; from petroleum fractions after various catalytic processing operations.
General Use: Used as a moth repellent, an antiseptic, toilet bowl deodorant, heat transfer agent, fungicide, smokeless powder, cutting fluid, lubricant, wood preservative; an intermediate for naphthol, phthalic anhydride, chlorinated naphthalenes, Tertralin, Decalin, naphthyl and naphthol derivatives, and dyes; in synthetic resins, synthetic tanning, textile chemicals, scintillation counters, and emulsion breakers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Naphthalene	91-20-3	ca 100% wt.

Grade - By melting point, 165 °F (74 °C) min (crude) to greater than 174 °F (79 °C) (refined); scintillation 176-177 °F (80-81 °C)

OSHA PEL
TWA: 10 ppm; 50 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 10 ppm; 50 mg/m^3; STEL: 15 ppm; 75 mg/m^3.

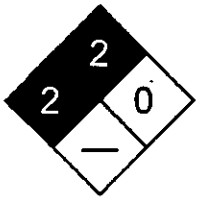
ACGIH TLV
TWA: 10 ppm, 52 mg/m^3; STEL: 15 ppm, 79 mg/m^3; skin.

NIOSH REL
TWA: 10 ppm, 50 mg/m^3; STEL: 15 ppm, 75 mg/m^3.

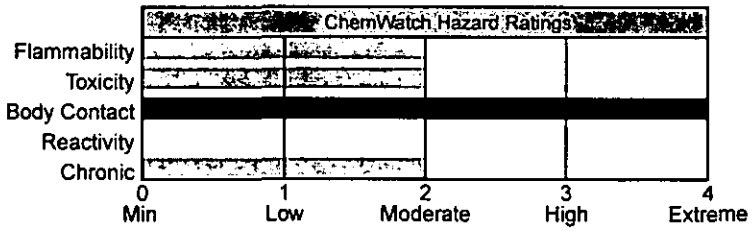
IDLH Level
250 ppm.

DFG (Germany) MAK
Skin

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Naphthalene is a white crystalline solid with a 'moth ball' or coal-tar odor. It is toxic by ingestion. Irritating to skin, eyes, and respiratory system. Naphthalene is a combustible solid. Dust may form explosive mixtures in air if subjected to an ignition source.

Potential Health Effects

Target Organs: Blood (red blood cell effects), eyes, skin, central nervous system (CNS), liver and kidneys
Primary Entry Routes: Inhalation, skin absorption, skin and/or eye contact
Acute Effects
Inhalation: Vapor inhalation causes headache, confusion, nausea, sometimes vomiting, loss of appetite, extensive sweating, dysuria (painful urination), hematuria (blood in the urine), and hemolysis (destruction of red blood cells).
Eye: Irritation, conjunctivitis, and corneal injury upon prolonged contact.
Skin: Irritation and hypersensitivity dermatitis.

Ingestion: Unlikely. However, ingestion causes irritation of the mouth and stomach, hemolytic anemia with hepatic and renal lesions and vesical congestion, kidney failure, hematuria, jaundice, depression of CNS, nausea, vomiting, abdominal pain, blue face, lips, or hands, rapid and difficult breathing, headache, confusion, excitement, malaise, fever, perspiration, urinary tract pain, dizziness, convulsions, coma, and death. Symptoms may appear 2 to 4 hours after exposure.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver and kidneys; individuals with a hereditary deficiency of the enzyme glucose-6-phosphate dehydrogenase in red blood cells are particularly susceptible to the hemolytic properties of naphthalene metabolites.

Chronic Effects: May cause optical neuritis, corneal injuries, cataracts, kidney damage. There are two reports of naphthalene crossing the placenta in humans.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. Contact a physician immediately if symptoms of systemic poisoning are present.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

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

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

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

Note to Physicians: Obtain baseline CBC, electrolytes, liver and renal function rests, glucose-6-phosphatase dehydrogenase level, urinalysis, and benzidine dipstick to check for hemoglobinuria. Urinary metabolite, 1-naphthol or mercapturic acid, may help confirm the diagnosis.

Section 5 - Fire-Fighting Measures

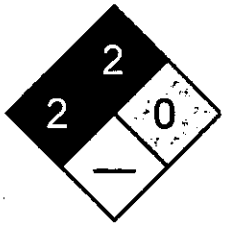
Flash Point: 174 °F (79 °C) OC; 190 °F (88 °C) CC

Autoignition Temperature: 979 °F (526 °C)

LEL: 0.9% v/v

UEL: 5.9% v/v

Flammability Classification: Combustible solid



Fire Diamond

Extinguishing Media: Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water or foam may cause frothing. Use water spray to keep fire-exposed containers cool.

General Fire Hazards/Hazardous Combustion Products: Toxic vapors including carbon monoxide. Volatile solid that gives off flammable vapors when heated. Dust may explode in air if an ignition source is provided.

Fire-Fighting Instructions: Move containers from the fire area if it can be done without risk. Otherwise cool fire-exposed containers until well after the fire is extinguished. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Wear full protective clothing (see Sec. 8). Structural clothing is permeable, remain clear of smoke, water fall out, and water run off.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Stop leak if you can do it without risk. Use spark-proof tools and explosion proof equipment. Cleanup personnel should wear personal protective equipment to protect against exposure (see Sec. 8).

Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

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

Section 7 - Handling and Storage

Handling Precautions: To avoid vapor inhalation use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Avoid skin and eye contact. Wear personal protective clothing and equipment to prevent any contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed, explosion-proof containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles (see Sec. 10). May be stored under nitrogen gas. Protect containers against physical damage. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor and dust dispersion into the work area. Ventilate at the site of chemical release. During the fractional distillation of naphthalene and in any operation entailing the heating or volatilization of naphthalene, enclosed apparatus should be employed. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with naphthalene. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the eyes, skin, liver, kidneys, CBC (RBC count, WBC count, differential count of a stained smear, hemoglobin, and hematocrit), and urinalysis including at a minimum specific gravity, albumin, glucose, and a microscopic examination on centrifuged sediment.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Teflon is recommended. *Do not* use butyl rubber, natural rubber, neoprene or polyvinyl chloride. Wear chemical dust-proof safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: White volatile flakes, cakes, cubes, spheres, or powder; strong coal-tar or moth ball odor.

Physical State: Crystalline solid

Odor Threshold: 0.084 ppm to 0.3 ppm

Vapor Pressure (kPa): 0.05 mm Hg at 68 °F (20 °C); 1.0 mm Hg at 127 °F (53 °C)

Formula Weight: 128.2

Density: 1.145 g/cm^3 at 68 °F (20 °C)

Boiling Point: 424 °F (218 °C)

Freezing/Melting Point: 176 °F (80.2 °C)

Water Solubility: Insoluble [31.7 mg/L at 68 °F (20 °C)]

Other Solubilities: Benzene, absolute alcohol; very soluble in ether, chloroform, carbon disulfide, hydronaphthalenes, fixed and volatile oils

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Naphthalene is stable at room temperature in closed containers under normal storage and handling conditions. It volatilizes at room temperature. Hazardous polymerization cannot occur. Exposure to heat and ignition sources, incompatibles.

Storage Incompatibilities: Include aluminum chloride, benzoyl chloride, chromic acid, chromium trioxide, oxidizers. Explosive reaction with dinitrogen pentaoxide. Melted naphthalene will attack some forms of plastics.

Hazardous Decomposition Products: Thermal oxidative decomposition of naphthalene can produce toxic fumes including carbon monoxide.

Section 11 - Toxicological Information

Acute Oral Effects:\
Rat, oral, LD_{50}: 490 mg/kg.\
Mouse, oral, LD_{50}: 533 mg/kg.\
Human (child), oral, LD_{Lo}: 100 mg/kg.\
Acute Inhalation Effects:\
Rat, inhalation, LC_{50}: >340 mg/m^3 produced lacrimation and somnolence.\
Irritation Effects:\
Rabbit, eye, standard Draize test: 100 mg produced mild irritation.\
Rabbit, skin, open Draize test: 495 mg produced mild irritation.\
Other Effects:\
Rat, oral: 4500 mg/kg administered on gestational days 6-15 produced fetotoxicity and other developmental abnormalities. \
Man, unreported, LD_{Lo}: 74 mg/kg.\
Mouse, inhalation: 30 ppm/6 hr/2 yr administered intermittently produced toxic effects: tumorigenic - neoplastic by RTECS criteria; lungs, thorax, or respiration - tumors.\
Hamster, ovary: 15 mg/L induced sister chromatid exchange.

See NIOSH, *RTECS* QJ0525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, naphthalene rapidly photodegrades with a half-life of 3-8 hr. Volatilization, photolysis, adsorption, and biodegradation are important loss mechanisms for naphthalene discharged into water. Depending on local conditions, the half-lives range from a couple of days to a few months. If released on land, it is adsorbed moderately to soil, undergoes biodegradation; but in some cases biodegradation may still occur if conditions are aerobic. Bioconcentration occurs to a moderate extent, but is a temporary problem since depuration and metabolism readily proceed in aquatic organisms.

Ecotoxicity: *Oncorhynchus gorbuscha* (pink salmon): 1.37 ppm/96 hr at 39 °F (4 °C). *Pimephales promelas* (fathead minnow): 7.76 mg/L/24 hr.

Octanol/Water Partition Coefficient: log K_{ow} = 3.30

Section 13 - Disposal Considerations

Disposal: Consider rotary kiln or fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Naphthalene, crude or
Naphthalene, refined
Hazard Class: 4.1
ID No.: UN1334
Packing Group: III
Label: FLAMMABLE SOLID

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U165 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2000-07

Nickel
MSDS 723
NIC1000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Nickel **CAS Number:** 7440-02-0
Chemical Formula: Ni
Structural Chemical Formula: Ni
Synonyms: ALCAN 756; C.I. 77775; CARBONYL NICKEL POWDER; EL12; FIBREX; FIBREX P; NI 0901-S; NI 4303-S; NI 4303T; NI-4303T; NI 270; NI 0901-S (HARSHAW); NICHEL; NICKEL; NICKEL 200; NICKEL 201; NICKEL 205; NICKEL 207; NICKEL 270; NICKEL CATALYST SYNONYMS OF OTHER NICKEL COMPOUNDS VARY DEPENDING UPON THE SPECIFIC COMPOUND; NICKEL (DUST); NICKEL METAL: ELEMENTAL NICKEL; NICKEL PARTICLES; NICKEL SPONGE; NICKEL,METAL; NICKLE CATALYST,WET; NP-2; NP 2; PULVERIZED NICKEL; RANEY ALLOY; RANEY NICKEL; RCH 55/5
General Use: Used in the manufacture of Monel metal, stainless steels, and nickel -chrome resistance wire; nickel-plating; various alloys such as new silver, Chinese silver, German silver; for coins, electrotypes, storage batteries. Used for magnets, lightning-rod tips, electrical contacts and electrodes, spark plugs, machinery parts; catalyst for hydrogenation of oils and other organic substances; in alloys for electronic and space applications.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
nickel	7440-02-0	> 99

OSHA PEL
TWA: 1 mg/m^3; as Ni.

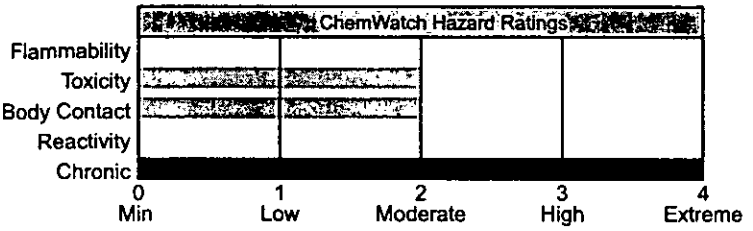
OSHA PEL Vacated 1989 Limits
TWA: 1 mg/m^3; Insoluble as Ni.
Other Values: soluble as Ni mg/m^3; 0.1.

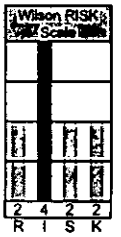
ACGIH TLV
TWA: 1 mg/m^3; as Ni.

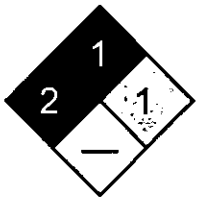
NIOSH REL
TWA: 1 mg/m^3; as Ni soluble & insoluble.

IDLH Level
10 mg/m^3; as Ni.

Section 3 - Hazards Identification







Fire Diamond

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Silvery-white metal powder. Irritating. Also causes: exposure to fume: metal fume fever, asthma, noninfectious pneumonia, vomiting, abdominal pain; direct contact: nickel itch. Possible cancer hazard. Chronic: sensitization, perforation of nasal septum.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, ingestion
Target Organs: nasal cavities, lungs, skin

Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.

Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Regular exposure to nickel fume, as the oxide, may result in "metal fume fever" a sometimes debilitating upper respiratory tract condition resembling influenza.

Symptoms include malaise, fever, weakness, nausea and may appear quickly if operations occur in closed or poorly ventilated areas.

Pulmonary edema, pulmonary fibrosis and asthma has been reported in welders using nickel alloys; levels of exposure are generally not available and case reports are often confounded by mixed exposures to other agents.

Inhalation of freshly formed metal oxide particles sized below 1.5 microns and generally between 0.02 to 0.05 microns may result in "metal fume fever". Symptoms may be delayed for up to 12 hours and begin with the sudden onset of thirst, and a sweet, metallic or foul taste in the mouth.

Other symptoms include upper respiratory tract irritation accompanied by coughing and a dryness of the mucous membranes, lassitude and a generalized feeling of malaise. Mild to severe headache, nausea, occasional vomiting, fever or chills, exaggerated mental activity, profuse sweating, diarrhea, excessive urination and prostration may also occur. Tolerance to the fumes develops rapidly, but is quickly lost. All symptoms usually subside within 24-36 hours following removal from exposure.

Eye: The dust may produce eye discomfort and abrasive eye inflammation.

Skin: The material may be mildly discomforting to the skin.

Nickel dusts, fumes and salts are potent contact allergens and sensitizers producing a dermatitis known as "nickel" rash.

In the absence of properly designed ventilation systems or where respiratory protective devises are inadequate, up to 10% of exposed workers are expected to be symptomatic.

Ingestion: The material may be mildly discomforting to the gastrointestinal tract if swallowed in large quantity.

The potential to generate small quantities of nickel chloride in the stomach may produce a low order toxic effect.

Nickel salts cause vomiting, following ingestion, as a result of astringent and irritant effects. In common with other irritant-emetics the lethal dose varies widely. Absorption is generally poor and systemic poisoning is rare.

Systemic effects include increased blood sugar levels (hyperglycemia), capillary damage (especially in the brain and adrenals), kidney damage, heart damage (myocardial weakness) and central nervous system depression.

Carcinogenicity: NTP - Class 2A, Reasonably anticipated to be a carcinogen, limited evidence of carcinogenicity from studies in humans; IARC - Group 1, Carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Not listed; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems.

The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

The most common toxic reaction to nickel is skin sensitization which may produce a chronic eczema called "nickel itch". The first symptom is itching which occurs up to 7 days prior to the appearance of skin eruption.

The primary skin eruption is erythematous or follicular and may be followed by superficial discrete ulcers (which discharge and become crusted), or eczema. In the chronic stages, pigmented or depigmented plaques may be formed.

Recovery from the dermatitis usually occurs within 7 days but may take several weeks.

Nickel dusts and several specific compounds are carcinogenic in animals following inhalation or parenteral administration (but not by ingestion or skin contact). Increases in lung and nasal cavity cancers have been observed amongst nickel workers in smelters and refineries.

Respiratory cancer risks primarily relate to chronic exposure to soluble nickels at concentrations in excess of 1 mg Ni/m^3 and exposure to the less soluble forms at concentrations greater than 10 mg Ni/m^3. Metallic nickel does not appear to pose such a threat.

When injected intramuscularly, nickel induced incidences of fibrosarcomas in rats and hamsters of both sexes, local sarcomas in rats of both sexes and local tumors with some metastases to pre-vertebral lymph nodes in female rats.

When injected intrapleurally, nickel powder induced round cell and spindle cell tumors at the site of injection in female rats.

Inhalation of nickel dusts induced lymphosarcomas in female mice and anaplastic intraalveolar carcinomas in male and female guinea pigs.

Subdermal implantation of nickel pellets induced sarcomas surrounding the pellet in rats of both sexes whilst intramedullar injection into the femur of rats produced neoplasms at or near the site of injection, including fibrosarcomas (neurogenic in origin).

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

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

Ingestion: Rinse mouth out with plenty of water. Seek medical attention if irritation or discomfort persist.

