US Army Corps
of Engineers

Landfill 7 Cover Improvements at the Former Griffiss Air Force Base Rome, New York

Site Safety and Health Plan Document Series 3 of 5

Conti Environmental, Inc.
South Plainfield, N.J.

March 2002

FINAL

COMMENTS AND RESPONSES
Landfill 7
EPA – Doug Pocze Comments

Comments and Responses to the Site Safety and Health Plan

Item	Sec.	Comment	Response
1	**GENERAL**	The Chemical Hazards section, Section 3.2.2, does not specifically discuss the relocation of the transformer that is planned as part of this cover improvement work. The age of the transformer is not specified in this document, but if it is an older transformer, it should be assumed to contain PCB-laden oil. Additional text should be added to discuss the manner in which this transformer will be handled and sampled, including special procedures to prevent spillage of oil.	The transformer was replaced in 1991 and the new transformer is non-PCB. The contract for transformer replacement had a clause that sampling would take place if any evidence of staining or spills were observed. At the time, no staining was observed, therefore sampling is not required.
2	**Page 7, Section 1.5**	Materials Safety Data Sheets (MSDS), Attachment 2, were used in preparing this Plan as well. This reference should be incorporated in the list of sources used in development of the Plan.	Genium Publishing Material Safety Data Sheets reference has been added to the Section 1.5
3	**Page 13, Section 3.1**	The text in this section identifies the activities that will be involved in the cover improvements at Landfill 7. However, there appears to be a significant omission: mention of the reclamation excavation and environmental sampling activities. The Sampling and Analysis Plan that accompanies this Safety and Health Plan clearly indicates that specific types of sampling will be completed in conjunction with the construction activities at the landfill. These are not included in the bulleted list of activities. Revise this list to include the following, so that a complete time line can be established: Excavations at boundaries of landfill to reclaim footprint Environmental sampling at these excavations to verify that exposed soils are uncontaminated Environmental sampling at the borrow sources for fill for the additional cover The same requirement applies to the Tasks identified in Table 1 in Section 6.3 on Page 32.	Reclamation/consolidation is not anticipated, Section 3.1 Site Task and Operations has been revised as follow ▪ Reclamation/Consolidation Activities (Not Anticipated, Contingency Only) ▪ Environmental sampling activities (borrow sources, waste characterization and Reclamation/Consolidation, if required) Additionally, Table 1 – Initial Level of protection has been revised to include Reclamation/Consolidation Activities and Environmental Sampling Activities
4	**Page 14, Section 3.2.1.1**	The text in this section describes precautions that will be taken with respect to all electrical utilities, including notifying local utilities. This same notification should be made to all local utilities, not just electrical ones. For example, water departments may have buried water lines at the site. It is not clear whether these utilities will also be notified. Revise text in appropriate sections for clarity.	Section 3.2.1.13 Underground Utilities has been added to the plan/ 3.2.1.13 Underground Utilities Before any material handling activities (top soil stripping and site grading) begins, Conti will determine the location of underground utilities (sewer, telephone, fuel, electric, water lines, or any other underground installations) that may be encountered during remedial activities. To protect these underground utilities (electrical, gas, water, telephone, etc.) during intrusive activities Conti will request a Work Clearance from for the USACE Contracting Officer Representative using the *AFBCA Work Clearance Request Form.* The Contracting Officer will coordinate with the AFBCA for processing and approval. ***Refer to Attachment 3 – Safety and Health Forms for the AFBCA Work Clearance Request Form.***

5	**Page 16, Section 3.2.1.3**	This section identifies safety precautions and procedures that should be considered when lifting heavy objects. In addition to the items listed, workers engaged in this activity should wear steel-toed (or equivalent) safety boots. This requirement is not otherwise mentioned until Section 6.1.4. Note briefly in this section as well.	The following bullet as been added to Section 3.2.1.3 ▪ Workers must wear steel-toed (or equivalent) safety boots.
6	**Page 17, Section 3.2.1.6**	In the first paragraph of this section, it is stated that flammable atmospheres may be encountered during excavations. This is very much the case in a deeper trench because some flammable compounds, when volatilized, are heavier than air. Therefore, the air in trenches should be monitored, for both flammable conditions (lower explosive limit) as well as to ensure adequate oxygen.	The following statement has been added to the Section 3.2.1.6 Excavation: During excavation activities the SHO will continuously monitor excavation and general work area using direct reading instruments for explosives atmospheres, oxygen deficiency and volatile organic compounds.
7	**Page 37, Section 8.9**	The text in this section discusses operating procedures for power tools during this cover improvement work. However, all references in the section are to "powder" tools. Correct the minor typographical error.	Section 8.9 Powder Actuated Tools; refer to tools that are actuated using a powder charge. It "shoots" a fastener, or stud, into a surface, such as concrete or steel, such as a "Hilti" gun
8	**Page 40, Section 8.18**	Use of extension cords is mentioned at the end of this section. It may also be prudent to include inspection of all extension cords for kinked wire, cut insulation, or other damage that may prevent proper operation or cause a fire at the site.	The following paragraph has been added to Section 8.18 Portable Power Tools: Portable cord- and plug-connected equipment and flexible cord sets (extension cords) will be visually inspected before use for external defects and for evidence of possible damage such as kinked wire, cut insulation, or other damage that may prevent proper operation or cause a fire at the site. Defective or damaged items shall be removed from service.
9	**Page 43, Section 9.1**	This section describes the distinct work zones that will be established at the landfill during the cover improvement activities. Include a figure that delineates the anticipated boundaries of each zone at the site.	Figure 3 – Site Layout Plan has been added to Section 9.0 Site Control Measures.
10	**Page 52, Section 11.8.2**	At the end of this section, text indicates that a copy of a Spill Incident Report will be submitted to the Contracting Officer Representative and USEPA. It follows that NYSDEC should also be notified in this situation. Revise the text if necessary.	Section 11.8.2 has been revised to include the NYSDEC receiving a copy of the spill report.
11	**Attachment 2**	The MSDS provided for Chromic (VI) Oxide appears to have an extra page listing the boroughs in two New Jersey counties. Remove this page, as it does not appear to be pertinent to this document.	Page has been removed.

Landfill 7 Cover Improvements
Former Griffiss Air Force Base
Rome, New York

Site Safety And Health Plan

Conti Environmental, Inc.
March 2002
FINAL

DOCUMENT SERIES OVERVIEW

The U.S. Army Corps of Engineers (USACE)–Kansas City District, issued Task Order No. 0001 under Contract No. DACA41-01-D-0004 to Conti Environmental, Inc. Under this Task Order, Conti Environmental, Inc. and its' subcontractor, EA Engineering, P.C. and its affiliate EA Engineering, Science, and Technology have been tasked to prepare documents to support landfill closure activities at the former Griffiss Air Force Base, Rome, New York.

A series of documents has been developed in support of each of the five landfills to be closed. The series includes one primary document, and four supporting documents and associated appendices. The following is a list of the documents in the series developed in support of landfill closure, and an abbreviated description of the document. Bold highlighting indicates which document in the series the reader is currently reviewing.

The Closure Plan is the primary document and is the first document in a series of five documents. The Closure Plan has been developed in accordance with New York Codes, Rules and Regulations Part 360. The Closure Plan provides project history and background information for the site, the regulatory status, the proposed design elements with supporting calculations, specifications and design drawings.