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

Note to Physicians: Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.
* Preplacement and periodic medical examinations of workers exposed to nickel are recommended. Preplacement examination should evaluate any history of skin allergies or asthma, other exposures to nickel, smoking history, condition of nasal cavity and lungs. Periodic examinations should include chest X-rays.

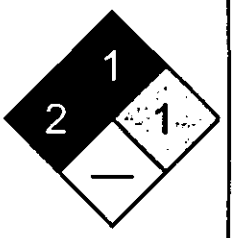
Section 5 - Fire-Fighting Measures

Flash Point: Not available; probably combustible

LEL: Not applicable

UEL: Not applicable

Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high.
Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust. Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.
When heated with sulfur reacts with incandescence.
If involved in fire, may produce toxic fumes of nickel carbonyl and nickel.

Fire Incompatibility: Avoid reaction with nitric acid and other strong acids, oxidizing agents and sulfur compounds.
Nickel dust reacts violently with titanium, ammonium nitrate, potassium perchlorate and hydrazoic acid.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective clothing, impervious gloves and safety glasses.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place in suitable containers for disposal.

Large Spills: Clear area of personnel and move upwind.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.
Use dry clean-up procedures and avoid generating dust.
Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash spill area with large quantities of water.

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

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.

Always wash hands with soap and water after handling.
Avoid physical damage to containers. Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.

Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Glass container.
Plastic drum.
Plastic bag.
Polyethylene or polypropylene container.
Metal drum.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Metal dusts must be collected at the source of generation as they are potentially explosive.
1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.
2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

Special ventilation requirements apply for processes which result in the generation of barium, chromium, lead, or nickel fume and in those processes which generate ozone.
The use of mechanical ventilation by local exhaust systems is required as a minimum in all circumstances (including outdoor work).
In confined spaces always check that oxygen has not been depleted by excessive rusting of steel or snowflake corrosion of aluminum. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.

Personal Protective Clothing/Equipment

Eyes: Safety glasses. Chemical goggles.
Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Impervious gloves; rubber gloves.
Neoprene gloves.
Safety footwear.
Rubber boots.

Respiratory Protection:
Exposure Range >1 to <10 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 10 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: odor threshold unknown

Other: Overalls. Barrier cream. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Lustrous silver-white, hard, ferromagnetic metal. Soluble in dilute nitric acid; slightly soluble in hydrochloric acid and sulfuric acid. Insoluble in ammonia. Mohs' hardness:3.8
Welding flux grades typical sieve analysis (cumulative retention %):- 200 um 0, 150 um 2, 100 um 12, 75 um 60, 63 um 80, 43 um 98.

Physical State: Solid
Vapor Pressure (kPa): 0.13 at 1810 °C
Formula Weight: 58.71
Specific Gravity (H_2O=1, at 4 °C): 8.9
Water Solubility: Insoluble in water
Evaporation Rate: Non-volatile
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point Range: 2730 °C (4946 °F)
Freezing/Melting Point Range: 1455 °C (2651 °F)
Volatile Component (% Vol): Nil at 38 °C

Section 10 - Stability and Reactivity

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

Storage Incompatibilities: Avoid reaction with oxidizing agents. Reacts with acids producing flammable/explosive hydrogen (H_2) gas.

Section 11 - Toxicological Information

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

TOXICITY
Oral (rat) LD_{50}: 5000 mg/kg

IRRITATION

See NIOSH, *RTECS* QR 5950000, for additional data.

Section 12 - Ecological Information

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

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NONE
Hazard Class: None
ID No.: None
Packing Group: None
Label: No class label assigned

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

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

Issue Date: 2003-02

Section 1 - Chemical Product and Company Identification 44/57

Material Name: Phenanthrene **CAS Number:** 85-01-8
Chemical Formula: $C_{14}H_{10}$
Structural Chemical Formula: $(C_6H_4CH)_2$
EINECS Number: 201-581-5
Synonyms: COAL TAR PITCH VOLATILES: PHENANTHRENE; PHENANTHREN; PHENANTHRENE; PHENANTRIN
Derivation: A polynuclear aromatic hydrocarbon found as a component of coal tar pitch volatiles (products of bituminous coal distillation). Produced from toluene, bibenzil, 9-methyl fluorene or stilbene by passage through red hot tubes or by diene synthesis of 1-vinyl naphthalene and maleic anhydride.
General Use: Used in the manufacture of dyestuffs and explosives; in biological research or drug synthesis.

Section 2 - Composition / Information on Ingredients

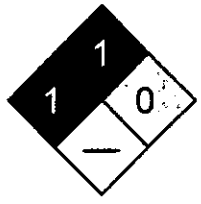
Name	CAS	%
Phenanthrene	85-01-8	ca 100 % wt

OSHA PEL
No data found.

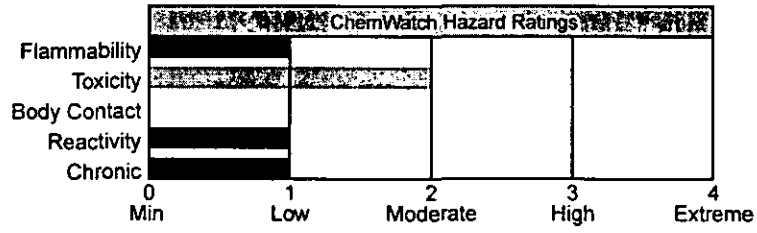
NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Phenanthrene exists as shiny crystals with a faint, aromatic odor. It can cause photosensitization of the skin. Phenanthrene is combustible and reacts dangerously with oxidizers.

Potential Health Effects

Target Organs: Skin.
Primary Entry Routes: Skin contact.
Acute Effects
Inhalation: Effects not reported.
Eye: Effects not reported.
Skin: Can cause photosensitization of the skin.
Ingestion: Effects not reported.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: Skin disorders.
Chronic Effects: None reported.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse exposed area with flooding amounts of water to remove loose material and then move quickly to a soap and water wash. For reddened or blistered skin, consult a physician.

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

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

Note to Physicians: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures

Flash Point: 340 °F (171 °C), Open Cup

LEL: Not reported.

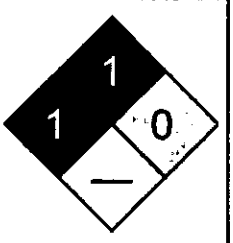
UEL: Not reported.

Flammability Classification: Class IIIB Combustible liquid

Extinguishing Media: Use dry chemical or carbon dioxide; water spray or foam may cause frothing.

General Fire Hazards/Hazardous Combustion Products: Carbon oxides (CO_x) and acrid smoke

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.



Fire Diamond

Section 6 - Accidental Release Measures

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

Small Spills: To avoid dust generation, *do not* sweep! Carefully scoop up or vacuum (with appropriate filter). Damp mop residue.

Large Spills: Flush large spill to containment area for later disposal. Do not release into sewers or waterways. Mop up any residue.

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

Section 7 - Handling and Storage

Handling Precautions: Use nonsparking tools to open containers.
Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from heat, ignition sources, and strong oxidizers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around phenanthrene. Provide general or local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin.

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

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

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, shiny crystals with a faint, aromatic odor.
Physical State: Solid
Vapor Pressure (kPa): 1 mm Hg at 244.76 °F (118.2 °C); 400 mm Hg at 586.4 (308 °C)
Formula Weight: 178.22
Density: 1.179 g/L at 77 °F (25 °C)
Refractive Index: 1.59427
Boiling Point: 644 °F (340 °C)
Freezing/Melting Point: 213 °F (101 °C)
Water Solubility: 1.6 mg/L at 59 °F (15 °C)
Other Solubilities: 1 g in: 2.4 mL toluene, 2.4 mL carbon tetrachloride, 2 mL benzene, 1 mL carbon disulfide, 25 mL absolute alcohol, 60 mL cold 95% alcohol, 10 mL boiling 95% alcohol and 3.3 mL anhydrous ether. Also soluble in glacial acetic acid, chloroform, and hot pyridine.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Phenanthrene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Phenanthrene dust generation and exposure to heat ignition sources, or oxidizers.
Storage Incompatibilities: Strong oxidizers.
Hazardous Decomposition Products: Thermal oxidative decomposition of phenanthrene can produce carbon oxide(s).

Section 11 - Toxicological Information

Acute Oral Effects:
Mouse, oral, LD_{50}: 700 mg/kg.
Other Effects:
Tumorgenicity, mouse, skin: 71 mg/kg produced tumors at site of application.
Genetic Effects - Rat, liver cell: 3 mmol/L caused DNA damage.
Human, lymphocyte: 100 µmol/L caused mutation.

See NIOSH, *RTECS* SF7175000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, some phenanthrene may biodegrade but the majority will bind to the soil without much leaching to groundwater. Volatilization is not expected to be significant. In water, it will adhere to particulates and sediment. Photolysis may occur near the surface producing toxic substances. Photolysis/photooxidation half-life = 8.4 hr. In the air, it will react with photochemically generated hydroxyl radicals (half-life = 1.67 days). Phenanthrene absorbs strongly to soil and sediment in water.
Ecotoxicity: *Neanhes arenaceodentata*, TL_m = 0.6 ppm/96 hr, sea water at 71.6 °F (22 °C)
Octanol/Water Partition Coefficient: log K_{ow} = 4.57

Section 13 - Disposal Considerations

Disposal: For treatment of phenanthrene contaminated water, the particulate bound portion can be removed by sedimentation, flocculation, and filtration. Chlorination is not recommended as it has been shown to produce mutagenic substances. The dissolved portion requires oxidation for partial removal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Environmentally hazardous substances, solid, n.o.s.*
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9
Additional Shipping Information: * Classified as a hazardous substance when phenanthrene is in a quantity, in one package, which equals or exceeds the RQ of 5000 lb (2270 kg)

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)

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

Section 16 - Other Information

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

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

Issue Date: 2002-02

Section 1 - Chemical Product and Company Identification 54

Material Name: Phenol **CAS Number:** 108-95-2
Chemical Formula: C_6H_6O
Structural Chemical Formula: C_6H_5OH
Synonyms: ACIDE CARBOLIQUE; BAKER'S P AND S LIQUID AND OINTMENT; BENZENOL; CARBOLIC ACID; CARBOLSAURE; FENOL; FENOLO; HYDROXYBENZENE; IZAL; MONOHYDROXYBENZENE; MONOPHENOL; OXYBENZENE; PHENIC ACID; PHENOL; PHENOL ALCOHOL; PHENOLE; PHENOL,MOLTEN; PHENYL ALCOHOL; PHENYL HYDRATE; PHENYL HYDROXIDE; PHENYLIC ACID; PHENYLIC ALCOHOL
General Use: Used as a general disinfectant, either in solution or mixed with slaked lime, etc., for toilets, stables, cesspools, floors, drains, etc.; for the manufacture of colorless or light-colored artificial resins.
Also used in many medicinal and industrial compounds and dyes; as a reagent in chemical analysis.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
phenol	108-95-2	>99

OSHA PEL
TWA: 5 ppm; 19 mg/m^3; skin.

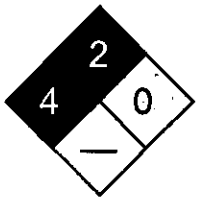
ACGIH TLV
TWA: 5 ppm, 19 mg/m^3; skin.

NIOSH REL
TWA: 5 ppm, 19 mg/m^3; Ceiling: 15.6 ppm; 60 mg/m^3; 15-minute, skin.

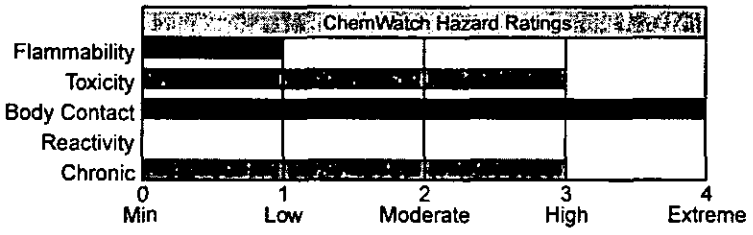
IDLH Level
250 ppm.

DFG (Germany) MAK
Skin

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Danger!


Poison Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, crystalline solid; medicinal odor. Poison! Corrosive, causes severe burns to the eyes (blindness)/skin/respiratory tract. Also causes: severe neurological effects (shock and coma), liver and kidney damage. Absorbed through the skin. Combustible.

Potential Health Effects

Target Organs: liver, kidneys, nervous system, skin
Primary Entry Routes: skin absorption, eye contact, ingestion, inhalation
Acute Effects
Inhalation: The vapor is extremely discomforting to the upper respiratory tract, may cause severe mucous membrane damage and may be harmful if inhaled.
Pulmonary absorption may lead to systemic toxicity affecting the cardiovascular and central nervous system.
Inhalation of phenol and some of its derivatives may produce profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis, hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema with pneumonia. Respiratory failure and kidney damage may follow.
Inhalation of the vapor causes a sore throat, coughing, shortness of breath and labored breathing.

Systemic effects include paleness, weakness, headache, sweating, ringing of the ears, shock, cyanosis, excitement, dark colored urine, frothing of the nose and mouth.

Pulmonary inflammation and pneumonia, inflammation and necrosis of the myocardium, hepatic centro-lobular necrosis, renal proximal tube swelling and edema and globular degeneration and hind-limb paralysis was observed in guinea-pigs exposed 29 times for 7 hours/day, five days/week to concentrations ranging from 26 to 52 ppm.

Eye: The material is highly corrosive to the eyes and is capable of causing severe burns and capable of causing severe damage with loss of sight.

The vapor from heated material is highly discomforting to the eyes.

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

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

Some phenol derivatives may produce mild to severe eye irritation with redness, pain and blurred vision. Permanent eye injury may occur; recovery may also be complete or partial.

Skin: The solid/dust is corrosive to the skin, may cause blisters or burns or severe burns and is it is rapidly absorbed by the skin.

Toxic effects may result from skin absorption.

Phenol and some of its derivatives may produce mild to severe skin irritation on repeated or prolonged contact, producing second and third degree chemical burns. Rapid cutaneous absorption may lead to systemic toxicity affecting the cardiovascular and central nervous system.

Absorption through the skin may result in profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis (following the formation of methemoglobin), hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema followed by pneumonia. Respiratory failure and kidney damage may follow.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).

This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.

Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Contact with the skin causes a white, wrinkled discoloration followed by a severe burn or systemic poisoning if not promptly and properly removed.

Intense burning and pain from skin contact may be delayed. Extreme dangers are posed by percutaneous absorption.

In one case a 32 year old male who spilled a solution of phenol over his scalp, face, neck, shoulders and back, died 10 minutes later.

There was coagulation necrosis of the skin, left eye and acute dermatitis veneta with acute passive congestion of the lungs, liver, spleen, kidneys.

Skin absorption occurs at low vapor pressure, without apparent discomfort and proceeds with the same efficiency as absorption by inhalation.

Damage to the lungs has been described following percutaneous absorption.

Methemoglobinemia and hemolytic anemia are frequently documented.

Ingestion: The material is corrosive to the gastrointestinal tract, may cause severe mucous membrane damage and may be fatal if swallowed.

Ingestion may result in nausea, abdominal irritation, pain and diarrhea.

Ingestion of phenol causes blotches on the lips and in the mouth.

Some phenol derivatives may produce mild to severe damage within the gastrointestinal tract. Phenolic groups with ortho and para positions free from substitution are reactive; this is because the ortho and para positions on the aromatic ring are highly activated by the phenolic hydroxyl group and are therefore readily substituted.

Severe phenol ingestions cause hypotension, coma, ventricular dysrhythmias, seizures and white coagulative chemical burns.

Absorption may result in profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis (following the formation of methemoglobin), hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema followed by pneumonia.

Respiratory failure and kidney damage may follow. Phenol does not uncouple oxidative phosphorylation like dinitrophenol and pentachlorophenol and thus does not cause a heat exhaustion-like syndrome.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Prolonged exposure to some derivatives of phenol may produce dermatitis, anorexia, weight loss, weakness, muscle aches and pain, liver damage, dark urine, ochronosis, skin eruptions, diarrhea, nervous disorders with headache, salivation, fainting, increased skin and scleral pigmentation, vertigo and mental disorders. Liver and kidney damage may also ensue. Chronic phenol toxicity was first noted in medical personnel in the late 1800s when 5 and 10% phenol was used as a skin disinfectant. The term carbolic (phenol) marasmus was given to this syndrome.

Chronic phenol poisoning is very rarely reported, but symptoms include vomiting, difficulty in swallowing, diarrhea, lack of appetite, headache, fainting, dizziness, dark urine, mental disturbances, and possibly skin rash. Death due to liver and kidney damage may occur.
Repeated exposure of animals to phenol vapor at concentrations ranging from 26 to 52 ppm has produced respiratory, cardiovascular, hepatic, renal and neurologic toxicity.
Administration of phenol in the drinking water of mice (2500 ppm for 103 weeks) produced an increased incidence of leukemia and lymphomas.
Phenol has been studied in initiation/promotion protocols with a number of polycyclic hydrocarbons and has been shown to have promoting activity in the two-stage skin model.

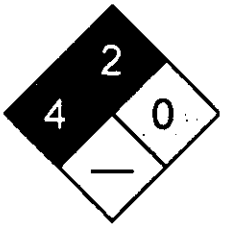
Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: If spilled on skin remove contaminated clothing, swab repeatedly with glycerin, PEG (polyethylene glycol), or PEG/ methylated spirit mixture or if necessary with methylated spirit alone.
Contamination of skin with phenol and some of its derivatives may produce rapid collapse and death. After skin contamination, keep patient under observation for at least 24-48 hours. Phenol-decontaminating fluid is more effective than water in removing phenol from the skin and retarding absorption; olive oil or vegetable oil may also be used; do not use mineral oil. Alcohols (methylated spirit, for example) may enhance absorption and their use alone may be ill-advised; some authorities, however, continue to advise the use of such treatment. Rapid water dilution of phenol burns may increase systemic absorption by decreasing the extent of the coagulum and thus allowing greater absorption.
Transport to hospital (or doctor).
Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: * Provide preplacement and annual medical examinations for employees exposed to phenol.
Persons with a history of convulsive disorders or abnormalities of the skin, respiratory tract, liver or kidneys would be expected to be at increased risk from exposure. Examination of the liver, kidneys and respiratory tract should be stressed. A urinalysis should be performed including at a minimum, specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.
For acute or short-term repeated exposures to phenols/ cresols:
1.Phenol is absorbed rapidly through lungs and skin. Massive skin contact may result in collapse and death.
2.Ingestion may result in ulceration of upper respiratory tract; perforation of esophagus and/or stomach, with attendant complications, may occur. Esophageal stricture may occur.
3.An initial excitory phase may present. Convulsions may appear as long as 18 hours after ingestion. Hypotension and ventricular tachycardia that require vasopressor and antiarrhythmic therapy, respectively, can occur.
4.Respiratory arrest, ventricular dysrhythmias, seizures and metabolic acidosis may complicate severe phenol exposures so the initial attention should be directed towards stabilization of breathing and circulation with ventilation, intubation, intravenous lines, fluids and cardiac monitoring as indicated.
5.Vegetable oils retard absorption; do NOT use paraffin oils or alcohols. Gastric lavage, with endotracheal intubation, should be repeated until phenol odor is no longer detectable; follow with vegetable oil. A saline cathartic should then be given. ALTERNATELY: Activated charcoal (1g/kg) may be given. A cathartic should be given after oral activated charcoal.
6.Severe poisoning may require slow intravenous injection of methylene blue to treat methemoglobinemia.
7.Renal failure may require hemodialysis.
8.Most absorbed phenol is biotransformed by the liver to ethereal and glucoronide sulfates and is eliminated almost completely after 24 hours
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker who has been exposed to the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Total phenol in blood	250 mg/gm creatinine	End of shift	B, NS

B: Background levels occur in specimens collected from subjects NOT exposed
NS: Non-specific determinant; also seen after exposure to other materials.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 79 °C Closed Cup
Autoignition Temperature: 715 °C
LEL: 1.7% v/v
UEL: 8.6% v/v
Extinguishing Media: Carbon dioxide; dry chemical powder.
Alcohol stable foam.
General Fire Hazards/Hazardous Combustion Products: Combustible. Moderate fire hazard when exposed to heat, flame or oxidizers.
Vapor may readily form an explosive mixture with air.
Decomposes on heating and produces toxic fumes of carbon monoxide (CO), carbon dioxide (CO_2).
Fire Incompatibility: Avoid reaction with strong oxidizing agents and halogens.
Reaction with calcium hypochlorite is exothermic and produces toxic fumes which may ignite. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium and zinc.
Do not heat phenol above 60 °C.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Use water delivered as a fine spray to control the fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: POLLUTANT -contain spillageEnvironmental hazard - contain spillage.
Wear protective clothing, impervious gloves and safety glasses.
Avoid breathing vapors and contact with skin and eyes.
Use dry clean-up procedures and avoid generating dust.
Place spilled material in clean, dry, sealable, labeled container.
Wash area down with large quantity of water and prevent runoff into drains.
Large Spills: POLLUTANT -contain spillageEnvironmental hazard - contain spillage.
Clear area of personnel and move upwind.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
If contamination of drains or waterways occurs, advise emergency services.
Shut off all possible sources of ignition and increase ventilation.
Stop leak if safe to do so.
Use dry clean-up procedures and avoid generating dust.
Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Use in a well-ventilated area.
Wear personal protective equipment when handling.
Avoid contact with incompatible materials.
Avoid smoking, bare lights or ignition sources.
Vapor may travel a considerable distance to source of ignition.
Avoid thermal shock.
Avoid physical damage to containers.
Handle and open container with care.
When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.
Recommended Storage Methods: Polylined drum. Stainless steel.

Steel drum.
Check that containers are clearly labeled.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment

Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Neoprene gloves; PVC gloves.
Rubber boots.

Respiratory Protection:
Exposure Range >5 to 50 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to <250 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range 250 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)

Other: Acid-resistant overalls.
PVC apron.
Hard hat with brim.
Ensure there is ready access to a safety shower.
Eyewash unit.

Glove Selection Index:

BUTYL	Best selection
BUTYL/NEOPRENE	Best selection
NATURAL+NEOPRENE	Best selection
NEOPRENE/NATURAL	Best selection
PE/EVAL/PE	Best selection
VITON	Best selection
VITON/NEOPRENE	Best selection
NEOPRENE	Best selection
TEFLON	Best selection
NATURAL RUBBER	Satisfactory; may degrade after 4 hours continuous immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
NAT+NEOPR+NITRILE	Poor to dangerous choice for other than short-term immersion
PVA	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: White, crystalline solid with a characteristic sharp medicinal, sweet, tangy odor, which is detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities, or if it is exposed to heat or light. Soluble in benzene. Very soluble in alcohol, chloroform, ether, glycerol, carbon disulfide, petrolatum, volatile and fixed oils, aqueous alkali hydroxides.

Physical State: Divided solid
Vapor Pressure (kPa): 101.33 at 181 °C
Vapor Density (Air=1): 3.24
Formula Weight: 94.11
Specific Gravity (H_2O=1, at 4 °C): 1.06 at 20 °C
Water Solubility: 1 g/15 ml water
Boiling Point Range: 181.8 °C (359 °F) at 760 mm Hg
Freezing/Melting Point Range: 40.9 °C (105.62 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers, halogens, calcium hypochlorite, and metals such as aluminum, lead, zinc, magnesium.

Section 11 - Toxicological Information

TOXICITY
Oral (rat) LD_{50}: 317 mg/kg
Oral (human) LD_{Lo}: 140 mg/kg
Inhalation (rat) LC_{50}: 316 mg/m^3
Dermal (rabbit) LD_{50}: 850 mg/kg

IRRITATION
Skin (rabbit): 500 mg/24hr - SEVERE
Skin (rabbit): 500 mg open -SEVERE
Eye (rabbit): 5 mg - SEVERE
Eye (rabbit): 100 mg rinse - mild

See NIOSH, *RTECS* SJ 3325000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the environment, the primary removal mechanism is biodegradation which is generally rapid (days). Since it is a benchmark chemical for biodegradability studies, there is a large body of information on its degradation which concludes that it rapidly degrades in sewage, soil, fresh water and seawater. Acclimation of resident populations of microorganisms is rapid. Under anaerobic conditions degradation is slower and microbial adaptation periods longer. If released to soil, it will readily leach and biodegrade. The biodegradation in soil is generally rapid with half-lives of under 5 days even in subsurface soils. Biodegradation is sufficiently rapid that most groundwater is generally free of this pollutant. The exception would be in the cases of spills where high concentrations destroy degrading microbial populations. Biodegradation is also the primary removal process when released into water (half-lives are of the order of hours to days) although sensitized photolysis may also be important. In one study using estuarine water, the combination of biodegradation and photolysis resulted in a half-life in summer and winter of 39 and 94 hr, respectively. Since the pKa is 9.994, it will be partially dissociated at higher pHs in water and moist soils and its transport and reactivity may be pH-dependent. It does not bioconcentrate in aquatic organisms. In the atmosphere, it occurs as a vapor and reacts with photochemically-produced hydroxyl radicals resulting in a half-life of approximately 15 hours. During the nighttime, it reacts with nitrate radicals with a resulting half-life of 12 minutes. It has also been shown to be readily removed from the atmosphere by rain.

Ecotoxicity: LC_{50} Crangon crangon 5600 mg/l 3 min, 20 mg/l 1 hr, 80 mg/l 3 hr, 40 mg/l 6-24 hr, 30 mg/l 48-72 hr, 25 mg/l 96 hr in sea water at 15 °C /Conditions of bioassay not specified; LC_{50} Rainbow trout 5.6-11.3 mg/l/24 hr in a static bioassay; LC_{50} Ophicephalus punctatus 46.0 mg/l/48 hr in a static bioassay; TLm Mercenaria mercenaria (hard clam) egg 5.263 x10^4 ppb/48 hr in a static bioassay; Algae: Microcystis aeruginosa inhibition of cell multiplication noted at 4.6 mg/l /Conditions of bioassay not specified; Protozoa: Vorticella campanula perturbation level 3 mg/l /Conditions of bioassay not specified ; Arthropoda: LD_0 Daphnia magna 16 mg/l /Conditions of bioassay not specified; Arthropoda: TLm Daphnia magna (young) 17/7 mg/l 25-50 hr /Conditions of bioassay not specified ; TLm Roach 15 mg/l/24 hr /Conditions of bioassay not specified

Henry's Law Constant: 3.33 x10^{-7}

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): 200%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 1.46

Soil Sorption Partition Coefficient: K_{oc} = 1 to 3

Section 13 - Disposal Considerations

Disposal: Follow applicable federal, state, and local regulations.
Incinerate contaminated waste at an approved site.
Phenol may be recovered by charcoal absorption, solvent extraction or steam stripping. A concentration of 1% by weight is required for economical recovery.
Recycle containers wherever possible, otherwise dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: PHENOL, SOLID
Additional Shipping Information: CARBOLIC ACID, SOLID
Hazard Class: 6.1(a)
ID No.: 1671
Packing Group: II
Label: Poison[6]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U188 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed

SARA EHS 40 CFR 355: Listed
RQ: 1000 lb
TPQ: 500/10000 lb
TSCA: Listed

Section 16 - Other Information

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

Material Safety Data Sheet Collection

Genium group inc.
1171 RiverFront Center Amsterdam, NY 12010
(518) 842-4111

Polychlorinated Biphenyls (PCBs) POL2140

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 54 / 60

Material Name: Polychlorinated Biphenyls (PCBs)

CAS Number: 1336-36-3

Chemical Formula: Unspecified or Variable

Structured Chemical Formula: $(C_{12}H_{10-x})Cl_x$

EINECS Number: 215-648-1

ACX Number: X1004032-9

Synonyms: AROCLOR; AROCLOR 1221; AROCLOR 1232; AROCLOR 1242; AROCLOR 1248; AROCLOR 1254; AROCLOR 1260; AROCLOR 1262; AROCLOR 1268; AROCLOR 2565; AROCLOR 4465; AROCLOR 5442; 1,1'-BIPHENYL,CHLORO DERIVS; BIPHENYL,POLYCHLORO-; CHLOPHEN; CHLOREXTOL; CHLORINATED BIPHENYL; CHLORINATED DIPHENYL; CHLORINATED DIPHENYLENE; CHLORO 1,1-BIPHENYL; CHLORO 1,1-BIPHENYL-; CHLORO BIPHENYL; CLOPHEN; CLOPHEN A 60; DYKANOL; EPA PESTICIDE CHEMICAL CODE 017801; FENCLOR; FENCLOR 42; INERTEEN; KANECHLOR; KANECHLOR 300; KANECHLOR 400; MONTAR; MONTER; NOFLAMOL; PCB; PCBS; PHENOCHLOR; PHENOCLOR; POLYCHLORINATED BIPHENYL; POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS (PCBS); POLYCHLOROBIPHENYL; PYRALENE; PYRANOL; SANTOTHERM; SANTOTHERM FR; SOVOL; THERMINOL; THERMINOL FR-1

General Use: Used as dielectric fluids in transformers and capacitors. Prior to 1972, were used as hydraulic and other industrial fluids (e.g., in vacuum pumps, as lubricants and cutting oils), in paints, inks and fire retardants.
Also used in heat transfer systems; gas-transmission turbines; carbonless reproducing paper; adhesives; as plasticizer in epoxy paints; fluorescent light ballasts; wax extenders; coolants; dedusting agents; pesticide extenders; surface treatment and coatings; sealants; caulking material.
This is one of a group of once widely used industrial chemicals whose high stability contributed both to their commercial usefulness and the long term deleterious environmental health effects. Consequently their use has been phased out. Their manufacture in the U.S.A. was discontinued in 1977.

Section 2 - Composition / Information on Ingredients

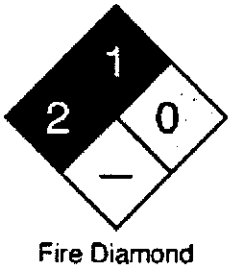
Name	CAS	%
polychlorinated biphenyls (PCB's)	1336-36-3	100

OSHA PEL

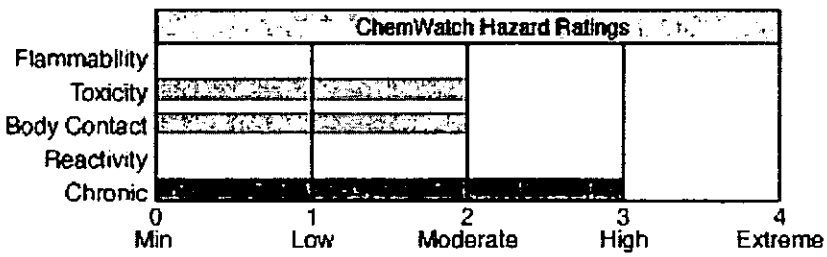
NIOSH REL

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Warning!

♦♦♦♦♦ Emergency Overview ♦♦♦♦♦

Oily liquid, white crystalline solid, or hard resin. Severely irritating. Suspect cancer hazard. Chronic Effects: chloracne, GI disturbances, neurological symptoms, liver enlargement, menstrual changes, bronchitis, possible reproductive/teratogenic effects.

Potential Health Effects

Target Organs: skin, liver, eyes, mucous membranes, respiratory system

Primary Entry Routes: inhalation, skin contact, ingestion

Acute Effects

Inhalation: Not normally a hazard due to nonvolatile nature of product. Inhalation of vapor is more likely at higher than normal temperatures. The vapor/mist is discomforting and may be extremely toxic if inhaled.

Eye: The vapor/liquid is moderately discomforting and may be harmful to the eyes.

Skin: The liquid is harmful to the skin, it is rapidly absorbed and is capable of causing skin reactions.

Exposure to material may result in a dermatitis, described as chloracne, a persistent acneiform characterized by comedones (white-, and black-heads), keratin cysts, and inflammed papules with hyperpigmentation and an anatomical distribution frequently involving the skin under the eyes and behind the ears. It occurs after acute or chronic exposure to a variety of chlorinated aromatic compounds by skin contact, ingestion or inhalation and may appear within days and months following the first exposure. Other dermatological alterations including hypertrichosis (the growth of excess hair), an increased incidence of actinic or solar elastosis (the degeneration of elastic tissue within muscles or loss of dermal elasticity produced by the effects of sunlight), and Peyrone's disease (a rare progressive scarring of the penile membrane).

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

The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis. Digestion may lead to nausea, vomiting, abdominal pain, anorexia, jaundice and liver damage, coma and death. Headache, dizziness, lethargy, depression, nervousness, loss of libido, muscle, joint pains may be found.

Symptoms appear after a latent period of 5 to 6 months.

PCB's may appear in breast milk of exposed mothers and in newborn infants.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects:

People occupationally exposed to PCB's have relatively high PCB residue levels in blood plasma. Symptoms include chloracne dermatitis and degreasing the skin, pigmentation of skin and nails, excessive eye discharge, swelling of eyelids, transient visual disturbances, distinctive hair follicles, edema of the face and hands.

In common with other polyhalogenated aromatic hydrocarbons, the chlorinated biphenyls exhibit dioxin-like behavior.

Polyhalogenated aromatic hydrocarbons (PHAHs) comprise two major groups.