The Project Work Plan is the second document in the series. The Project Work Plan has been developed to outline the scope of work to be implemented and the general methodologies used to execute the scope of work. The plan presents Conti's work approach and sequence of activities for accomplishing the construction of landfill cover improvements. The Project Work Plan also includes, as appendices, the Environmental Protection and Soil Erosion Control Plan and the Traffic Control Plan. The Environmental Protection and Soil Erosion Control Plan outlines the procedures to be implemented to minimize impacts on the surrounding environment during construction. The Traffic Control Plan details the policies and procedures for proper control of vehicles during construction to protect workers and increase efficiency.

The Site Safety and Health Plan is the third document in the series. The Site Safety and Health Plan has been developed to outline the health and safety requirements and guidelines to be followed during construction related activities associated with the landfill closures.

The Contractor Quality Control Plan is the fourth document in the series. The Contractor Quality Control Plan has been developed to outline the policies and procedures to be followed to ensure that proper quality control measures are implemented to provide usable defendable data, ensure compliance with contract drawings and specifications, and to meet contractual requirements with USACE.

The Sampling and Analysis Plan is the fifth document in the series. The Sampling and Analysis Plan has been developed to outline the sampling and analysis procedures to be conducted at each landfill during closure activities.

Former Griffiss Air Force Base - Landfill 7
Rome, New York

Site Safety and Health Plan Approvals

John Czapor, Vice President of Environmental Services — *Date* 3/27/02
Conti Environmental, Inc

Tom Hernon, PE, Project Manager — *Date* 3/27/02
Conti Environmental, Inc

Aldo M. Gonzalez, CSP, Health and Safety Manager — *Date* 3/27/02
Conti Environmental, Inc

Melinda Horan, Certified Industrial Hygienist — *Date* 3/27/02
MHB Associates, Inc

Richard Hamlin, Project Superintendent — *Date*
Conti Environmental, Inc

Kenneth Shultz, Site Safety and Health Officer — *Date* 3/28/02
Conti Environmental, Inc

FIGURES

TABLES

ATTACHMENTS

1.0 INTRODUCTION

Conti Environmental, Inc. is under contract to the US Army Corps of Engineers, Kansas City District Pre-placed Remedial Action Contract for Base Realignment and Closure (BRAC), to perform remedial action activities at the former Griffiss Air Force Base, Rome, New York.

Landfill 7 is scheduled for closure as part of ongoing BRAC activities at GAFB. Certain landfill cover improvements are required at Landfill 7 in advance of closure. The landfill cover improvements include but are not limited to surveying and establishing lines and grades, clearing, stripping and stockpiling of 6 inches of topsoil, preparation of subgrade, placement of an 18-inch-thick layer of low-permeability soil over the landfill, replacement of topsoil over the landfill as the new top vegetative layer, providing erosion control and replacement of an existing culvert.

1.1 Plan Objective

The objective of this Site Safety and Health Plan (SSHP) is to define the requirements and designate protocols to be followed during the Landfill 7 remedial activities at the former Griffiss Air Force Base. Applicability extends to Conti personnel, Conti's subcontractors, and visitors inclusive of USACE personnel and representatives, engineers and subcontractors. Work performed under this contract will comply with applicable Federal, State, and Local Safety and Occupational Health laws and regulations. Through careful planning and implementation of corporate and site-specific safety protocols, Conti will strive for zero accidents and incidents on the project.

1.2 Safety and Health Policy Statement

The Conti Companies management is committed to the safety of each and every employee. There is no place at Conti for an employee who will not work safely or who will endanger the safety of his fellow workers. It is essential that all Managers and Supervisors insist on the maximum safety performance and awareness of all employees under their direction, by enthusiastically and consistently administering all safety rules and regulations. It is the Conti's policy to take the necessary actions, in engineering, planning, designing, assigning and supervising work operations, to create a safe work-site. The Conti Companies will:

- Maintain safe and healthful working conditions.
- Provide and assure the use of all necessary personnel protection equipment to ensure the safety and health of site employees and the public at large.
- Require that site work be planned to provide a range of protection based on the degree of hazards encountered under actual working conditions.
- Provide site workers with the information and training required to make them fully aware of known and suspected hazards that may be encountered and of the appropriate methods for protecting themselves, their co-workers and the public at large.

1.3 Drug and Alcohol Policy

Conti Environmental is committed to providing a safe, efficient, and productive work environment for all employees. Using or being under the influence of drugs or alcohol on the job may pose serious safety and health risks. To help ensure a safe and healthful working environment, employees may be asked to provide body substance samples (such as urine and/or blood) to determine the illicit or illegal use of drugs and alcohol. Refusal to submit to drug testing may result in disciplinary action, up to and including termination of employment.

Under the Drug-Free Workplace Act, an employee who performs work for a government contract or grant must notify Conti Environmental of a criminal conviction for drug-related activity occurring in the workplace. The report must be made within five days of the conviction. Employees with questions on this policy or issues related to drug or alcohol use in the workplace should raise their concerns with their supervisor or the Human Resources Department without fear of reprisal.

Copies of the above drug testing policy (Conti Substance Abuse Program) will be provided to **all employees -**. Employees will be asked to sign an acknowledgement form indicating that they have received a copy of the drug testing policy. Questions concerning this policy or its administration should be directed to the Human Resources Department.

1.4 Project Safety and Health Expectations

The safety and health of workers, clients and the public and the protection of the environment are fundamental responsibility assumed by Conti Environmental under this contract. Conti will:

- Promote project safety with an objective of zero lost-time accident
- Manage activities in a proactive way that effectively increase the protection of site workers, the public and the environment
- Reduce safety and health risk by identifying and eliminating hazards from site activities.
- Carry out site activities in a manner that complies with all applicable safety, health and environmental laws and regulations.

The success of our S&H Program is ensured by our ability to seamlessly integrate our S&H Procedures into a Site Specific Document that establishes safe and healthy work conditions for on-site operations. Conti's success in accomplishing work in a safe and healthy manner is demonstrated by our EMR rating which is well below the industry norm of 1.0, OSHA Recordable Cases and OSHA Compliance History; these statistics are summarized in ***Table 1 – Safety and Health Statistics***.

Table 1 – Safety and Health Statistics

	1998	1999	2000	2001
OSHA Recordable Incident Rate	0.00	0.00	0.00	0.00
Lost Work Day Incident Rate	0.00	0.00	0.00	0.00
Number of Hours Worked	142,111	166,006	65,044	51,642
OSHA Recordable Cases	0	0	0	0
Fatalities	0	0	0	0
OSHA Citations	0	0	0	0
EMR	0.78	0.65	0.75	0.62

1.5 Project Safety and Health Compliance Program

Compliance with the requirements of applicable Federal, State and local laws will be accomplished through a combination of written programs, employee training, workplace monitoring, and system enforcement. Continued and regular inspections by supervisors and safety personnel as well as the culture of ownership and total involvement in the safety program will produce an atmosphere of voluntary compliance. However, disciplinary action for violations of project requirements will be taken, when necessary.

All site personnel and visitors entering a Contamination-Reduction Zone and Exclusion Zone at the site will be required to read and verify compliance with the provisions of this SSHP and specific appendices. In addition, visitors will be expected to comply with relevant OSHA requirements such as medical surveillance, training, and personal protective equipment. In the event that a person does not adhere to the provisions of the SSHP, he/she will be requested to leave the work area. All nonconformance incidents will be recorded in the Daily Safety and Inspection Log.