The first group represented by the halogenated derivatives of dibenzodioxins (the chlorinated form is PCDD), dibenzofurans (PCDF) and biphenyls (PCB) exert their toxic effect (as hepatoxicants, reproductive toxicants, immunotoxicants and procarcinogens) by interaction with a cytostolic protein known as the Ah receptor. In guinea pigs the Ah receptor is active in a mechanism which "pumps" PHAH into the cell whilst in humans the reverse appears to true. This, in part, may account for species differences often cited in the literature. This receptor exhibits an affinity for the planar members of this group and carries these to the cellular nucleus where they bind, reversibly, to specific genomes on DNA.

This results in the regulation of the production of certain proteins which elicit the toxic response. The potency of the effect is dependent on the strength of the original interaction with the Ah receptor and is influenced by the degree of substitution by the halogen and the position of such substitutions on the parent compound.

The most potent molecule is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) while the coplanar PCBs (including mono-ortho coplanars) possess approximately 1% of this potency. Nevertheless, all are said to exhibit "dioxin-like" behavior and in environmental and health assessments it has been the practice to assign each a TCDD-equivalence value.

The most subtle and important biological effects of the PHAHs are the effects on endocrine hormones and vitamin homeostasis. TCDD mimics the effect of thyroxin (a key metamorphosis signal during maturation) and may disrupt patterns of embryonic development at critical stages. Individuals from exposed wildlife populations have been observed to have altered sexual development, sexual dysfunction as adults and immune system suppression.

Immunotoxic effects of the PHAHs (including the brominated congener, PBB) have been the subject of several studies. No clear pattern emerges in human studies however with T-cell numbers and function (a blood marker for immunological response) increasing in some and decreasing in others.

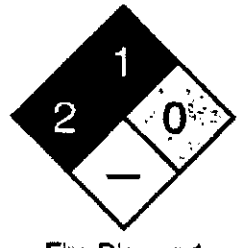
Three incidences have occurred which have introduced abnormally high levels of dioxin or dioxin-like congeners to humans. The explosion at a trichlorophenol-manufacturing plant in Seveso, Italy distributed TCDD across a large area of the country-side, whilst rice-oil contaminated with heat-transfer PCBs (and dioxin-like contaminants) has been consumed by two groups, on separate occasions (one in Yusho, Japan and another in Yu-cheng, Taiwan). The only symptom which can unequivocally be related to all these exposures is the development of chloracne,

a disfiguring skin condition, following each incident. Contaminated oil poisonings also produced eye-discharge, swelling of eyelids and visual disturbances. The Babies born up to 3 years after maternal exposure (so-called "Yusho-babies") were characteristically brown skinned, colored gums and nails and (frequently) produced eye-discharges. Delays in intellectual development have been noted. It has been estimated that Yu-cheng patients consumed an average level of 0.06 mg/kg body weight/day total PCB and 0.0002 mg/kg/day of PCDF before the onset of symptoms after 3 months. When the oil was withdrawn after 6 months they had consumed 1 gm total PCB containing 3.8 mg PCDF.
Preliminary data from the Yusho cohort suggests a six-fold excess of liver cancer mortality in males and a three-fold excess in women.
Recent findings from Seveso indicate that the biological effects of low level exposure (BELLEs), experienced by a cohort located at a great distance from the plant, may be hormetic, i.e. may be protective AGAINST the development of cancer.
TCDD induces carcinogenic effects in the laboratory in all species, strains and sexes tested. These effects are dose-related and occur in many organs.
Exposures as low as 0.001 ug/kg body weight/day produce carcinoma.
Several studies implicate PCBs in the development of liver cancer in workers as well as multi-site cancers in animals.
The second major group of PHAH consists of the non-planar PCB congeners which possess two or more ortho-substituted halogens. These have been shown to produce neurotoxic effects which are thought to reduce the concentration of the brain neurotransmitter, dopamine, by inhibiting certain enzyme-mediated processes.
The specific effect elicited by both classes of PHAH seems to depend on the as much on the developmental status of the organism at the time of the exposure as on the level of exposure over a lifetime.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center. DO NOT induce vomiting. Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink. Transport to hospital or doctor without delay.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically. If large amounts are ingested, gastric lavage is suggested. For splash in the eyes, a petrolatum-based ophthalmic ointment may be applied to the eye to relieve the irritating effects of PCBs.
If electrical equipment arcs over, PCB dielectric fluids may decompose to produce hydrogen chloride (HCl), a respiratory irritant. [Monsanto]
Preplacement and annual medical examinations of workers, with emphasis on liver function, skin condition, reproductive history, is recommended.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: > 141 °C
Autoignition Temperature: 240 °C
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Foam.Alcohol stable foam.
Dry chemical powder.
General Fire Hazards/Hazardous Combustion Products: Noncombustible liquid. POLLUTANT -contain spillage.
Decomposes on heating and produces acrid black soot and toxic fumes of aldehydes, hydrogen chloride (HCl), chlorides and extremely toxic polychlorinated dibenzofuran (PCDF), polychlorinated dibenzodioxin (PCDD).

Fire Incompatibility: Reacts vigorously with chlorine (Cl2).
Fire-Fighting Instructions: POLLUTANT -contain spillage. Noncombustible.
Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Cool fire-exposed containers with water spray from a protected location.
Avoid spraying water onto liquid pools.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: POLLUTANT -contain spillage. Clean up all spills immediately.
Environmental hazard - contain spillage.
Avoid breathing vapors and contact with skin and eyes.
Wear protective clothing, impervious gloves and safety glasses.
Contain spill with sand, earth or vermiculite.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: POLLUTANT -contain spillage. Clear area of personnel.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect residues and seal in labeled drums for disposal.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If equipment is grossly contaminated, decontaminate and destroy.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Do not allow clothing wet with material to stay in contact with skin Use good occupational work practices. Observe manufacturer's storing and handling recommendations.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Avoid all personal contact, including inhalation.
Wear protective clothing and gloves when handling containers.
Avoid physical damage to containers.
Use in a well-ventilated area and Use only in completely enclosed system.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Metal can or metal drum or Steel drum with plastic liner.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Provide adequate ventilation in warehouse or closed storage areas.
If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; chemical goggles.
Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Impervious gloves or Viton gloves or Polyethylene gloves or PVC gloves.
Protective footwear.
Other: Impervious protective clothing. Overalls. Impervious apron.
Eyewash unit.
Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to yellow-green, mobile oily to viscous liquid, or sticky to hard resin, or white crystalline solid, depending on degree of chlorination. Slightly soluble in glycerol and glycols. Soluble in organic solvents and lipids. Viscosity range: 71 - 2500 Saybolt unit sec. at 38 °C. PCBs are resistant to chemical and biological degradation and because of their solubility in fats and oils they tend to be concentrated in living organisms. The highly chlorinated PCBs are retained in animal's bodies longer and seems to delay the excretion of the lower chlorinated PCB's. They have become widely dispersed in the world-wide environment and in the food-chain since their introduction in 1929. They are now recognized internationally to be a major environmental pollutant, their persistence causing ecological damage via water pollution. Consequently loss of PCBs to the environment is to be avoided at all costs.

Physical State: Liquid
Vapor Pressure (kPa): Negligible
Formula Weight: 188.66 - 395
Specific Gravity (H_2O=1, at 4 °C): 1.18 - 1.8
Evaporation Rate: Non Vol. at 38 °C
pH: Not applicable

pH (1% Solution): Not applicable.
Boiling Point: 340 °C (644 °F) to 375 °C (707 °F)
Decomposition Temperature (°C): 375-550
Water Solubility: Solubility in water extremely low

Section 10 - Stability and Reactivity

Stability / Polymerization / Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers. Segregate from chlorine.
Avoid contamination of water, foodstuffs, feed or seed.

Section 11 - Toxicological Information

Toxicity
Oral (human) LD_{Lo}: 500 mg/kg
Oral (rat) LD_{50}: 3980 mg/kg

Irritation
Nil reported

See *RTECS* TQ1350000 for additional data.

Section 12 - Ecological Information

Environmental Fate: PCBs are mixtures of different congeners of chlorobiphenyl and the relative importance of the environmental fate mechanisms generally depends on the degree of chlorination. In general, the persistence of PCBs increases with an increase in the degree of chlorination. Mono-, di- and trichlorinated biphenyls (Aroclor 1221 and 1232) biodegrade relatively rapidly, tetrachlorinated biphenyls (Aroclors 1016 and 1242) biodegrade slowly, and higher chlorinated biphenyls (Aroclors 1248, 1254, and 1260) are resistant to biodegradation. Although biodegradation of higher chlorinated congeners may occur very slowly on an environmental basis, no other degradation mechanisms have been shown to be important in natural water and soil systems; therefore, biodegradation may be the ultimate degradation process in water and soil.

If released to soil, PCBs experience tight adsorption with adsorption generally increasing with the degree of chlorination. PCBs will generally not leach significantly in aqueous soil systems; the higher chlorinated congeners will have a lower tendency to leach than the lower chlorinated congeners. In the presence of organic solvents PCBs may leach quite rapidly through soil. Vapor loss from soil surfaces appears to be an important fate mechanism with the rate of volatilization decreasing with increasing chlorination. Although the volatilization rate may be low, the total loss by volatilization over time may be significant because of persistence and stability. Enrichment of the low Cl PCBs occurs in the vapor phase relative to the original Aroclor; the residue will be enriched in the PCBs containing high Cl content.

If released to water, adsorption to sediment and suspended matter will be an important fate process; PCB concentrations in sediment and suspended matter have been shown to be greater than in the associated water column. Although adsorption can immobilize PCBs (especially the higher chlorinated congeners) for relatively long periods of time, eventual resolution into the water column has been shown to occur. The PCB composition in the water will be enriched in the lower chlorinated PCBs because of their greater water solubility, and the least water soluble PCBs (highest Cl content) will remain adsorbed. In the absence of adsorption, PCBs volatilize relatively rapidly from water. However, strong PCB adsorption to sediment significantly competes with volatilization, with the higher chlorinated PCBs having longer half-lives than the lower chlorinated PCBs. Although the resulting volatilization rate may be low, the total loss by volatilization over time may be significant because of persistence and stability. PCBs have been shown to bioconcentrate significantly in aquatic organisms. If released to the atmosphere, PCBs will primarily exist in the vapor-phase; the tendency to become associated with the particulate-phase will increase as the degree of chlorination of the PCB increases. The dominant atmospheric transformation process is probably the vapor-phase reaction with hydroxyl radicals which has estimated half-lives ranging from 12.9 days for monochlorobiphenyl to 1.31 years for heptachlorobiphenyl. Physical removal from the atmosphere, which is very important environmentally, is accomplished by wet and dry deposition.

Ecotoxicity: Aquatic toxicity: 0.278 ppm/96 hr/bluegill/TL_m/fresh water 0.005 ppm/336-1080 hr/pinfish/TL_m/salt water; Waterfowl toxicity: LD_{50} 2000 ppm (mallard duck); Food chain concentration potential: High

Henry's Law Constant: 5×10^{-5}

BCF: bioconcentrate in tissue

Biochemical Oxygen Demand (BOD): very low

Soil Sorption Partition Coefficient: K_{oc} = 510 to 1.33×10^4

Section 13 - Disposal Considerations

Disposal:

Recycle wherever possible. Consult manufacturer for recycling options.

Follow applicable federal, state, and local regulations.

Due to their environmental persistence and potential health hazards, PCBs cannot be disposed of in landfills or dumped at sea. The only environmentally acceptable method for the disposal of PCBs is by high temperature incineration.

All wastes and residues containing PCB's (e. g. , wiping cloths, absorbent material, used disposable protective gloves, contaminated clothing, etc.) should be collected, placed in proper containers, labelled and disposed of in accordance with applicable regulations.

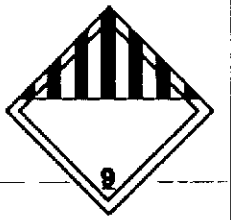
Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

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

Shipping Name and Description: Polychlorinated biphenyls, liquid
ID: UN2315
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 9 - Class 9
Special Provisions: 9, 81, 140, IB3, T4, TP1
Packaging:
Exceptions: 155
Non-bulk: 202
Bulk: 241
Quantity Limitations:
Passenger aircraft/rail: 100 L
Cargo aircraft only: 220 L
Vessel Stowage:
Location: A
Other: 95

Shipping Name and Description: Polychlorinated biphenyls, solid
ID: UN2315
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 9 - Class 9
Special Provisions: 9, 81, 140, IB7
Packaging:
Exceptions: 155
Non-bulk: 212
Bulk: 240
Quantity Limitations:
Passenger aircraft/rail: 100 kg
Cargo aircraft only: 200 kg
Vessel Stowage:
Location: A
Other:



Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per CWA Section 307(a) 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Issue Date: 2002-02

Section 1 - Chemical Product and Company Identification 54

Material Name: Pyrene **CAS Number:** 129-00-0
Chemical Formula: $C_{16}H_{10}$
Synonyms: BENZO(DEF)PHENANTHRENE; BENZO(D,E,F)PHENANTHRENE; COAL TAR PITCH VOLATILES:PYRENE; PYREN; BETA-PYRENE; PYRENE; PYRENE
General Use: Laboratory reference standard.
Occurs in coal tar or in destructive hydrogenation of hard coals.

Section 2 - Composition / Information on Ingredients

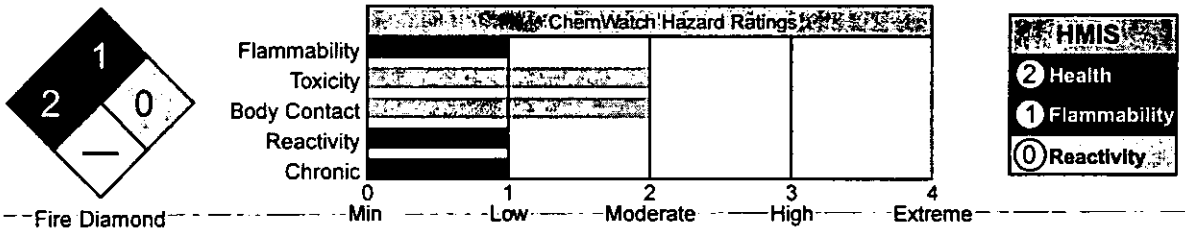
Name	CAS	%
pyrene	129-00-0	>98

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

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

ACGIH TLV
TWA: 0.2 mg/m^3; particulate polycyclic aromatic hydrocarbon.

Section 3 - Hazards Identification



ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless solid. Irritating to eyes/skin/respiratory tract. Also causes: conjunctival irritation, dermal irritation, ingestion may irritate and burn esophagus/gastrointestinal tract.

Potential Health Effects

Target Organs: skin, eyes, respiratory system
Primary Entry Routes: inhalation, ingestion, skin contact
Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract and may be fatal if inhaled.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Animal inhalation studies have demonstrated hepatic, pulmonary and intragastric pathologic changes. The levels of neutrophil, leukocyte and erythrocytes decreased.

Eye: The dust may be discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The material may be mildly discomforting to the skin.
Open cuts, abraded or irritated skin should not be exposed to this material.
Toxic effects may result from skin absorption.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Skin application resulted in hyperemia (blood engorgement), weight loss and hematopoietic (blood cell development) changes. Contact dermatitis was also evident.

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

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic exposure to pyrene results increase in blood leukocytes (leukocytosis).
The so-called polycyclic aromatic hydrocarbons (PAHs) comprise a large family; some members occur in coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified, in animal studies, as amongst the most highly active carcinogens.
Rodent species are sensitive to some PAHs with skin application producing cancerous growths. Injection produces soft tissue tumors (sarcomas) in rats and mice.
Administration of PAHs to Rhesus monkey on the other hand has not yet proved successful in yielding tumors and there is inadequate date to support the proposition that individual PAHs produce cancer in humans. There are however a number of epidemiology and mortality studies that show increased incidence of cancer in humans exposed to mixtures of PAHs. Evidence exists of lung and genito-urinary cancer mortality amongst coke-oven workers and skin tumors in workers exposed to creosote. Exposures to other chemical mixtures containing PAHs such as cigarette smoke, coal tar, coal tar pitch and bitumens, have been associated with increased incidences of lung cancer in humans. Anthracene, the basic unit on which most PAHs are built, is not carcinogenic whereas benz[a]anthracene appears to have weak carcinogenicity. Additions of other benzene rings to select positions on the benz[a]anthracene skeleton results in agents with powerful carcinogenicity (e.g. dibenz[a,h]anthracene and benz[a]pyrene). Further substitution of methyl groups in position on the rings enhances carcinogenicity (7,12 dimethylbenz[a]anthracene is one of the most powerful PAH carcinogens known). Biotransformation to produce soluble metabolites suitable for excretion appears to transform some PAHs to reactive electrophiles (as epoxides) which bind to DNA. Initiation of carcinogenesis is thought to rely upon such interactions.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.
Lay patient down. Keep warm and rested.
Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

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

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

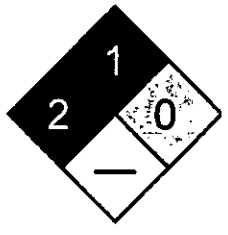
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: Not available; probably combustible

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



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Solid which exhibits difficult combustion or is difficult to ignite.
Avoid generating dust, particularly clouds of dust in a confined or unventilated space. Dust may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion.
Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport. Build-up of electrostatic charge may be prevented by bonding and grounding.
Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

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

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective clothing, gloves, safety glasses and dust respirator.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up. Place in clean drum then flush area with water.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain or absorb spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid smoking, bare lights or ignition sources. When handling, DO NOT eat, drink or smoke. Avoid contact with incompatible materials.
Keep containers securely sealed when not in used. Avoid physical damage to containers. Always wash hands with soap and water after handling. Working clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing/handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Glass container; plastic container.
Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.
Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless crystalline solid when pure. Contamination by tetracene results in slight yellowing. Solid and solutions have slight blue fluorescence.