The Site Safety and Health Officer will conduct impromptu surveillance on a daily basis of all work areas and subcontractor's activities to ensure that safety, and health is properly implemented. In addition, any reports from employees concerning unsafe work practices, acts, or conditions will be investigated promptly. Unsafe acts, practices, or conditions will be reported to the responsible supervisor at the time of inspection.

The safe and efficient work practices of this company require a spirit of teamwork and cooperation from all employees. Also required are uniform standards of expected behavior. Employees who refuse or fail to follow the standard set forth by this plan, the Conti Companies Safety, Health and Environmental Program and Procedures Manual and/or Regulatory standards, will subject themselves to disciplinary action up to, and including discharge. In cases not specifically mentioned, employees are expected to use good judgment and refer any questions to their supervisors.

1.6 Project Safety Incentive Program

A safe and health project is an efficient and competitive one. We believe attention to safety and health is important to the overall well being of Conti and all of its employees. This Project Safety Incentive Program will serve as a reminder to all of us that *doing it right is doing it safely!*

One of our prime concerns is to provide a safe and healthful work environment for all employees. Cooperation among all project personnel practicing carefully prepared principles of safe operation is the key to the success of the project safety and health program.

Giving safety our attention means safety conscious employees and safer projects. This can be accomplished through an incentive program to promote safety and health on the project. Conti's will establish a project incentive program to recognize exceptional safety and health performance. This project incentive program will consist of two separate incentives. These are the Monthly Safety Lunch Program and the Safety Jackpot Program, which will both add new meaning to the words "Safety Pays."

1.6.1 Monthly Safety Lunch Program

The Monthly Safety Lunch Program will be effective the first day of the project mobilization, after each Month without any OSHA Recordable Injury, ALL project personnel will be treated to a Safety Lunch. The Safety Lunch will be schedule for the Friday past the last day of the Month. Conti will have a raffle at each Safety Luncheon.

1.6.2 Safety Jackpot Program

The Safety Jackpot Program will reward project personnel for safety behavior during the normal course of the project. The Site Safety and Health Officer or a member of the Corporate Team may reward individuals based on safety behavior with Prize Points, which are redeemable for merchandise in the Safety Jackpot Program.

1.7 References

During development of this SSHP consideration was given to current safety and health standards as defined by the U.S. Army Corps of Engineers (USACE), United States Environmental Protection Agency (USEPA), Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). Specifically, the following reference sources have been utilized in the development of this SSHP:

- OSHA Regulations: 29 CFR 1910 and 1926
- USEPA Standard Operating Safety Guides, June 1992
- NIOSH/OSHA/Coast Guard (USCG)/USEPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities"
- NIOSH Pocket Guide to Chemical Hazards, June 1997
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Chemical Agents, 2000
- Hazardous Waste Handbook for Health & Safety, Martin, Lippitti, Prothero, 1987
- Handbook of Toxic and Hazardous Chemicals and Carcinogens, Sittig, 1985
- Genium Publishing Material Safety Data Sheets, Various Chemicals
- USACE, Safety and Health Requirements, EM 385-1-1, 3 September 1996
- USACE, Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities, ER 385-1-92, 1 September 2000
- Remedial Investigation Report, Griffiss Air Force Base, Law Environmental, Inc, 1994
- Former Griffiss Air Force Base Landfill 7, Scope of Work, CENWK, April 2001
- Ordinance and Explosive (OE) Removal Action Report Griffiss Air Force Base, Human Factor Applications, Inc., 30 October 1998.

In addition to the above-referenced documents, Conti has established a comprehensive and realistic Safety, Health and Environmental Program; based on past experience, sound engineering practice, employee training and enforcement of Safety and Health regulations to prevent unreasonable Safety and Health risks. For specific procedures/programs associated with this project, refer to the Conti Safety, Health and Environmental Program, which will be available onsite.

1.8 Site Safety and Health Plan Revisions

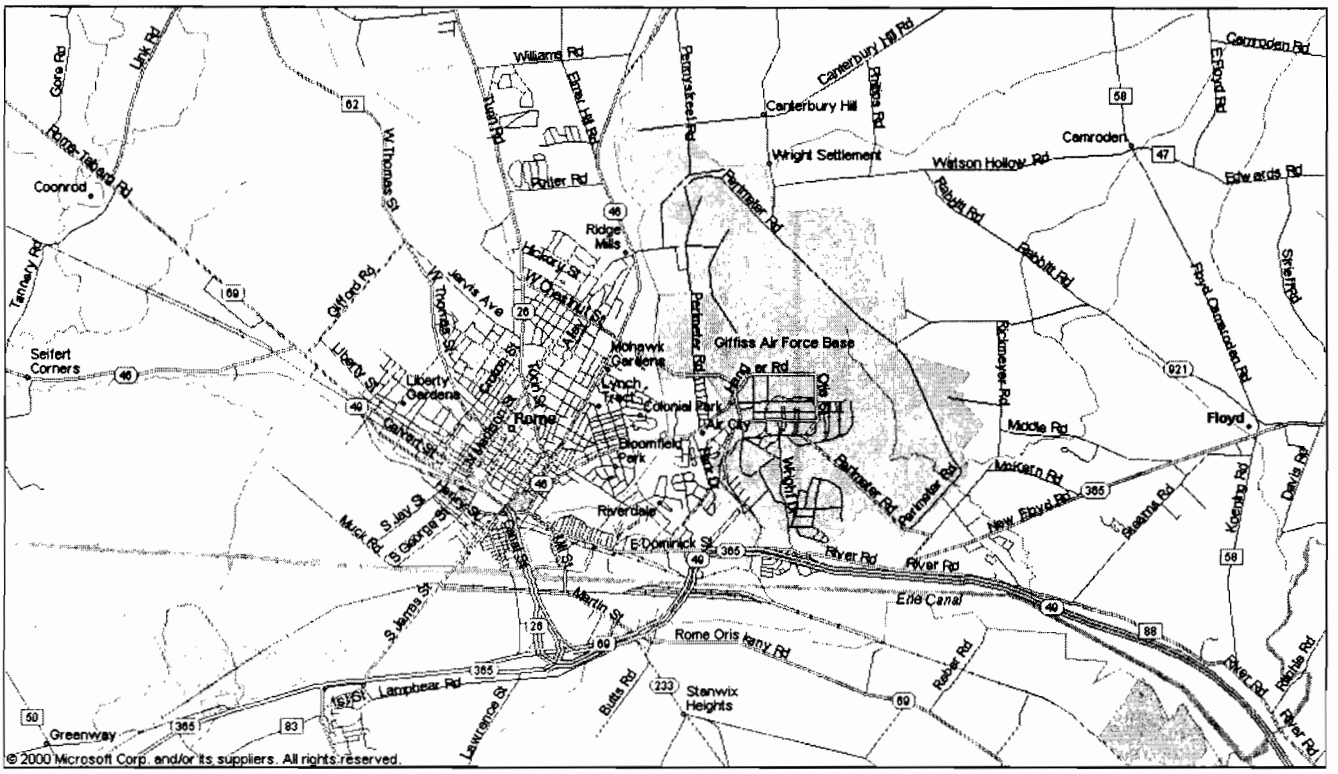
The development and preparation of this Site Safety and Health Plan has been based on site-specific information provided to Conti. Should any unforeseen hazard become evident during the performance of the work, the Site Safety and Health Officer (SSHO) shall bring such hazard to the attention of the Contracting Officer Representative both verbally and in writing for resolution as soon as possible. In the interim, Conti will take necessary actions to maintain safe working conditions in order to safeguard on-site personnel, visitors, the public, and the environment. Modifications of any portion or provisions of the SSHP will be requested in writing from the Contracting Officer by the SSHO, and authorized in writing. No changes to the SSHP will be allowed until the item has been reviewed and an addendum prepared and approved by Safety and Health Manager. Changes to Site Specific Safety and Health Plan will be documented and approved by using the ***"Safety and Health Plan Revision Request Form"*** Refer to Attachment 3 – Safety and Health Forms

1.9 Site Information

Griffiss Air Force Base (GAFB) is a former United States Air Force installation covering approximately 3,552 acres in the lowlands of the Mohawk River Valley in Rome, Oneida County, New York. Refer to ***Figure 1 -***

"Site Location Map". The mission of the GAFB varied over the years. The base was activated on February 1, 1942, as Rome Air Depot with the mission of storage, maintenance and shipment of material for the US Army Air Corps. Upon creation of the US Air Force in 1947, the depot was renamed Griffiss Air Force Base. The base became an electronics center in 1950, with the transfer of Watson Laboratory Complex (later Rome Laboratory). The 49th Fighter Interceptor Squadron was also added in that year. In June 1951, the Rome Air Development Center was established with the mission of accomplishing applied research, development, and testing of electronic air-ground systems. The Headquarters of the Ground Electronics Engineering Installations Agency was added in June 1958 to engineer and install ground communications equipment throughout the world. On July 1, 1970, the 416th Bombardment Wing of Strategic Air Command (SAC) was activated with the mission of maintenance and implementation of both effective air refueling operations and long-range bombardment capability. Griffiss AFB was designated for realignment under the Base Realignment and Closure Act (BRAC) in 1993 resulting in the deactivation of the 416th Bombardment Wing in September 1995. Rome Laboratory and the Northeast Air Defense Sector (NEADS) will continue to operate at their current locations. The New York Air National Guard (NYANG) operated the runway for the 10th Mountain Division deployments until October 1998 when they were relocated to Fort Drum. The Defense Finance and Accounting Services (DFAS) has established an operating location at the former Griffiss AFB.

Figure 1 – Site Location Map



Landfill 7 was active from 1950 to 1954 and reportedly received domestic refuse solid waste, liquid wastes that may have included spent solvents and petroleum products, and miscellaneous wastes such as airplane parts.

Landfill 7 is located near the east-central portion of the former GAFB, between the main runway and Perimeter Road. The landfill was capped in 1985 with a 6-inch clay cap and a minimum of 6 inches of topsoil and seed (grass). Landfill 7 comprises approximately 10.7 acres and the majority of the landfill is covered with grass. Wetlands are present in the area between the toe of the landfill and the runway on the west section of the

landfill (Law 1996). Additional delineated wetlands are located on the east section of the landfill near the south side near the runway.

The landfill is situated on a topographic high relative to the runway. An observation point overlooking the main runway is accessed from Perimeter Road. The observation point includes an asphalt-covered area, a portion of which is within the landfill cover area. A flight-line instrument station is located adjacent to the runway southeast of Landfill 7.

Areas of ponded liquid and apparent subsidence have been observed along the length of the southwest slope of the landfill, parallel to the runway. Ponding has also occurred along the base of the landfill, where the ground surface is below the elevation of a series of storm water catch basins located between the runway and the landfill. Leachate has been observed in the southeast corner of the landfill covering a depression adjacent to the runway instrument station.

2.0 ORGANIZATION AND RESPONSIBILITIES

While the Conti, Inc. Safety and Health Department directs and supervises the overall Safety, Health and Environmental Program, the responsibility for Safety and Health extends throughout our organization from top management to every employee. For this reason, it is each person's duty to notify the management personnel if a hazardous condition is identified and to make a "stop work" call if the condition represents an immediate danger to life or health, until the SSHO can make a further determination. The following are the Conti project personnel positions and responsibilities for this project. Refer to ***Figure 2 – "Organizational Chart"***.

- **Vice President of Operations** Jim Stewart
- **Project Manager:** Tom Hernon
- **Project Superintendent:** Richard Hamlin
- **Safety and Health Manager:** Aldo M. Gonzalez, CSP
- **Certified Industrial Hygienist** Melinda Horan, CIH
- **Occupational Physician:** Dr. Robert MacMillan, EOSI
- **Site Safety and Health Officer:** Kenneth Shultz
- **UXO Support** Leo Carden, SCI UXO/OE Services
- **First Aid/CPR Qualified Personnel:** Richard Hamlin, Project Superintendent
  Kenneth Shultz, Site Safety and Health Officer
- **Subcontractors:** TBD

2.1 Vice President of Operations

The Vice President of Operations directs and manages all aspects of the project in compliance with all contract and technical requirements. The Vice President of Operations will monitor and control all subcontractors to achieve optimal performance and ensure safe, high quality performance that complies with all contract requirements.

2.2 Project Manager

The Project Manager reports to the Vice President of Operations. His responsibilities include coordinating project activities with the Project Superintendent and serving as the primary liaison with the Contracting Officer Rep. The Project Manager prepares all correspondence, submittals, and other documentation required for the project and coordinate, schedules and administers the contract. The Project Manager prepares reports

and documentation, supervises inspection personnel, reviews and approves procurement and subcontract activities.

2.3 Project Superintendent

The Project Superintendent supervises and coordinates all construction crew activities relating to site preparation, excavation, and restoration. The Project Superintendent has the operational responsibility for the implementation of the SSHP on this project. This includes establishing an attitude of concern for safety matters by initiating prompt corrective action of hazards brought to his attention and ensuring that the project safety and health requirements are initiated and observed by all project personnel.

The Superintendent plans and requires that all work be performed in compliance with this SSHP, the Conti Companies Safety, Health and Environmental Program and/or the client's safety program including all applicable local, state and federal regulations. He shall impress upon all subcontractors' supervisory personnel a sense of responsibility and accountability of each individual to maintain a safe workplace and to work in a safe manner.

2.4 Safety and Health Manager (SHM)

Responsible to the Program Manager, the Safety and Health Manager formulates, administers and coordinates programs for the company to reduce the risk of loss due to employee injury, regulatory non-compliance, general liability, fire, theft or damage. The Safety and Health Manager will develop written detailed policies and procedures covering elements in the Safety, Health and Environmental Program. The Safety and Health Manager will:

- Be responsible for the development, implementation, oversight and enforcement of the SSHP.
- Conduct initial site-specific training.
- Be present onsite during the first day of remedial activities at the startup of each new major phase.
- Visit the site as needed and at least once per month for the duration of activities, to audit the effectiveness of the SSHP.
- Be available for emergencies.
- Provide onsite consultation as needed to ensure that the SSHP is fully implemented.
- Coordinate any modifications to the SSHP with the Site Superintendent, the SSHO, and the Contracting Officer.
- Provide continued support for upgrading/downgrading of the level of personal protection.
- Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.
- Serve as a member of the Contractor' s quality control staff.