Physical State: Divided solid
Vapor Pressure (kPa): Negligible
Formula Weight: 202.24
Specific Gravity (H_2O=1, at 4 °C): 1.271
Water Solubility: 0.135 mg/L (+ or - 0005 mg/L) in water
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point Range: 393 °C (739 °F) at 760 mm Hg
Freezing/Melting Point Range: 156 °C (312.8 °F)
Volatile Component (% Vol): Negligible

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

TOXICITY
Oral (rat) LD_{50}: 2700 mg/kg
Inhalation (rat) LC_{50}: 170 mg/m^3
Oral (mouse) LD_{50}: 800 mg/kg
Intraperitoneal (mouse) LD_{50}: 514 mg/kg
Conjunctival irritation, excitement and muscle contraction recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

IRRITATION
Skin (rabbit): 500 mg/24h - mild

See NIOSH, *RTECS* UR 2450000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Although environmental concentrations are highest near sources, its presence in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long distance transport. When released to air it may be subject to direct photolysis, although adsorption to particulates apparently can retard this process. Half-lives for reaction of vapor phase with atmospheric pollutants are: O3, 0.67 days, NO2, 14 days; estimated half-life for reaction with photochemically produced hydroxyl radicals is 1.12 days. If released to water, it will adsorb very strongly to sediments and particulate matter, bioconcentrate in aquatic organisms slightly to moderately, but will not hydrolyze. It may be subject to significant biodegradation, and direct photolysis may be important near the surface of waters. Evaporation may be important with a half-life of 4.8 to 39.2 days predicted for evaporation from a river 1 m deep, flowing at 1 m/sec with a wind velocity of 3 m/sec; half-life for evaporation from a model pond was 1176 days. Adsorption to sediments and particulates will limit evaporation. If released to soil it will be expected to adsorb very strongly to the soil and will not be expected to appreciably leach to the groundwater, although its presence in groundwater illustrates that it can be transported there. It will not be expected to hydrolyze or significantly evaporate from soils and surfaces. It may be subject to appreciable biodegradation in soils.
Ecotoxicity: TLm (Median threshold limit) Mosquito fish 0.0026 mg/l/96 hr at 24-27 °C in a static bioassay
Henry's Law Constant: calculated at 5.42 x10^{-5}
BCF: rainbow trout 72
Octanol/Water Partition Coefficient: log K_{ow} = 4.88
Soil Sorption Partition Coefficient: K_{oc} = soils 57 to 764

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Listed
RQ: 5000 lb
TPQ: 1000/10000 lb
TSCA: Listed

Section 16 - Other Information

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

Genium Publishing Corp.
One Genium Plaza
Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Zinc **MSDS No. 73**

Date of Preparation: 7/80 Revision: B, 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Zinc **Chemical Formula:** Zn **CAS Number:** 7440-66-6

Synonyms: asarco L15; blue powder; C.I. 77945; C.I. pigment black 16; C.I. pigment metal 6; emenay zinc dust; granular zinc; jasad; merrillite; pasco; rheinzink; zinc ashes; zinc dust; zinc powder

Derivation: Manufactured by concentrating zinc ore, roasting the concentrate, followed with thermal smelting (reduction with carbon); by reducing the zinc oxide with carbon in retorts from which the resultant zinc is distilled and condensed; or by the hydrometallurgical or electrolytical process where the zinc oxide is leached from the roasted or calcined material with sulfuric acid to form zinc sulfate solution which is then leached from electrolyzed cells to deposit zinc on the cathodes.

General Use: Used in alloys (dental amalgams, brass), metallic driers, mixed-metal stabilizers, automotive parts, electrical fuses, storage and dry-cell batteries, in vacuum fluorescence displays, in electrical contact grease, in bearings, in paper defoxing, galvanizing iron and other metals, protective coating, desilverizing agent for lead, deoxidizing bronze, reducing agent in organic chemistry, reagent in analytical chemistry, extracting gold, electroplating, metal spraying, anodic inhibitors, fungicides, nutrition, roofing, gutters, engravers' plates, cable wrappings, railroad car linings, purifying fats, bleaching glue, canteens, and organ pipes.

Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Zinc, special high-grade (99.990%), high-grade (99.95%), intermediate (99.5%), brass special (99%), prime western (98%).
Trace Impurities: Tin, lead, iron, cadmium, arsenic, cesium, antimony, and zinc chloride (increases corrosion resistance).

OSHA PEL*	ACGIH TLV*	NIOSH REL*	DFG (Germany) MAK*
None established	None established	None established	None established

*When working with heated or powdered zinc, consider exposure limits for zinc oxide: OSHA TWA: 15 mg/m^3 (total dust), 5 mg/m^3 (respirable dust, fume); ACGIH TLV: 5 mg/m^3 (fume), 10 mg/m^3 (dust - containing no asbestos and <1% crystalline silica); ACGIH STEL: 10 mg/m^3 (fume); NIOSH TWA 5 mg/m^3 (dust, fume); STEL: 10 mg/m^3 (fume), 15 minute ceiling, 15 mg/m^3 (dust); DFG MAK: TWA 5 mg/m^3 (fume/respirable dust).

Section 3 - Hazards Identification

ANSI Signal Word: Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Zinc is a bluish-white lustrous metal that becomes covered with a white oxide coating of basic carbonate on exposure to moist air. Zinc itself is relatively non-toxic, but the presence of impurities such as cesium, antimony, arsenic, and lead, or the production of airborne zinc oxide fumes may cause toxic effects. It is incompatible with many materials and the dust produces explosive hydrogen gas when mixed with water. Zinc dust is flammable and may ignite spontaneously in air when dry.

Wilson Risk Scale	
R	1
I	2
S	1
K	1

HMIS	
H	1*
F	1
R	1
PPE†	

*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation and eye and skin contact

Target Organs: Respiratory system, eyes, and skin

Acute Effects

Inhalation: Exposure to dust may result in cough. Heated zinc may give off zinc oxide (ZnO) fumes. Characteristics of exposure include sweet taste, dry throat, injury to mucous membrane, cough, weakness, aches, chills, fever, nausea, and vomiting. Concentrations of ZnO particulates at 45 to 870 mg/m^3 cause "metal fume fever," a transient condition characterized by fever, chills, muscle pain, and vomiting. Recovery normally occurs within 24 to 48 hours. Tolerance may develop but is generally lost over a weekend.

Eye: Zinc dust particles can irritate the eyes. Zinc salts will precipitate eye protein and cause corneal and lens changes.

Skin: A human skin irritant.

Ingestion: Relatively non-toxic, though significant ingestion (12 g) of metallic zinc was reported to cause lethargy, light headedness, staggering gait, and difficulty writing, suggesting cerebellar dysfunction. Ingestion of acidic food or beverages stored in zinc or galvanized containers can lead to nausea, vomiting, diarrhea, and abdominal pain.

Carcinogenicity: IARC, NTP, and OSHA do not list zinc as a carcinogen.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Chronic Effects: Abnormally large amounts of zinc may enter and leave the body for years without resulting in symptoms or clinical evidence. Zinc poisoning has been associated with prolonged consumption of water from galvanized pipes. Symptoms

include irritability, muscular stiffness and pain, loss of appetite and nausea. Ingestion of excessive doses for prolonged periods alters the immune response and causes copper and iron deficiency, anemia, headache, vomiting, chills, fever, malaise, and abdominal pain.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. Apply artificial respiration if victim is not breathing. Administer oxygen if breathing is difficult.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation develop.

Skin Contact: Remove contaminated clothing and rinse with flooding amounts of water. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

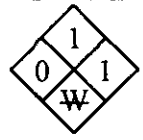
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

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

Note to Physicians: Maintain hydration and observe for metabolic acidosis, hypocalcemic tetany, anuria, liver damage, gastric perforation, and pyloric stenosis. For pulmonary edema (noncardiogenic), maintain ventilation and oxygenation with close arterial blood gas monitoring. Early use of PEEP and mechanical ventilation may be needed to maintain pO_2 greater than 50 mm Hg with FI O_2 less than 60%. For eye exposure, rinse with 0.05 M neutral sodium edetate to help prevent or reverse a portion of the protein precipitation.

Section 5 - Fire-Fighting Measures

Genium



Flash Point: Not applicable, combustible solid

Autoignition Temperature: Cloud, 1256 °F (680 °C); dust layer, 860 °F (460 °C); powder 650 mJ spark.

LEL: Dust cloud explosion, 0.5 oz/ft^3

UEL: None reported.

Flammability Classification: Combustible solid

Extinguishing Media: *Do not* use water or foam. Use a Class D fire extinguisher, dry chemical, dry ground limestone, dry clay, soda ash, lime, or sand, or withdraw from area and let fire burn.

Unusual Fire or Explosion Hazards: Zinc dust reacts vigorously or explosively on contact with water. It produces flammable gases on contact with water or moist air. It may be ignited by heat, sparks or flames and may re-ignite after fire is extinguished. Dust forms explosive mixtures with air.

Hazardous Combustion Products: Fire will produce irritating, corrosive and/or toxic gases. Inhalation or contact with vapors, substance, or decomposition products may cause severe injury or death.

Fire-Fighting Instructions: *Do not* get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank as rupture or explosion may be imminent. *Do not* release runoff from fire control methods to sewers or waterways as runoff may create fire or explosion hazard. Corrosive solutions may be produced on contact with water. Move containers from fire area if it can be done without undue risk.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing will only provide limited protection.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Eliminate all ignition sources (no smoking, flares, sparks or flames). Isolate spill or leak area immediately for at least 160 to 330 feet (50 to 100 meters) in all directions. *Do not* walk through or touch spilled material. For large spills consider downwind evacuation for at least 800 feet (250 meters). Keep unauthorized personnel away, stay upwind, keep out of low areas, and ventilate area before entry.

Small Spills: Cover with dry earth, dry sand, or other non-combustible material followed with plastic sheet to minimize spreading or contact with rain. With a clean shovel, carefully scoop material into a dry, sealed container and move container from spill area. Cleanup personnel should protect against dust inhalation and skin and eye contact.

Large Spills

Containment: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.

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

Section 7 - Handling and Storage

Handling Precautions: Bulk dust in damp state may heat spontaneously and ignite on exposure to air.

Storage Requirements: Protect against physical damage. Store in a cool, dry ventilated place away from heat and ignition sources and incompatibles.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Routinely evaluate exposure to zinc by collecting personal and area air samples. Prevention of metal fume fever is a matter of keeping exposure of workers below the level of zinc oxide concentration currently accepted as satisfactory for working with metal in the industry (15 mg/m^3) by employment of proper local exhaust ventilation to collect fumes at their source.

Ventilation: Enclose operations and/or provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Post hazard and warning information in the work area. In addition, educate, train, and communicate all information on the health and safety hazards of zinc to potentially exposed workers.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator equipped with particulate (dust/fume/mist) filters. Particulate filters must be checked daily before work for physical damage and replaced as needed. If, while wearing a filter cartridge or canister respirator, you can smell, taste, or otherwise detect zinc, or in the case of a full facepiece respirator you experience eye irritation, leave the area immediately. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

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

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. *Do not* take contaminated work clothes home. Launder before reuse. Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to zinc dust. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid

Appearance and Odor: Bluish-white lustrous metal or dark powder

Vapor Pressure: 1 mm Hg at 908.6 °F (487 °C); 60 mm Hg at 1292 °F (700 °C)

Formula Weight: 65.38

Specific Gravity (H_2O=1, at 4 °C): 7.14 at 77 °F (25°C)

Water Solubility: Insoluble

Other Solubilities: Soluble in acid, alkalies, acetic acid

Boiling Point: 1666.4 °F (908 °C)

Melting Point: 787.1 °F (419.5 °C)

Heat Capacity at Constant Pressure (25 °C): 6.07 cal/mole deg

Mohs' Hardness: 2.5

Standard Electrode Potential: +0.761

Ionizing Potential (eV): 9.39405

Section 10 - Stability and Reactivity

Stability: Zinc powder is stable at room temperature in closed containers under normal storage and handling conditions. However, moist zinc can react exothermically and ignite spontaneously in air.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Avoid contact with acids, alkali hydroxides (e.g., sodium hydroxide), ammonium nitrate, ammonium sulfide, arsenic oxide, barium dioxide, barium oxide, barium nitrate, cadmium, carbon disulfide, catalytic metals, chlorates, chlorides, chlorine, chlorinated rubber, chromium (VI) oxide, ethyl acetoacetate + tribromoneopentyl alcohol, fluorine, halogenated hydrocarbons, hydrazine mononitrate, hydroxylamine, lead azide, lead nitride, magnesium nitrate, manganese chloride, nitric acid, *o*-nitroanisole, nitrobenzene, nonmetals, oxidizing agents (sulfur, oxygen), paint primer base, pentacarbonyliron, performic acid, potassium chlorate, potassium nitrate, potassium peroxide, seleninyl bromide, selenium, sodium chlorate, sodium peroxide, tellurium, transition metal halides, and water.

Conditions to Avoid: Avoid exposure to moisture, heat, and ignition sources (flares, sparks, cigarettes, and open flames).

Hazardous Decomposition Products: Thermal oxidative decomposition of zinc metal/powder can produce hydrogen gas and zinc oxide fumes (of particle diameter ≤1 μm).

Section 11- Toxicological Information

Toxicity Data:*

Skin Effects:
Human, skin, standard Draize test, 300 µg over 3 days intermittently caused mild irritation.

Acute Inhalation Effects:
Human, inhalation, 124 mg/m^3/50 minutes, resulted in toxic effects on lung, thorax, or respiration - cough and dyspnea, and skin and appendages - sweating.

*See NIOSH, *RTECS* (ZG8600000), for additional toxicity data. Refer to Genium MSDS #45 for toxicity data relevant to exposure to zinc oxide fumes generated from heated zinc metal.

Section 12 - Ecological Information

Ecotoxicity: Chronic aquatic toxicity limits: 0.04 ppm; toxicity to aquatic plants: 25 ppm. Rainbow trout, LC_{50} = 4 ppm/48 hrs; zebrafish (embryo), LC_{50} = 19 ppm/72 hrs. Zinc accumulates in gill tissue and bone. Zinc is thought to exert its toxic action by forming insoluble compounds with the mucous that covers the gills, by damage to the gill epithelium, or by an internal poison.
Environmental Fate: Bioaccumulation may be significant (Biological Concentration Factor (BCF) ranges from 85 to 100,000).
Environmental Degradation: Zinc can persist in water indefinitely.