2.5 Certified Industrial Hygienist

Under direction of the Safety and Health Manager, the CIH will assist in the development, implementation and enforcement of the Site Specific Safety and Health Plan, provide consultation, review air monitoring data, and assist in safety audits and document review.

2.6 Occupational Physician

Under the direction of the Safety and Health Manager, the Occupational Physician will be responsible for the determination of medical surveillance protocols and for review of examination/test results performed in

compliance with 29 CFR 1910.120(f), and 1926.53(f). The Occupational Physician will provide the Safety and Health Manager with a written opinion of each employee's ability to perform hazardous remedial work.

2.7 Site Safety and Health Officer (SSHO)

Under the direction of the Safety and Health Manager, the SSHO shall be responsible for the implementation of this SSHP and for the daily coordination of safety activities with the Project Superintendent and the Contracting Officer Rep. to ensure that the planned work objectives reflect adequate safety and health considerations. The SSHO will submit to the Contracting Officer Rep. Certificates of Worker/Visitor Acknowledgements for site personnel prior to initial entry onto the site. He will maintain a complete copy of this plan (and its supplements and addenda) at the site during all field activities and assure that all workers and visitors are familiar with it. He will perform site-specific training and briefing sessions for employee(s) prior to the start of field activities at the site and a briefing session each day before starting work. He will ensure the availability, proper use and maintenance of specified personal protective equipment, decontamination, and other safety and health equipment. He will maintain a high level of safety awareness among team members and communicate pertinent matters to them promptly. The Site Safety and Health Officer will:

- Assist and represent the Safety and Health Manager in on-site training and the day-to-day on-site implementation and enforcement of the accepted SSHP.
- Be assigned to the site on a full time basis for the duration of field activities. The SSHO will have no duties other than Safety and Health related duties.
- Have the authority to ensure site compliance with specified safety and health requirements, Federal, state and OSHA regulations and all aspects of the SSHP. This includes, but is not limited to: activity hazard analyses, air monitoring; use of PPE, decontamination site control; standard operating procedures used to minimize hazards; safe use of engineering controls; the emergency response plan; confined space entry procedures; spill containment program; and preparation of records. This will be accomplished by performing a daily safety and health inspection and documenting results on the Daily Safety Inspection Log.
- Stop work activities if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.
- Consult and coordinate any modifications to the SSHP with the Safety and Health Manager, the Site Superintendent, and the Contracting Officer.
- Serve as a member of the Contractor's quality control staff on matter's relating to safety and health.
- Conduct accident investigations and prepare accident reports.
- Review results of daily quality control inspections and document safety and health findings in the Daily Safety Inspection Log.
- Coordinate with Site Management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.

2.8 UXO Contractor

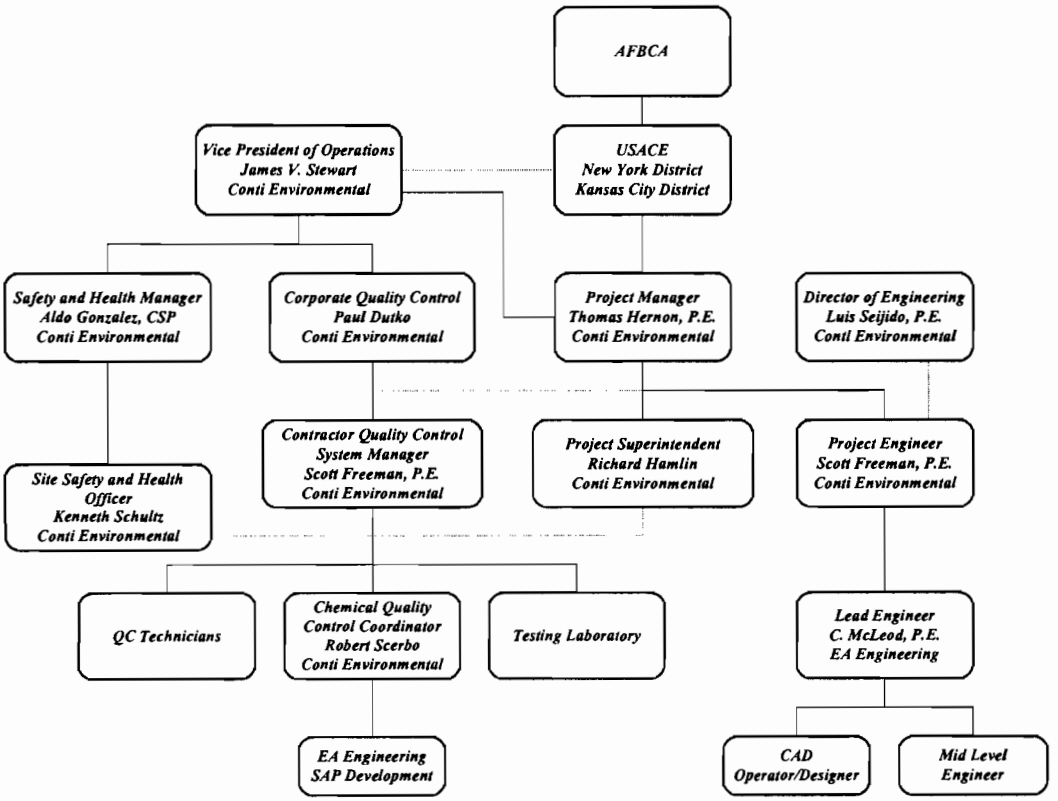
Based on the Archive Search Report, the Conclusions and Removal Action Report and the Statement of Clearance by Human Factors Application, Inc, Explosive/Unexploded Ordnance are not anticipated to be a problem at these landfills. In the unlikely event that Explosive/Unexploded Ordnance be encounter, Conti Environmental will contract with SCI UXO/OE Services. SCI will provide (if required) UXO personnel

2.9 Subcontractors

Subcontractors utilized during Landfill 7 remedial activities at the former Griffiss Air Force Base are covered by this SSHP and will be provided a copy of the plan prior to commencing work. The Conti SSHO will verify that subcontractor employee training; medical clearance, and respirator fit test records are current and will monitor and enforce compliance with the established plan and standard operating procedures. As with all site personnel, subcontractors will be briefed on the provisions of this plan and attend all daily toolbox and weekly safety meetings.

Conti will continually monitor a subcontractor's safety performance. Conti will observe subcontractors for hazards or unsafe practices that are both readily observable and occur in common work areas. The SSHO will note subcontractor work practices on the daily Safety and Health report. If non-compliance or unsafe conditions or practices are observed, the subcontractor safety representative will be notified and corrective action will be required. The subcontractor will determine and implement necessary controls and corrective actions. If repeat non-compliance/unsafe conditions are observed, the subcontractor will be required to stop affected work until adequate corrective measures are implemented.

Figure 2 – Organizational Chart



3.0 HAZARD/RISK ANALYSIS

Uncontrolled hazardous material sites can cause a multitude of health and safety concerns any of which can result in serious injuries and/or illnesses of workers. Some hazards are a function of the physical, biological or chemical nature of the site itself. Others are a direct result of the construction being done. Based upon the information provided to Conti regarding the primary historical uses of the property and the knowledge of the current conditions, the overall Safety and Health hazard assigned to the contemplated activities at the Site is determined to be low to moderate.