Section 13 - Disposal Considerations

Disposal: Reclaim for salvage or reuse. Unsalvageable waste may be buried in an approved landfill. Maximum concentration in effluent to sewer or stream is 1 ppm. Criteria for land treatment or burial disposal practices are under significant review. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Zinc powder
Shipping Symbols: –
Hazard Class: 4.3
ID No.: UN 1436
Packing Group: II
Label: Dangerous When Wet, Spontaneously Combustible
Special Provisions (172.102): A19, B109, N40

Packaging Authorizations
a) Exceptions: None
b) Non-bulk Packaging: 173.211
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: Forbidden
b) Cargo Aircraft Only: 15 kg

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: –

Section 15 - Regulatory Information

EPA Regulations:
Classified as a RCRA Hazardous Waste (40 CFR 261.21, 23), Characteristics of Ignitability and Reactivity
RCRA Hazardous Waste Number: D001, D003
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per CWA, Sec. 307(a)
CERCLA Final Reportable Quantity (RQ), 1000 lb (454 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65) as zinc (fume or dust)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

Section 16 - Other Information

References: 1, 73, 103, 124, 136, 149, 190, 209, 216, 222, 224, 230

Prepared By..... R Reals, MS/HM Spliethoff, MS
Industrial Hygiene Review..... PA Roy, MPH, CIH
Medical Review..... T Thoburn, MD, MPH

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

Attachment E

Table 3-1 Chemical Hazard Information

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

TABLE 3-1
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Barium soluble compounds (as Ba) [7440-39-3]	ND	NA	Inh Ing Con	Upper respiratory irritation; gastroenteritis; muscular spasms; slow pulse, extra systoles; hypokalemia; eye and skin irritation; skin burns	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	0.5 mg/m^3 0.5 mg/m^3 0.5 mg/m^3		PEL TLV REL	50 mg/m^3
Benzo(b)fluoranthene [205-99-2]	ND	ND	Inh Abs Ing Con	Skin tumors – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	NE		PEL TLV REL	
Benzo(a)Anthracene [56-55-3]	ND	ND	Inh Ing Con	Eye and skin irritation, respiratory tract irritation. Potential cancer causing chemical	Eye: Irrigate immediately Skin: Rinse & Soap wash immediately Breath: Move to fresh air, rest Swallow: Rinse mouth	NE		PEL TLV REL	
Benzo(a)pyrene 50-32-8	ND	ND	Inh Ing Con	Eye and skin irritation, respiratory tract irritation. Potential cancer causing chemical	Eye: Irrigate immediately Skin: Soap wash, seek medical attention Breath: Move to fresh air, give respiratory support if needed, seek medical aid Swallow: Rinse mouth, drink milk or water, seek medical aid	0.2 mg/m3 (as benzene soluble aerosol) ACGIH .1 mg/m3 NIOSH		PEL TLV REL	
Benzo(k)flouranthene [207-08-9]	ND	ND	Inh Abs Ing Con	Eye and skin irritation, respiratory track irritation.	Eye: Irrigate immediately Skin: Rinse & Soap wash, seek medical attention Breath: Move to fresh air, drink water Swallow: Immediate medical attention	NE	NE	PEL TLV REL	NE
Bis(2-ethylhexyl) phthalate [117-81-7]	NA	NE	Ing Inh Con	Irritation to eyes and mucous membranes; liver damage; teratogenic effects; carcinogen	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	5 mg/m3 5 mg/m3		PEL TLV REL	5000 mg/m3
Cadmium dust (as Cd) [7440-43-9]	NA	NA	Inh Ing	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscular aches; nausea, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.005 mg/m3 0.01 mg/m3 Ca, lowest feasible concentration		PEL TLV REL	Ca (9 mg/m3)
Chromium metal (as Cr) [7440-47-3]	NA	NA	Inh Ing	Histologic fibrosis of lungs	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m3 0.5 mg/m3 0.5 mg/m3		PEL TLV REL	250 mg/m3
Chrysene [218-01-9]	ND	ND	Inh Abs Ing Con	Irritated eyes, nose, and skin; coughing and bronchitis; photosensitivity; dermal burns; hematuria	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m3 0.1 mg/m3		PEL TLV REL	80 mg/m3
Copper dusts and mists (metal) (copper sulfate) [7440-50-8]	NA	NA	Inh Ing Con	Irritated pharynx and nasal mucous membrane; nasal perforation; eye irritation; metallic taste; dermatitis; in animals: lung, kidney, and liver damage; anemia	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m3 1 mg/m3 1 mg/m3		PEL TLV REL	100 mg/m4

TABLE 3-1 (CONT'D)
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Dibenzofuran [132-64-9]	ND	ND	Inh Abs Ing Con	Irritated eyes, skin, GI, and respiratory tract	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	NE	NE	PEL TLV REL	NE
Dibenzo(a,h)anthracene [53-70-3]	ND	ND	Inh Abs Ing Con	Irritated eyes, skin, and respiratory track; carcinogetic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Remove to fresh air, rinse mouth with water, rest Swallow: Immediate medical attention	NE	NE	PEL TLV REL	NE
Fluoranthene [206-44-0]			Inh Con Ing	Irritated eyes, skin, and throat; nausea, tachycardia, cardiac arrhythmias, pulmonary edema, and respiratory arrest	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	NE		PEL TLV REL	
Indeno(1,2,3-cd)pyrene [193-39-5]	ND	ND	Inh Abs Ing Con	Irritated eyes, skin, GI, and upper respiratory track	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Remove to fresh air, rinse mouth with water, rest Swallow: Immediate medical attention	NE	NE	PEL TLV REL	NE
Lead, inorganic dusts and fumes (as Pb) [7439-92-1]	NA	NA	Inh Ing Con	Weakness, lassitude, insomnia; facial pallor; eye pallor; anorexia, low weight, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremors; wrist and ankle paralysis; brain damage; kidney damage; irritated eyes; hypotension	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.05 mg/m3 0.05 mg/m3 <0.1 mg/m3 See 29 CFR 1910.1025		PEL TLV REL	100 mg/m3
Mercury vapor [7439-97-6]	ND	ND	Inh Abs Con	Coughing, chest pain, dyspnea, bronchial pneumonitis; tremors, insomnia; irritability, indecision; headache; fatigue, weakness, stomatitis, salivation; gastrointestinal disturbance, anorexia, low weight; proteinuria; irritated eyes and skin	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.05 mg/m3 0.025 mg/m3 0.05 mg/m3 (skin)	C0.1 ppm C0.1 ppm	PEL TLV REL	2 mg/m3
Naphthalene [91-203]	8.12	ND	Inh Abs Ing Con	Irritated eyes; headache; confusion, excitement, malaise; nausea, vomiting, abdominal pain; irritated bladder, profuse sweating; jaundice, renal shutdown; dermatitis	Eye: Irrigate immediately Skin: Molten flush immediately/ sol-liq soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	10 ppm 10 ppm 10 ppm	15 ppm	PEL TLV REL	250 ppm
Nickel, metal, and other compounds (as Ni) [7440-02-0]	NA	NA	Inh Ing Con	Headache, vertigo; nausea, vomiting, epigastric pain; substernal pain; coughing, hyperpnea; cyanosis; weakness; leukocytosis, pneumonitis; delirium, convulsions – carcinogenic	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m3 1.5 mg/m3* 0.015 mg/m3 Ca *NIC-0.05 A1		PEL TLV REL	Ca 10 mg/m3
Phenanthrene [85-01-8]	ND	ND	Inh Abs Ing Con	Irritated eyes, skin, digestive tract, and respiratory system	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m3 0.2 mg/m3 0.1 mg/m3* *Reported as coal tar pitch volatiles		PEL TLV REL	80 mg/m3

TABLE 3-1 (CONT'D)
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Phenol [108-95-2]	8.5	0.040-3.0	Inh Abs Ing Con	Irritated eyes, nose, and throat; anorexia, low weight; weakness, muscular aches and pains; dark urine; cyanosis; liver and kidney damage; skin burns; dermatitis; ochronosis; tremors, convulsions, twitching.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	5 ppm (skin) 5 ppm (skin) 5 ppm (skin)	C15.6 ppm	PEL TLV REL	250 ppm
Polychlorinated biphenyls (PCB) Aroclor 1242 [53469-21-9] and Aroclor 1254 [11097-69-1]	ND	ND	Inh Abs Ing Con	Aroclor 1242: irritated eyes; chloracne; acne-form dermatitis; mildly toxic by ingestion; poison by subcutaneous route – carcinogenic Aroclor 1254: irritated eyes and skin; acne-form dermatitis; poison by intravenous route; moderately toxic by ingestion and intraperitoneal routes – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	Aroclor 1242: 1 mg/m^3 (skin) 1 mg/m^3 (skin) 0.001 mg/m^3 Aroclor 1254: 0.5 mg/m^3 (skin) 0.5 mg/m^3 (skin) 0.001 mg/m^3		PEL TLV REL PEL TLV REL	Ca (10 mg/m^3) Ca (5 mg/m^3)
Pyrene [129-00-0]	ND	ND	Inh Abs Ing Con	Irritated eyes, skin, and digestive tract; dermatitis, hyperemia, weight loss	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m^3		PEL TLV REL	NE
Zinc (as oxide fume) [1314-13-2]	NA	NA	Inh	Sweet metallic taste; dry throat, cough, chills, fever; tight chest, dyspnea, rales, reduced pulmonary function; headache; blurred vision; muscular cramps, low back pain; nausea, vomiting; fatigue, lassitude, malaise	Breath: Respiratory support	5 mg/m^3 5 mg/m^3 5 mg/m^3	10 mg/m^3	PEL TLV REL	50 mg/m^3

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

References:

American Conference of Governmental Industrial Hygienists Guide to Occupational Exposure Values, 2003, compiled by the American Conference of Governmental Industrial Hygienists.
American Conference of Governmental Industrial Hygienists Threshold Limit Values, 2003, compiled by the American Conference of Governmental Industrial Hygienists
Amoore, J. and E. Hautula, "Odor as an Aid to Chemical Safety," Journal of Applied Toxicology, 1983.
Clayton, George D. and F.E. Clayton, Patty's Industrial Hygiene and Toxicology, 3rd ed., John Wiley & Sons, New York.
Documentation of TLVs and BEIs, American Conference of Governmental Industrial Hygienists, 5th ed., 1986.
Fazzuluri, F.A., Compilation of Odor and Taste Threshold Values Data, American Society for Testing and Materials, 1978.
Gemet, L. and J. Van, Compilation of Odor Threshold Values in Air and Water, CIVO, Netherlands, 1977.
Gemet, L. and J. Van, Compilation of Odor Threshold Values in Air and Water, Supplement IV, CIVO, Netherlands, 1977.
Lewis, Richard J., Sr., 1992, Sax's Dangerous Properties of Industrial Materials, 8th ed., Van Nostrand Reinhold, New York.
Micromedex Tomes Plus (R) System, 1992, Micromedex, Inc.
National Institute for Occupational Safety and health Pocket Guide to Chemicals, Pub. 1990, No. 97-140, National Institute for Occupational Safety and Health, 2003.
Odor Threshold for Chemicals with Established Occupational Health Standards, American industrial Hygiene Association, 1989.
Respirator Selection Guide, 3M Occupational Health and Safety Division, 1993.
Verschuseren, K., Handbook of Environmental Data on Organic Chemicals, Van Nostrand and Reinhold, 1977.
Warning Properties of Industrial Chemicals – Occupational Health Resource Center, Oregon Lung Association
Workplace Environmental Exposure Levels, American Industrial Hygiene Association, 1992.

Attachment F

Incident/Near-Miss Investigation Report

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Incident / Near-Miss Investigation Report

☐ OSHA Recordable ☐ First Aid Injury ☐ Fire Date of Incident:
☐ Lost Workday Injury ☐ Vehicle Accident ☒ Spill / Leak
☐ Restricted Duty Injury ☐ Equipment Damage ☒ Near Miss Incident Number:

Every employee injury, accident, and near miss must be reported within 24 hours of the injury. If the incident results in hospitalization, an immediate report must be made by telephone to the Project Manager and the Health and Safety Officer.

Project Information

Project Name:	Project #
Location of Incident:	

Employee

Name:	Employee Number:
Employment Status: ☐ Regular ☐ Part Time	How long in present job?

Injury or Illness Information

Where did the incident / near miss occur? (number, street, city, state, zip):

Employee's specific activity at the time of the incident / near miss:

Equipment, materials, or chemicals the employee was using when the incident / near miss occurred (e.g., the equipment employee struck against or that struck the employee; the vapor inhaled or material swallowed; what the employee was lifting, pulling, etc.):

Describe the specific injury or illness (e.g., cut, strain, fracture, etc.):

Body part(s) affected (e.g., back, left wrist, right eye, etc.):

Name and address of treatment provider (e.g., physician or clinic):	Phone No.:
If hospitalized, name and address of hospital:	Phone No.:

Date of injury or onset of illness: / /	Time of event or exposure: ☐ AM ☐ PM

Did employee miss at least one full shift's work? ☐ No ☐ Yes, 1st date absent (MM/DD/YYYY) / /

Has employee returned to work? ☐ Regular work ☐ Restricted work ☐ No
☐ Yes, date returned (MM/DD/YYYY) / /

To whom reported:	Other workers injured / made ill in this event? ☐ Yes ☐ No

Description of Incident / Near Miss: (Describe what happened and how it happened.)

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Incident / Near-Miss Investigation Report

Motor Vehicle Accident (MVA)

Company Vehicle?	☐ Yes ☐ No

Accident Location (street, city, state)									
Vehicle Towed?	☐ Yes ☐ No	Other Vehicle?	☐ Yes ☐ No	# Vehicles Towed:		# of Injuries:			

Spill

Material Spilled:	Quantity:	Source:
Agency Notifications:		
Cost of Incident $		

Third Party Incidents

Name of Owner:		Address:	Telephone:
Description of Damage:			
Witness Name:		Address:	Telephone:
Witness Name:		Address:	Telephone:

Root Cause and Contributing Factors: Conclusion (Describe in Detail Why Incident / Near Miss Occurred)

1	
2	
3	

Root Cause(s) Analysis (RCA):

1. Lack of skill or knowledge.
2. Lack of or inadequate operational procedures or work standards.
3. Inadequate communication of expectations regarding procedures or work standards.
4. Inadequate tools or equipment.
5. Correct way takes more time and / or requires more effort.
6. Short-cutting standard procedures is positively reinforced or tolerated.
7. Person thinks there is no personal benefit to always doing the job according to standards.
8. Uncontrollable.

#	RCA #	Solution(s): How to Prevent Incident / Near Miss From Reoccurring	Person Responsible	Due Date	Closure Date

Investigation Team Members

Name	Job Title	Date

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date
	Project Manager	
	Health and Safety Reviewer	

Attachment G

Loss Prevention Observation (LPO) Form

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Loss Prevention Observation (LPO) Form

Observer Name:	Observer Title:	Contractor Company Name:
Date: _____ Time: ____ ☐ AM ☐ PM	Project Type / Task Observed:	

Background Information and Miscellaneous Comments

Observer's Positive Comments

Feedback Conducted By		Date		Time	☐ AM ☐ PM

Conclusion (Describe in Detail Why the Questionable Item Occurred). Add Any Employee Comments.

Root Cause(s) Analysis (RCA):

1. Lack of skill or knowledge.
2. Lack of or inadequate operational procedures or work standards.
3. Inadequate communication of expectations regarding procedures or work standards.
4. Inadequate tools or equipment.
5. Correct way takes more time and/or requires more effort.
6. Short-cutting standard procedures is positively reinforced or tolerated.
7. Person thinks there is no personal benefit to always doing the job according to standards.
8. Uncontrollable.

Questionable Item #	RCA #	Solution(s): How to Prevent Questionable Behavior From Reoccurring	Person Responsible	Due Date	Closure Date

Results of Solution Verification and Validation

Reviewed by	Date	Reviewed by	Date

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Loss Prevention Observation (LPO) Form

Environmental Operations

	PRE-TASK PREPARATION	Correct	Questionable	Comments
1.	Are Health and Safety Plan / MSDSs on site?			
2.	Is the employee familiar / trained on task?			
3.	OSHA-required training / medical surveillance?			
4.	Was utility mark out / check performed?			
5.	Was traffic hazard addressed / work area marked?			
6.	Are walking / working surfaces free of hazards?			
7.	Was the tailgate safety meeting performed?			
8.	Was SPSA performed prior to beginning work?			
9.	Communicates intentions to other personnel?			
10.	Knowledge of emergency procedures?			
11.	Distance between equipment and power lines?			
12.	Personal protective equipment?			
13.	Air monitoring equipment on site, calibrated?			
14.	Is a first aid kit / fire extinguisher on site?			
15.	Is one person trained in first aid / CPR?			
16.	Are work zones established and marked?			
	PERFORMING TASK			
17.	SPSA before beginning new task?			
18.	Correct body positioning?			
19.	Proper lifting / pushing / pulling techniques?			
20.	Keep hands / body away from pinch points?			
21.	Are walking / working surfaces kept clear of debris?			
22.	Faces traffic as appropriate?			
23.	Do vehicles / barricades exist to protect against traffic?			
24.	Is the drill rig located properly, blocked / chocked?			
25.	Is the drill rig moved only with derrick lowered?			
26.	Is the excavator located on stable ground?			