3.1 Site Tasks and Operations

The landfill cover improvements include but are not limited to surveying and establishing lines and grades, clearing, stripping and stockpiling of 6 inches of topsoil, preparation of subgrade, placement of an 18-inch-thick layer of low-permeability soil over the landfill, replacement of topsoil over the landfill as the new top vegetative layer, providing erosion control and replacement of existing culvert. The following is a list of the work to be completed:

- Mobilize to and Demobilize from the project site
- Site Prep (to include fencing and signage, establish EZ & CRZ).
- Provide site safety in compliance with the Site Health and Safety Plan.
- Provide Quality Control measures for duration of project.
- Place and maintain temporary erosion and sediment control measures throughout the duration of the project. A Soil Erosion Control Plan will be prepared for this project.
- Perform selected demolition and clearing.
- Perform a Pre-Construction Survey.
- Survey the site to confirm vertical elevations, establish horizontal control, and provide controls during the work.
- Provide As-Built Drawings of final cap and definable features of work.
- Perform periodic surveying to verify layouts and to calculate volumes of material placed.
- Place and maintain storm water management controls throughout the project.
- Strip existing topsoil and stockpile in designated areas.
- Prepare subgrade and provide, place and compact common fill.
- Provide, place and compact low permeability soil cover.
- Place stockpiled topsoil.
- Provide and place off-site topsoil.
- Perform final grading and seeding.
- Provide erosion control lining and outlet protection.
- Perform monitoring well decommissioning.
- Provide permanent benchmarks.
- Relocate Transformer.
- Remove and replace a culvert.
- Provide Closure Documentation.
- Reclamation/Consolidation Activities (Not Anticipated, Contingency Only)
- Environmental sampling activities (borrow sources and Reclamation/Consolidation, if required)
- Waste Characterization sampling

Conti has developed an Activity Hazard Analysis (AHA) for major phase of work of each landfill. A major phase of work is defined as a an operation involving a type of activity presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform the specified phase. The analysis will define the activity being performed and identify the sequence of work, the specific hazards anticipated, and

the control measures to be implemented to eliminate or reduce each hazard. Refer to ***Attachment 1 - "Activity Hazard Analysis".*** An AHA shall also be prepared when new tasks are added, job situations change, or when it becomes necessary to alter safety requirements. Work will not proceed on a particular task/work area until the AHA has been reviewed and a preparatory meeting has been conducted. General hazards associated with landfill covers and liners activities are described below

A preparatory meeting will be conducted by the SSHO for site personnel prior to their initiating any new or differing site activities. At the preparatory meeting, the SSHO will ensure that site personnel are knowledgeable of the SSHP and understand the hazards and controls of the activity to be performed.

3.2 Hazards

The following potential hazards may be encountered during Landfill 7 remedial activities at the former Griffiss Air Force Base.

3.2.1 Physical Hazards

Potential safety hazards include electrical, heavy equipment/ vehicle traffic; material handling, hot work, and hand and power tools. Safety hazards associated with the project are presented below.

3.2.1.1 Electrical

It is not anticipated the work activities at Landfill 2/3 will be in the vicinity of an overhead electrical line. Equipment Operators will be instructed to keep their distance from overhead electrical lines. Heavy equipment may not work any closer to an overhead electrical line than the 10 Feet. This distance will vary according to voltage the greater the voltage, the greater the clearance between any part of the equipment and the power line Refer to ***Table 2 - Minimum Clearance From Energized Overhead Electrical Lines.*** When required, a spotter will be utilized to maintain a safety distance between equipment and overhead wires. The basic rule is "Don't locate equipment in a position where it can come in contact with overhead power lines." Maintain the required distance from the lines. Overhead Electrical power lines will be considered energized unless the person owning such line or operating officials of the electrical utility supplying the line assures that it is not energized and it has been visibly grounded.

Table 2 – Minimum Clearance from Energized Overhead Electrical Lines

Nominal System Voltage	Minimum Rated Clearance
0 to 50 kV	10 Feet (3 m)
51 to 200 kV	15 Feet (4.5 m)
201 to 300 kV	20 Feet (6 m)
3001 to 500 kV	25 Feet (7.5 m)
501 to 750 kV	24 Feet (10.5 m)
751 to 1000 kV	31 Feet (13.5)

There are various means of insulating the wires, as well as barriers and alarms that may be available to reduce the risk of injury to workers, but the use of such devices does not change the requirements of any other applicable standards or laws. In addition, these and other measures (such as grounding the equipment itself) may not be fully effective but may create a false sense of security. Only the utility company is authorized to de-energize, insulate or handle the lines. No one else may attempt these operations.

Electrical equipment used on-site may also pose a hazard to workers. Whenever possible Conti will use low-voltage equipment with ground-fault interrupters and watertight, corrosion-resistant connecting cables to help minimize this hazard. In addition, lightning is a hazard during outdoor operations, particularly for workers handling metal containers or equipment. In the event of an electrical storm, all operations will cease for the duration of the storm.

No employee shall be permitted to work in the proximity of any part of an electrical power circuit unless the person is protected against electric shock by de-energizing the circuit and grounding it, or it has been locked and tagged out. These procedures will be utilized when work has to be performed on energized equipment.

All electrical wiring and equipment shall be intrinsically safe for use in potentially explosive environments and atmospheres. Ground-fault circuit interrupters are standard for use at the site.

For detailed electric safety procedures, refer to SOP 40 – Electrical Procedures in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.2 Heavy Equipment/Vehicle Traffic

Considerations for controlling the movement of personnel and equipment in a construction area are vitally important to any project, as injuries may occur while working with or adjacent to such equipment. This category includes all operations which utilize moving heavy equipment: excavators, loaders, graders, dozers, and trucks. Conti will take every precaution necessary to ensure the safety of the residents and the on-site personnel during traffic movement operations.

All workers will adhere to all applicable standards and regulations while operating heavy equipment at the site. Operators will be trained and experienced in the use and maintenance of the equipment they are operating. Equipment will be inspected on a daily basis to identify any worn parts, and/or unsafe conditions. Inspections will be documented using the Equipment Checklist, refer to ***Attachment 3 – Safety and Health Forms***. Any unsafe equipment will be removed from service until safety defects can be corrected. Equipment operators will not leave their machine unattended while it is running. Each piece of equipment will be equipped with a 5 lb ABC fire extinguisher. No vehicles or equipment will be operated in a careless or unsafe manner. Personnel will wear high visibility reflective vests when working around equipment/vehicles. All personnel will stay a minimum of 4 ft clear of the operational area of the equipment.

During remedial activities, it is often necessary to have a worker direct the operator. In these cases, close communication between the operator and the laborer is of critical importance. One designated person will give signals to the operator of both equipment and vehicles in the work area. Workers should not take any action unless they have made eye contact with the operator and clearly communicated their intentions. In addition, all machines are equipped with back-up alarms, which are checked daily and repaired immediately. Truck traffic will be controlled by a flagger/spotter, as required.

Maintenance and inspection of vehicles and heavy equipment is a vital part of the overall safety program. Conti has a fully staffed equipment maintenance shop that handles all preventative and overhaul work for our entire vehicle and equipment fleet. As part of the preventative maintenance, all equipment is checked for properly functioning safety devices (e.g., backup alarms, brakes, lights, fire extinguishers, etc.) Before each piece of equipment leaves the shop it must pass a safety checklist. All rental equipment is subjected to a similar inspection when delivered to the job site. Any piece of rental equipment that fails the inspection must be repaired by the vendor before it is accepted for use. In addition, all equipment is inspected in the field prior to the start of each day's activities. If a superintendent, operator, or safety officer detects a defect, a properly qualified mechanic is dispatched from the shop to make the repairs on-site.