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Loss Prevention Observation (LPO) Form

Environmental Operations

27.	Is eye contact made with equipment operator?			
28.	Is spoil at least 2 feet back from edge of excavation?			
29.	Is the excavation shored / sloped / benched?			
30.	Is the excavation entry controlled?			
31.	Are equipment / tools used properly?			
32.	Is electrical equipment connected through GFCI?			
33.	Are power tools handled properly?			
34.	Are electrical cords inspected / in good condition?			
35.	Follows lockout / tagout procedures?			
36.	Air monitoring conducted / action levels understood?			
37.	Was equipment decontaminated properly?			
38.	Were personnel decontaminated prior to eating / drinking / smoking?			
39.	Was the decontamination effective?			
	POST – TASK			
40.	Procedures / JSA adequate?			
41.	Are equipment / tools stored properly?			
42.	Proper storage of soil / water / waste material?			
43.	Is the work area secured?			
44.	Other?			
	Total #			**% Safe:** (Total Correct/[Total Correct + Total Questionable]) * 100]

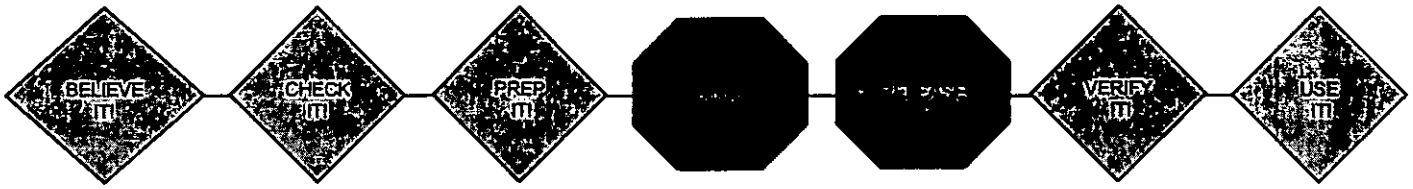
Attachment H

Hazardous Energy Control (LO/TO) Form

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Lockout / Tagout Equipment-Specific Energy Control Procedure



Equipment Identification:

Hazardous Energy Source		Isolation Device			Verifying Lockout
Type and Magnitude	Function	Type	Location	I.D. No.	Means of Verification of Lockout
Electrical 120v					
Pneumatic					
Hydraulic					
Mechanical					
Potential					
Gravity					
Other					
Other					
Other					
Area:		Date of Last Review:			Authorized by:

Attachment I

Fall Protection Standard Operating Procedure (SOP)

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

Approval Signatures

Prepared by: _____ Date: _____

Reviewed by: _____ Date: _____
(Technical Expert)

Reviewed by: _____ Date: _____
(Editorial Reviewer)

Reviewed by: _____ Date: _____
(Quality Assurance Reviewer)

Approved by: _____ Date: _____
(Project Manager)

Standard Operating Procedure: Elevated Work and Fall Protection

I. Scope and Application

The Firm is committed to operate in a manner which protects the health and safety of its personnel. Employees of the Firm must abide by applicable local, state, and federal regulations while conducting activities for the Firm. To maintain a safe and healthful workplace, employees of the Firm must utilize the procedures outlined in this SOP for any elevated work activities conducted as part of the Firm's business.

This SOP sets forth standard procedures to be utilized by employees of the Firm when working from elevated surfaces. This procedure also establishes administrative roles and responsibilities to meet the requirements and definitions found in the following OSHA Standards:

29 CFR 1926 Subpart L – Scaffolds
29 CFR 1926 Subpart M – Fall Protection
29 CFR 1926 Subpart R – Steel Erection
29 CFR 1926 Subpart X – Ladders

To reduce the potential for injury, personnel must avoid working from elevated work surfaces whenever feasible alternatives exist. If working from heights cannot be avoided, the safety and engineering controls outlined in this procedure must be implemented by authorized personnel under direct supervision of personnel competent with respect to potential elevated work hazards and regulatory requirements.

II. Personnel Qualifications

The following outlines the **responsibilities** of various personnel:

Officers/Division Heads/Project Managers

1. Verify that all elevated work activities are properly identified and addressed within a project work plan, site health and safety plan (HASP) and/or other project documents.

2. Verify that employees designated as "competent person" for scaffolding, elevated work and fall protection use have the experience, training, and authority to fulfill the requirements of the position.

3. Verify that proper fall protection and personal protective equipment is available for use by affected employees.

Corporate Health and Safety (CHS)

1. Review and revise this procedure as required to meet regulatory requirements.

2. Provide technical assistance regarding elevated work procedures, hazard identification, "competent person" designation, and personal protective systems.

3. Audit project elevated work activities for compliance with this procedure.

4. Review and revise, as appropriate, site-specific health and safety plans to include requirements for elevated work activities.

5. Verify that all employees assigned as a "competent person" for scaffolding, elevated work and fall protection activities meet the OSHA definition as such with respect to training and authority.

6. Provide initial competent person training and retraining, or recommend qualified training provider, for affected employees.

Site Designated "Competent Person"

Under most instances BBL will not provide the fall protection competent person. The project manager must verify that the subcontractor has a trained competent person as specified below. BBL employees will not serve as the competent person for employees of another firm.

1. Must be capable of identifying existing or predictable hazards in surroundings and/or working conditions associated with scaffolding, elevated work and fall protection systems.

2. Must be authorized to take prompt corrective measures to eliminate hazardous conditions associated with scaffolding, elevated work and fall protection activities, including, but not limited to stopping work.

3. Verify that the safety procedures identified in this SOP, the site specific HASP and 29 CFR 1926 are utilized when required to protect employees during elevated work activities.

4. Conduct and document inspections of all scaffolding and protective systems (see attached Elevated Work Inspection Checklist or subcontractor equivalent).

5. Conduct and document inspections of all fall protection systems prior to use and after any event that may affect the performance of the equipment

6. Attend "Competent Person" training for scaffolding, elevated work and fall protection.

7. Attend 8-Hour Hazwoper Supervisory training.

Employees Required to Work on Scaffolds or Elevated Work Surfaces

1. Must be capable of recognizing existing or predictable hazards in surroundings and/or working conditions associated with elevated work activities.

2. Understand all safety requirements outlined in this SOP and 29 CFR 1926 to be utilized to protect employees during elevated work activities

3. Attend annual OSHA refresher training.

4. Attend Elevated Work / Fall Protection training.

III. Equipment List

Elevated work and scaffolding activities require a variety of equipment including, but not limited to the following:

- Signs, barricades or other devices to control access to the danger zones and unprotected elevated work areas;
- Approved fall protection devices that meet OSHA specifications, including but not limited to: guardrails, covers or warning line systems;
- Personal Fall Arrest Systems including anchor points, harness and lanyards;
- Scaffolding – many types including, fixed, mobile, pole and outrigger;
- Ladders – many types including fixed, extension and stepladders; and
- Personal Protective Equipment – as specified by the site-specific HASP and the PPE SOP.

All equipment must be appropriate for the elevated work activities and be approved or certified as specified by regulatory requirements.

IV. Cautions

Elevated work is one of the leading causes of construction related fatalities and is an extremely hazardous task, only trained, qualified employees will work on elevated work surfaces according to the procedures of this SOP.

V. Health and Safety Considerations

All policies, procedures and regulatory requirements as specified in this SOP, the site-specific HASP and applicable standards must be followed by employees of the Firm.

Any employee of the firm or subcontractor at a work site, is expected to and has the authority to, stop work if an imminent hazard exists.

VI. Procedure

1. Definitions - The following definitions have been provided to aid Project Managers and employees of the Firm with implementation of this section:

Scaffold Definitions:

Boatswains' chair means a single-point adjustable suspension scaffold consisting of a seat or sling designed to support one employee in a sitting position.

Brace means a rigid connection that holds one scaffold member in a fixed position with respect to another member, or to a building or structure.

Competent person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Deceleration device means any mechanism, such as a rope grab, rip-stitch lanyard, specially-woven lanyard, tearing or deforming lanyard, or automatic self-retracting lifeline lanyard, which dissipates a substantial amount of energy during a fall arrest or limits the energy imposed on an employee during fall arrest.

Equivalent means alternative designs, materials or methods to protect against a hazard which the employer can demonstrate will provide an equal or greater degree of safety for employees than the methods, materials or designs specified in the standard.

Exposed power lines means electrical power lines which are accessible to employees and which are not shielded from contact. Such lines do not include extension cords or power tool cords.

Eye or Eye splice means a loop with or without a thimble at the end of a wire rope.

Fabricated decking and planking means manufactured platforms made of wood (including laminated wood, and solid sawn wood planks), metal or other materials.

Failure means load refusal, breakage, or separation of component parts. Load refusal is the point where the ultimate strength is exceeded.

Guardrail system (scaffolds) means a vertical barrier, consisting of, but not limited to, toprails, midrails, and posts, erected to prevent employees from falling off a scaffold platform or walkway to lower levels.

Hoist means a manual or power-operated mechanical device to raise or lower a suspended scaffold.

Ladder jack scaffold means a supported scaffold consisting of a platform resting on brackets attached to ladders.

Ladder stand means a mobile, fixed-size, self-supporting ladder consisting of a wide flat tread ladder in the form of stairs.

Landing means a platform at the end of a flight of stairs.

Lifeline means a component consisting of a flexible line that connects to an anchorage at one end to hang vertically (vertical lifeline), or that connects to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

Lower levels means areas below the level where the employee is located and to which an employee can fall. Such areas include, but are not limited to, ground levels, floors, roofs, ramps, runways, excavations, pits, tanks, materials, water, and equipment.

Maximum intended load means the total load of all persons, equipment, tools, materials, transmitted loads, and other loads reasonably anticipated to be applied to a scaffold or scaffold component at any one time.

Mobile scaffold means a powered or unpowered, portable, caster or wheel-mounted supported scaffold.

Open sides and ends means the edges of a platform that are more than 14 inches (36 cm) away horizontally from a sturdy, continuous, vertical surface (such as a building wall) or a sturdy, continuous horizontal surface

(such as a floor), or a point of access. Exception: For plastering and lathing operations the horizontal threshold distance is 18 inches (46 cm).

Outrigger means the structural member of a supported scaffold used to increase the base width of a scaffold in order to provide support for and increased stability of the scaffold.

Overhand bricklaying means the process of laying bricks and masonry units such that the surface of the wall to be jointed is on the opposite side of the wall from the mason, requiring the mason to lean over the wall to complete the work. It includes mason tending and electrical installation incorporated into the brick wall during the overhand bricklaying process.

Platform means a work surface elevated above lower levels. Platforms can be constructed using individual wood planks, fabricated planks, fabricated decks, and fabricated platforms.

Power operated hoist means a hoist which is powered by other than human energy.

Qualified means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems related to the subject matter, the work, or the project.

Rated load means the manufacturer's specified maximum load to be lifted by a hoist or to be applied to a scaffold or scaffold component.

Scaffold means any temporary elevated platform (supported or suspended) and its supporting structure (including points of anchorage), used for supporting employees or materials or both. There are many sub-types of scaffolds not covered in these definitions.

Stilts means a pair of poles or similar supports with raised footrests, used to permit walking above the ground or working surface.

Unstable objects means items whose strength, configuration, or lack of stability may allow them to become dislocated and shift and therefore may not properly support the loads imposed on them. Unstable objects do not constitute a safe base support for scaffolds, platforms, or employees. Examples include, but are not limited to, barrels, boxes, loose brick, and concrete blocks.

Walkway means a portion of a scaffold platform used only for access and not as a work level.

Fall Protection Definitions:

Anchorage means a secure point of attachment for lifelines, lanyards or deceleration devices.

Body belt (safety belt) means a strap with means both for securing it about the waist and for attaching it to a lanyard, lifeline, or deceleration device.

Body harness means straps which may be secured about the employee in a manner that will distribute the fall arrest forces over at least the thighs, pelvis, waist, chest and shoulders with means for attaching it to other components of a personal fall arrest system.

Buckle means any device for holding the body belt or body harness closed around the employee's body.

Competent person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Connector means a device which is used to couple (connect) parts of the personal fall arrest system and positioning device systems together. It may be an independent component of the system, such as a carabiner, or it may be an integral component of part of the system (such as a buckle or dee-ring sewn into a body belt or body harness, or a snap-hook spliced or sewn to a lanyard or self-retracting lanyard).

Controlled access zone (CAZ) means an area in which certain work (e.g., overhand bricklaying) may take place without the use of guardrail systems, personal fall arrest systems, or safety net systems and access to the zone is controlled.

Dangerous equipment means equipment (such as pickling or galvanizing tanks, degreasing units, machinery, electrical equipment, and other units) which, as a result of form or function, may be hazardous to employees who fall onto or into such equipment.

Deceleration device means any mechanism, such as a rope grab, rip-stitch lanyard, specially-woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards, etc., which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on an employee during fall arrest.

Deceleration distance means the additional vertical distance a falling employee travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which the deceleration device begins to operate. It is measured as the distance between the location of an employee's body belt or body harness attachment point at the moment of activation (at the onset of fall arrest forces) of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.

Equivalent means alternative designs, materials, or methods to protect against a hazard which the employer can demonstrate will provide an equal or greater degree of safety for employees than the methods, materials or designs specified in the standard.

Failure means load refusal, breakage, or separation of component parts. Load refusal is the point where the ultimate strength is exceeded.

Free fall means the act of falling before a personal fall arrest system begins to apply force to arrest the fall.

Free fall distance means the vertical displacement of the fall arrest attachment point on the employee's body belt or body harness between onset of the fall and just before the system begins to apply force to arrest the fall. This distance excludes deceleration distance, and lifeline/lanyard elongation, but includes any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur.

Guardrail system means a barrier erected to prevent employees from falling to lower levels.

Hole means a gap or void 2 inches (5.1 cm) or more in its least dimension, in a floor, roof, or other walking/working surface.

Infeasible means that it is impossible to perform the construction work using a conventional fall protection system (i.e., guardrail system, safety net system, or personal fall arrest system) or that it is technologically impossible to use any one of these systems to provide fall protection.

Lanyard means a flexible line of rope, wire rope, or strap which generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.

Leading edge means the edge of a floor, roof, or formwork for a floor or other walking/working surface (such as the deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed, or constructed. A leading edge is considered to be an "unprotected side and edge" during periods when it is not actively and continuously under construction.

Lifeline means a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

Low-slope roof means a roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

Lower levels means those areas or surfaces to which an employee can fall. Such areas or surfaces include, but are not limited to, ground levels, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment, structures, or portions thereof.

Mechanical equipment means all motor or human propelled wheeled equipment used for roofing work, except wheelbarrows and mopcarts.

Opening means a gap or void 30 inches (76 cm) or more high and 18 inches (48 cm) or more wide, in a wall or partition, through which employees can fall to a lower level.

Overhand bricklaying and related work means the process of laying bricks and masonry units such that the surface of the wall to be jointed is on the opposite side of the wall from the mason, requiring the mason to lean over the wall to complete the work. Related work includes mason tending and electrical installation incorporated into the brick wall during the overhand bricklaying process.

Personal fall arrest system means a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a body belt or body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these. As of January 1, 1998, the use of a body belt for fall arrest is prohibited.

Positioning device system means a body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning.

Rope grab means a deceleration device which travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee. A rope grab usually employs the principle of inertial locking, cam/level locking, or both.

Roof means the exterior surface on the top of a building. This does not include floors or formwork which, because a building has not been completed, temporarily become the top surface of a building.

Roofing work means the hoisting, storage, application, and removal of roofing materials and equipment, including related insulation, sheet metal, and vapor barrier work, but not including the construction of the roof deck.

Safety-monitoring system means a safety system in which a competent person is responsible for recognizing and warning employees of fall hazards.

Self-retracting lifeline/lanyard means a deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.

Ladder and Stairway Definitions:

Equivalent means alternative designs, materials, or methods that the employer can demonstrate will provide an equal or greater degree of safety for employees than the method or item specified in the standard.

Failure means load refusal, breakage or separation of component parts.

Fixed-ladder means a ladder that cannot be readily moved or carried because it is an integral part of a building or structure. A side-step fixed ladder is a fixed ladder that requires a person getting off at the top to step to the side of the ladder side rails to reach the landing. A through fixed ladder is a fixed ladder that requires a person getting off at the top to step between the side rails of the ladder to reach the landing.

Handrail means a rail used to provide employees with a handhold for support.

Job-made ladder means a ladder that is fabricated by employees, typically at the construction site, and is not commercially manufactured. This definition does not apply to any individual-rung/step ladders.

Lower levels means those areas to which an employee can fall from a stairway or ladder. Such areas include ground levels, floors, roofs, ramps, runways, excavations, pits, tanks, material, water, equipment, and similar surfaces. It does not include the surface from which the employee falls.

Maximum intended load means the total load of all employees, equipment, tools, materials, transmitted loads, and other loads anticipated to be applied to a ladder component at any one time.

Nosing means that portion of a tread projecting beyond the face of the riser immediately below.

Point of access means all areas used by employees for work related passage from one area or level to another. Such open areas include doorways, passageways, stairway openings, studded walls, and various other permanent or temporary openings used for such travel.