For detailed heavy equipment/vehicle traffic safety procedures, refer to SOP 30 – Motor Vehicle and Mechanical Equipment in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.3 Material Handling

Various materials and equipment may be handled manually during project operations. Care should be taken when lifting and handling heavy or bulky items to avoid back injuries. The following fundamentals address the proper lifting techniques that are essential in preventing back injuries:

- The size, shape, and weight of the object to be lifted must first be considered. Multiple employees or the use of mechanical lifting devices are required for heavy objects.
- The anticipated path to be taken by the lifter should be considered for the presence of slip, trip, and fall hazards.
- The feet shall be placed far enough apart for good balance and stability (typically shoulder width).
- The worker shall get as close to the load as possible. The legs shall be bent at the knees.
- The back shall be kept as straight as possible and abdominal muscles should be tightened.
- Twisting motions should be avoided when performing manual lifts.
- To lift the object, the legs are straightened from their bending position.
- A worker shall never carry a load that cannot be seen over or around.
- Workers must wear steel-toed (or equivalent) safety boots

When placing an object down, the stance and position are identical to that for lifting. The legs are bent at the knees and the object lowered. When two or more workers are required to handle the same object, workers shall coordinate the effort so that the load is lifted uniformly and that the weight is equally divided between the individuals carrying the load. When carrying the object, each worker, if possible, shall face the direction in which the object is being carried. In handling bulky or heavy items, the following guidelines shall be followed to avoid injury to the hands and fingers:

- A firm grip on the object is essential; leather gloves shall be used if necessary.
- The hands and object shall be free of oil, grease, and water which might prevent a firm grip, and the fingers shall be kept away from any points that could cause them to be pinched or crushed, especially when setting the object down.
- The item shall be inspected for metal slivers, jagged edges, burrs, and rough or slippery surfaces prior to being lifted.

For detailed Material Handling procedures, refer to SOP 29 – Material Handling, Storage, Use & Disposal Procedures in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.4 Hand and Power Tools

Hand and power tools are used for various site activities. Procedures for using hand and power tools are as follows:

- Persons using power tools shall be trained in their use.
- Ground Faults must be present on all electrical tools.
- Only tools in good condition shall be used.
- Tools shall be kept clean.
- Guards and shields shall be kept on all tools.
- Air couplings shall be secured.
- Non-sparking tools shall be used in hazardous areas.

- Proper eye protection is critical when using power tools. At a minimum, safety glasses will be required during site operations. Where appropriate, full-face shields will be utilized in addition to the glasses.

For detailed Hand and Power Tool safety procedures, refer to SOP 25 – Hand and Power Tools Operation Procedures in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.5 Noise

Noise is found during remedial activities in such operations as transportation of materials and operation of heavy construction equipment. Noise has been defined as unwanted sounds. The human ear can tolerate a certain amount of sound without any harmful effects. The OSHA standard allows 90 dB (A) for a full 8 hours and for a lesser time when the levels exceed 90 db (A). It is usually safe to assume that if you need to shout to be heard at arms length, the noise level is at 90 dB (A) or above. Personnel operating or working around construction equipment or power tools will utilize hearing protection. Based on the nature of activities to be performed on site, the use of heavy equipment, power tools and other noise producing devices, Conti personnel are enrolled in a Hearing Conservation Program that meets the requirements of OSHA regulation 29 CFR 1910.95 as part of our Medical Surveillance Program. OSHA requires employee to be part of a Hearing Conservation Program when their exposure is 85 dB (A) or above.

Based upon Conti's past experience, it is known that the noise levels emanating from the operation of the heavy equipment often exceed what is allowable for worker exposure. Consequently, equipment operators and personnel working near the equipment are required to wear hearing protection. Conti will provide hearing protection to all site personnel. Additionally, to verify personnel exposure Conti will perform should level measurements during remedial activities.

3.2.1.6 Excavation

The hazard associated with excavation is low to moderate. In general, the hazards encountered during soil excavation are: cave in of excavation sides with possible burial or crushing of workers. Causes of cave ins may include: (a) absence of shoring, (b) misjudgment of stability, (c) defective shoring, and (d) undercut sides. Other potential hazards are: falling during access/egress, while monitoring or dismounting equipment, or stumbling into excavation. An overhead hazard can result from material, tools, rock, and/or soil falling into the excavation. Flammable atmospheres may also be encountered in excavation. During excavation activities the SHO will continuously monitor excavation and general work area using direct reading instruments for explosives atmospheres, oxygen deficiency and volatile organic compounds.

During landfill excavation chemical/hazardous substance may be encountered. Potential chemicals of concern are addressed in Section 3.2.2 Chemical Hazard and Attachment 2 – Material Safety Data Sheets.

Conti will provide adequate shoring or sloping of sides of the excavation. Excavation/trenches will be inspected daily for changing conditions. Air monitoring for airborne contaminants shall be performed in areas where contaminated soils are encountered.

Excavation spoils will be directly loaded into transportation containers or stockpiled and covered at a designated area away from the work area. Excavation/trenches, regardless of the depth or width, shall be barricaded. The use of raised berms, caution signs and caution tape will be instituted to protect both the public and other personnel on the site. The excavation area will be delineated with caution tape during operations and barricaded/secured with safety fence at the end of each workday.

Where personnel are required to enter excavations over 4 ft) in depth, sufficient stairs, ramps, or ladders will be provided to require no more than 25 ft. of lateral travel. At least two means of exit shall be provided for personnel working in excavations, where the width of the excavation exceeds 100 ft, two or more means of exit shall be provided on each side of the excavation.

For detailed Excavation/Trenching safety procedures, refer to SOP 37– Trenching and Excavation Procedures and SOP 39 – One call Damage Prevention System in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.7 Slip/Trip/Hit/Fall

Slip/trip/hit/fall injuries are the most frequent of all injuries to workers. They occur for a wide variety of reasons, but all injuries can be prevented by the following prudent practices:

- Spot-check the work area to identify hazards.
- Establish and utilize a pathway, which is most free of slip and trip hazards.
- Beware of trip hazards such as wet floors, slippery floors, and uneven surfaces or terrain.
- Carry only loads, that you can see over.
- Keep work areas clean and free of clutter, especially in storage rooms and walkways.
- Communicate hazards to on-site personnel
- Secure all loose clothing, ties, and remove jewelry while around machinery.
- Report and/or remove hazards.
- Keep a safe buffer zone between workers using equipment and tools.
- Workers must take particular care when walking on the geotextile-working mat.

For detailed Slip/Trip/Hits/Falls prevention procedures, refer to SOP 20 – Fall Protection Program, SOP 27 Stairways and Ladder and SOP36 Signs, Signaling, Tags, and Barricade Procedures in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.8 Heat Stress

Heat stress may be a hazard for workers wearing protective clothing even if the temperature is moderate. The same protective materials that shield the body from chemical exposure prevent heat and moisture from dissipating. Personal protective clothing can therefore create a hazardous condition. Depending on the ambient temperature and the work being performed, heat stress can occur very rapidly - within as little as 15 minutes.