Portable ladder means a ladder that can be readily moved or carried.

Riser height means the vertical distance from the top of a tread to the top of the next higher tread or platform/landing or the distance from the top of a platform/landing to the top of the next higher tread or platform/landing.

Single-cleat ladder means a ladder consisting of a pair of side rails, connected together by cleats, rungs, or steps.

Stairrail system means a vertical barrier erected along the unprotected sides and edges of a stairway to prevent employees from falling to lower levels. The top surface of a stairrail system may also be a "handrail."

Step stool (ladder type) means a self-supporting, foldable, portable ladder, nonadjustable in length, 32 inches or less in overall size, with flat steps and without a pail shelf, designed to be climbed on the ladder top cap as well as all steps. The side rails may continue above the top cap.

Tread depth means the horizontal distance from front to back of a tread (excluding nosing, if any).

Unprotected sides and edges means any side or edge (except at entrances to points of access) of a stairway where there is no stairrail system or wall 36 inches (.9 m) or more in height, and any side or edge (except at entrances to points of access) of a stairway landing, or ladder platform where there is no wall or guardrail system 39 inches (1 m) or more in height.

2. General Safety Requirements for Elevated Work Activities

BBL projects may periodically require working from an elevated surface to inspect building components, collect a sample or document subcontractor activities. This can present a significant life-threatening hazard to employees if they are not properly controlled. To identify these hazards and establish appropriate fall protection measures the following program and associated elevated work inspection checklist have been provided. The purpose of this section is to accomplish the following:

- Evaluate operations for elevated work hazards and provide direction on activities that require use of a fall restraint system;
- Identify appropriate fall protection measures, guards and control measures; and
- Maintain compliance with applicable client, BBL and government regulations.

Rate of Decent for a Free Fall:

Height (ft)	Ft/sec	MPH
6	19	13
10	25	17
20	35	24
30	43	29
50	56	38
100	80	55

A. To the extent feasible all elevated work surfaces must be protected with an approved method; guardrail, warning line system or cover to protect employees and equipment. Protection from falling objects on elevated work surfaces (4 inch toeboard and hard hats) must also be provided.

B. If work must be performed on an unprotected elevated work area an approved fall restraint system must be used as described in Section 3 below.

C. When working on scaffolding or other elevated work surfaces near utilities, process lines and other hazards precautions must be taken to determine the exact location of the installations and to adequately protect and avoid them. Adequate distance from electrical utilizes as specified below must be maintained:

Minimum Scaffold Electrical Clearance Distances:

Insulated Line Voltage	Minimum Distance
less than 300 volts (v)	3 feet (9 meters)
300 v to 50 kv	10 feet (3.1 meters)
Greater than 50 kv	10 feet (3.1 meters) plus 0.4 inches (1 cm) for each 1 kv over 50

Uninsulated Line Voltage	Minimum Distance
less than 50 kv	10 feet (3.1 meters)
Greater than 50 kv	10 feet (3.1 meters) plus 0.4 inches (1 cm) for each 1 kv over 50

D. All scaffolding must be installed and inspected by a "competent person", constructed of approved materials, level, secured and maintained to prevent slipping. Scaffolding over 125 in height must be designed by a registered Professional Engineer (PE).

E. All fall restraint systems must be used under the direction of a "competent person", constructed of approved materials and used according to the manufacturer's instructions. Employees must be trained in fall restraint system use and inspect all equipment prior to use.

F. Fall protection activities must be conducted in accordance with all regulatory and client/site-specific requirements. Fall protection must be addressed in the site-specific health and safety plan

In most instances BBL, the General Contractor or the client will hire a qualified subcontractor to install scaffolding. The Project Manger must verify that that a qualified firm with a trained competent person is at the site and that the scaffolding was installed according to OSHA requirements and the manufacturer's specifications.

3. Elevated Work Requiring Protective Systems

The following activities require use of a personal fall restraint system:

A. Working on an unprotected elevated work surface which is 6 feet or more above the lower level or when working around unprotected hazardous locations; chemical tanks, open hazardous equipment, etc.

B. When working outside of the protected area of scaffolding, scissor or boom lift or other mobile work platform.

The Project Manager or Health and Safety supervisor will evaluate project requirements to determine if fall restraint systems will be required. If required only employees trained on fall protection hazards and the proper use of the equipment will be allowed to perform the task.

BBL employees are prohibited from working on elevated work surfaces protected by controlled access zones, netting or safety monitor systems without prior approval from Corporate Health and Safety and the Project Manager.

4. Selection and Use of Fall Restraint Systems

The following requirements must be followed when using fall restraint systems:

Personal Fall Restraint Systems:

- Body belts are strictly forbidden to be used as part of a personal fall arrest system
- Connectors and hardware must be constructed of substantial materials, able to withstand the intended load and be corrosion resistant

- Fall restraint systems must have a designed safety factor of at least 2 times the expected load
- Lanyards and vertical lifelines must have a minimum breaking strength of 5,000 pounds and protected from cuts and abrasions
- Only one individual can attach to each lifeline
- Ropes and straps, shall be made of synthetic fibers
- Harness belts must be at least 1 5/8 inches (4.1 cm) wide
- Must bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07 m)
- Provisions for quick rescue in the event of a fall must be available at the site
- Restraint systems can not be anchored to guardrails
- Anchors must be able to withstand 5600 lbs of force
- All components must be inspected prior to use
- Employees must be trained prior to using fall restraint systems
- Fall restraint systems must be taken out of service immediately if subject to impact loading and inspected by a competent person prior to reuse
- Snap hooks must not be engaged: directly to webbing, rope or wire rope; to each other; to a Dee-ring to which another snap hook or other connector is attached; to a horizontal lifeline; or to any object which is incompatibly shaped or dimensioned in relation to the snap hook such that unintentional disengagement could occur by the connected object being able to depress the snap hook keeper and release itself.

5. Training

A. "Competent Person" Training

In order to be assigned duties as a competent person with respect to scaffolding or fall protection, personnel must complete the firm's training course or an equivalent course approved by Corporate Health and Safety including but not limited to the following topics:

1. Fall protection hazards
2. Scaffold erection techniques and materials
3. Fall protection systems; personal fall restraint, guardrails, covers and warning line systems
4. Requirements of 1926 subpart L, M, R, X and appendices
5. Procedures for addressing safety hazards
6. Fall equipment maintenance and inspection

B. General Hazard Awareness Training for employees that use fall protection equipment must be completed by CHS or an approved source.

VII. Waste Management

All equipment including disposal PPE must be disposed of according to State, Local and Client requirements. All equipment will be decontaminated before leaving the site.

VIII. Data Recording and Management

A. The completed Elevated Work Inspection Checklist or equivalent must be completed and available for review at the site.

B. Copies of the completed checklists must be retained within the project file.

C. Information on the elevated work health and safety issues (lessons learned, LPOs, etc.) must be forwarded to Corporate Health and Safety for quality assurance checks and record retention.

IX. Quality Assurance

Implementation of this SOP will be monitored through the use of site inspections, quality audits and document review.

X. References

US Based Regulations
29 CFR 1926 Subpart L – Scaffolds
29 CFR 1926 Subpart M – Fall Protection
29 CFR 1926 Subpart R – Steel Erection
29 CFR 1926 Subpart X – Ladders

Consensus Standards
ANSI Z359.1 Safety Requirements for Personal Fall Protection
ANSI ZA92.2 Vehicle Mounted Elevating and Rotating Work Platforms

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Elevated Work Inspection Inspection Checklis

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

This checklist must be completed for all elevated work activities. It documents that pre-use and daily/periodic inspections are conducted.

Have alternatives to working from an unprotected elevated work surface been considered? YES NO

By:

Type of Fall Restraint System in Use:

Describe the anchor point and rescue provisions in the event of a fall:

Inspection Item	YES	NO	Comments
Elevated work surfaces are protected by approved means? (guardrails, barriers or warning line systems)			
Employees working from unprotected elevated work surfaces have been trained?			
Anchor points are capable of withstanding 5600 lbs of force?			
Fall restraint systems are made from approved materials?			
Fall restraint systems materials are compatible and in good condition?			
Restraint systems limit free fall to 2 feet or less?			
Scaffolds and fall restraint systems are used under the guidance of a trained competent person?			
Scaffolds over 125 feet high have been designed and installed by a P.E.?			
Mobile elevated work platforms (scaffolds, boom/scissor lifts) are inspected prior to use and have approved guarding?			
Fall restraint equipment is being used according to the manufacturer's specifications?			
Ladders are inspected and used according to the manufacturer's recommendations?			
Employees are maintaining three points of contact when on ladders?			
Employees are keeping their center of gravity within the rails of the ladder and not using the top two steps on stepladders?			
The rated load capacity of elevated work surfaces and scaffolds is observed?			
BBL Elevated Work / Fall Protection Competent Person:			**Date/Time:**

Attachment J

Equipment Pre-Operation Checklist

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

EQUIPMENT PRE-OPERATION INSPECTION

Date: _____ Hours Start: _____

Unit: _____ Hours End: _____

Operator: _____ Shift: _____

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

NR = Needs Repaired

Attachment K

Confined Space Entry Checklist

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Confined Space Entry Checklist

Permit #:

Project:

ALL COPIES OF PERMIT MUST REMAIN AT JOB SITE UNTIL THE ENTRY IS COMPLETE

Location and Description of Confined Space:

Checklist	YES	NO	N/A	COMMENT
Are all lines to and from confined space blanked, capped, or isolated?				
Electrical service locked out (entrant with key)?				
Are mechanical devices / systems restrained and locked out?				
Is explosion-proof electrical equipment in use?				
Are ladders secured at top?				
Is the ground fault circuit interrupter checked and functioning?				
Are all ignition sources identified and isolated?				
Are respirators and air supply equipment in proper condition?				
Are safety harnesses and lifelines in proper condition?				
Is required PPE being used?				
Is monitoring equipment calibrated and functioning properly?				
Is atmospheric testing completed?				
Is a trained attendant on standby?				
Is emergency equipment ready for use?				
Are rescue provisions in place?				
Are warning signs posted?				
Is ventilation equipment functioning properly?				
Is the retrieval system functioning properly?				
Communication device for entrance and attendants?				
Is the area secured to eliminate unauthorized entry?				
Are entry personnel trained for confined space entry?				
Is the confined space entry permit completed and posted?				
Are the permanent ladder rungs in safe condition?				

Monitoring Frequency: **Continuous** **5 min.** **10 min.** **30 min.**

Monitor's Name: _____

Time of Reading	Confined Space Air Monitoring Parameters			
	% Oxygen>19.5%	% LEL <10%	CO <20 ppm	Other
Pre-Entry				

Entry Supervisor _____
Print Name

_____
Signature Date Time

Air Monitor _____
Print Name

_____
Signature Date Time

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Confined Space Entry Permit

Project Name:	**Date / Time:**
Project Number:	**Location:**
Prepared By:	**Project Manager:**
Location and Description of Confined Space:	
Rescue Contact and Phone Number:	
Entry Objectives:	
Equipment / Materials Required for Entry:	
Time of Entry:	Expiration of Entry:
Required Respirator for Entry:	
Required Protective Clothing for Entry:	

Monitoring Interval: **Continuous** **5 minutes** **10 minutes** **15 minutes** **30 minutes**

Air Monitoring Requirements

Monitor For	Monitoring Equipment	Calibrated	
		Date / Time	By
% O_2			
% of LEL			
H_2S			
CO			
Other:			
Other:			

Entrants and Attendants

Number of Entrants:	Number of Attendants:
Names of Entrants	**Names of Attendants**

Entry Supervisor Authorizing Confined Space Entry Permit

Print:	Date:	Time:
Signature:	Date:	Time:

Entry Supervisor Canceling Confined Space Entry Permit

Print:	Date:	Time:
Signature:	Date:	Time:

Attachment L

Air Monitoring Log

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Air Monitoring Log

Project: **Date:**

Monitoring Instruments:

Air Monitor: **Activity:**

Level of Protection:

Time	Location	Instrument Reading	Comments

Attachment M

Health and Safety Inspection Form

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Health and Safety Inspection Form

Project Name:	**Date:**			
Project Number:	**Location:**			
Prepared By:	**Project Manager:**			
Auditor:	**HSS On Site:**			
	YES	**NO**	**N/A**	**COMMENTS**
GENERAL				
Is the HASP on site?				
Is the HASP finalized and approved?				
Is the OSHA poster displayed?				
Are emergency telephone numbers posted?				
Is emergency eyewash immediately available?				
Is an emergency shower immediately available?				
Are emergency notification means available (radio, telephone)?				
Is a first-aid kit immediately available?				
Is the first-aid kit adequately stocked?				
Is there a proper sanitation facility on site?				
DOCUMENTATION AND RECORDKEEPING				
Are only personnel listed and approved in the HASP on site?				
Are all personnel properly trained? (Check company-issued wallet cards.)				
Is the daily field log kept by the Site Manager?				
Are levels of PPE recorded?				
Are contaminant levels recorded?				
Are site surveillance records kept by HSS?				
Is a copy of current fit test records on site?				
Are calibration records maintained for air monitoring equipment?				
Are accident / incident forms on site?				
Are field team review sheets signed?				
Are additional hospital route directions available?				
Is the visitors' logbook being accurately maintained?				
Are MSDSs available for all chemicals on site?				
Are HASP revisions recorded?				
Is the first-aid kit inspected weekly?				
Are daily safety meetings held?				
Are emergency procedures discussed during safety meetings?				

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Health and Safety Inspection Form

	YES	NO	N/A	COMMENTS
EMERGENCY RESPONSES				
Is a vehicle available on site for transportation to the hospital?				
Are fire extinguishers on site and immediately available at designated work areas?				
Is at least one person trained in CPR and first aid on site at all times during work activities?				
Do all personnel know who is trained in CPR / first aid?				
PERSONAL PROTECTIVE EQUIPMENT (PPE)				
Is proper PPE being worn as specified in HASP?				
Level of PPE being worn.				
Is PPE adequate for work conditions?				
If not, give reason.				
Upgrade/downgrade to PPE level.				
Does any employee have facial hair that would interfere with respirator fit?				
If yes, willing to shave, as necessary?				
Fit-tested within the last year? (Documentation present)				
If Level B, is a back-up / emergency person suited up (except for air)?				
Does the HSS periodically inspect PPE and equipment?				
Is the PPE not in use properly stored?				
Is all equipment required in the HASP on site?				
Properly calibrated?				
In good condition?				
Used properly?				
Other equipment needed?				
List.				
Is monitoring equipment covered with plastic to minimize contamination?				
PERSONNEL AND EQUIPMENT DECONTAMINATION				
Is the decontamination area properly designated?				
Is appropriate cleaning fluid used for known or suspected contaminants?				
Are appropriate decontamination procedures used?				
Are decontamination personnel wearing proper PPE?				
Is the equipment decontaminated?				

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Health and Safety Inspection Form

	YES	NO	N/A	COMMENTS
PERSONNEL AND EQUIPMENT DECONTAMINATION (continued)				
Are sample containers decontaminated?				
Are disposable items replaced as required?				
WORK PRACTICES				
Was proper collection and disposal of potentially contaminated PPE performed?				
Was proper collection and disposal of decontamination fluid performed?				
Is water available for decontamination?				
Is the buddy system used?				
Is equipment kept off drums and the ground?				
Is kneeling or sitting on drums or the ground prohibited?				
Do personnel avoid standing or walking through puddles or stained soil?				
Are work zones established?				
If night work is conducted, is there adequate illumination?				
Is smoking, eating, or drinking in the exclusion or CRZ prohibited?				
To the extent feasible, are contaminated materials handled remotely?				
Are contact lenses not allowed on site?				
Is entry into excavations not allowed unless properly shored or sloped?				
Is a competent person on site during excavation?				
Are all unusual situations on site listed in HASP?				
If not, when?				
Action taken?				
HASP revised?				
CONFINED SPACE ENTRY				
Are employees trained according to 1910.146 – Confined Space Entry?				
Are all confined spaces identified? If not, list:				
Is all appropriate equipment available and in good working order?				
Is equipment properly calibrated?				
Are confined space permits used?				
Are confined space permits completely and correctly filled out?				

*N/A = Not Applicable

Attachment N

Safety Meeting Log

BBL
ENVIRONMENTAL SERVICES, INC.
Remedial Management & Construction

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Safety Meeting Log

Project:	**Location:**
Date / Time:	**Activity:**

1. Work Summary

2. Physical Chemical Hazards

3. Protective Equipment/Procedures

4. Emergency Procedures

Does anyone have any medical issues that the rest of us should know about? (For example: allergic to bees or ants and requires an autoinjector)

5. Signatures of Attendees