In its early stages, heat stress can cause discomfort and inattention, resulting in impaired functional abilities that can threaten the safety of both the individual and his co-workers. Personnel will be instructed to recognize the symptoms of the onset of heat stress. While it is not anticipated that heat stress monitoring will be required for this project, the SSHO may periodically check all personnel working in thermal stress areas to ensure that the symptoms are recognized. Frequency of heat stress monitoring and checks for symptoms of heat stress will increase with rises in air temperature, humidity, and the degree of exposure to high temperature areas.

An ambient temperature of 72.5° F when workers are in Level C or higher, will be used as an action level to implement pulse monitoring, oral temperatures and administrative controls, including rest breaks and work rotation, to prevent employees from experiencing heat-related health effects including weight loss. The guidance for workers wearing permeable clothing is specified in the current version of the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress. If actual Clothing differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, changes should be made to the monitoring requirements and work rest period to account for these differences.

Table 3 – "Frequency of Physiological Monitoring" provides the suggested frequency of physiological monitoring for fit and acclimatized workers.

Table 3 – Frequency of Physiological Monitoring

Adjusted Temperature Calculation	Normal Work Clothing	Impermeable Clothing
90 F (32.2 C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5 - 90.0 F (30.8 - 32.2 C)	After each 60 minutes of work	After each 30 minutes of work
82.5 - 87.5 F (28.1 - 30.8 C)	After each 90 minutes of work	After each 60 minutes of work
77.5 - 82.5 F (25.3 - 28.1 C)	After each 120 minutes of work	After each 90 minutes of work
72.5 - 77.5 F (22.5 - 25.3 C)	After each 150 minutes of work	After each 120 minutes of work

The following parameters should be used when monitoring workers:

Heart rate - Count the radial pulse as early as possible in the rest period to ensure a more accurate reading. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period at the same length. If, at the end of the following work period, the heart rate still exceeds 110 beats per minute, shorten the work period again by one-third.

Oral Temperature - The utilization of oral temperature applies to the time immediately after the worker leaves the contamination reduction zone. Using a clinical thermometer, take the temperature for three minutes. If the oral temperature exceeds 99.6 F (37.6 C), shorten the next work cycle by one-third, without a change to the rest period. If the oral temperature still exceeds 99.6 F (37.6 C) at the end of the following work period, shorten the next work cycle by one-third. Do not permit a worker to perform duties requiring a semipermeable or impermeable garment if the oral temperature exceeds 100.6 F (38.1C). Ear canal readings are a valid method to monitor the temperature of workers who remain in the contamination reduction zone.

The oral temperature shall not exceed 100.4° F. If an employee's pulse rate exceeds the maximum age-adjusted heart rate (0.7(220-AGE)), and/or the oral temperature exceeds 100.4° F, the employee shall be required to stop work and rest at the work site or move to an air-conditioned room after proper decontamination. The affected employee may be allowed to return to work after his/her pulse rate has dropped below 100 beats per minute. The SSHO in consultation with the affected employee, and medical personnel if necessary, shall determine whether an employee is ready to return to work. Fluids shall be provided and rest breaks will be taken. The frequency of breaks will increase with the temperature. Such things as cooling vest; portable fans and breaks in air-conditioned areas shall be used if necessary.

When practicable, the most labor-intensive tasks should be carried out during the coolest part of the day. If necessary, a work/rest regimen will be instituted. The work/rest regimen consists of alternating periods of work and rest. The duration of these alternating periods will depend on the environmental conditions at the job site, i.e., the Wet Bulb Globe Temperature, duration and type of activities performed.

A worker who becomes irrational or confused or collapses on the job should be considered a heat stroke victim, and medical help should be called immediately. Early recognition of symptoms and prompt emergency treatment is the key to aiding someone with heat stroke. While awaiting the ambulance, begin efforts to cool the victim down by performing the following:

- Move the victim to a cooler environment and remove outer clothing.
- Wet the skin with water, and fan vigorously or repeatedly apply cold packs or immerse the victim in a tub of cool (not ice) water.
- If no water is available, fanning will help promote cooling.

Any individual showing susceptibility to heat stress will be referred to a physician for evaluation. In addition, the use of prescription drugs can also contribute to the effects of heat stress and will be considered during the assignment of work.

Cool (50°-60°F) water or a sport drink, such as Gatorade will be made available to workers and encourage them to drink small amounts frequently, e.g., one cup every 20 minutes. Ample supplies of liquids will be placed close to the work area.

For detailed Heat Stress prevention procedures, refer to SOP 26 – Heat and Cold Stress Management in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.9 Cold Stress

Cold injury (frostbite and hypothermia) and impaired ability to work are hazards to persons working outdoors in low temperatures at or below freezing. Extreme cold for a short time may cause severe injury to exposed body surfaces (frost nip or frostbite), or result in profound generalized cooling (hypothermia). Areas of the body which have high surface area-to-volume ratio such as fingers, toes, and ears, are the most susceptible to frost nip or frostbite.

Two factors influence the development of a cold weather injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration soaked. The windchill factor is the cooling effect of any combination of temperature and wind velocity or air movement. ***Table 4 – Windchill Index*** should be consulted when planning for exposure to low temperatures and wind. The windchill index does not take into account the specific part of the body exposed to cold, the level of activity, which affects body heat production, or the amount of clothing being worn.

Table 4 – Windchill Index

Wind (mph)	Actual Temperature (° F)												
	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25
	Equivalent Temperature (° F)												
5	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40
10	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47
15	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51
20	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55
25	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58
30	22	16	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60
35	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62
40	20	13	6	-1	-8	-15	-22	-29	-36	-42	-50	-57	-64

Wind Chill (°F) = 35.74 + 0.6215T - 35.75(V0.16) + 0.4275T(V0.16)
T = Air Temperature (°F)
V = Wind Speed (mph)

Frostbite occurs in 15 minutes or less

When practicable, the most sedentary tasks should be carried out during the warmest part of the day. If necessary, a light-work rotation schedule should be instituted or the work area heated. Heavy work that will cause heavy sweating that will result in wet clothing must also be monitored. The work/rest regimen consists of

alternating periods of work and rest. The duration of these alternating periods will depend on the environmental conditions at the job site, i.e., the Wind Chill Temperature, duration and type of activities performed.

Table 5 - Maximum Daily Time Limits for Exposure at Low Temperatures gives the recommended time limits for working in various low temperature ranges.

Table 5 – Maximum Daily Time Limits for Exposure at Low Temperatures

Temperature Range (F)	Maximum Daily Exposure
30 to 0	No limit, providing that the person is properly clothed.
0 to -30	Total work time: 4 hours. Alternate 1 hour in and 1 hour out of the low-temperature area.
-30 to -70	Two periods of 30 minutes each at least 4 hours apart. Total low temperature work time allowed is 1 hour.
-70 to -100	Maximum permissible work time is 5 minutes during an 8-hour working day. At these extreme temperatures, completely enclosed headgear, equipped with a breathing tube running under the clothing and down the leg to preheat the air, is recommended.

Table – 6 Work/Warm-up Schedule applies to any 4-hour work period with moderate to heavy work activity, with worm-up periods of ten (10) minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour period in a warm location. For light-to-moderate work (limited physical movement): apply schedule one step lower. For example, at -35° C (-30° F) with no noticeable wind, a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period.

Table 6 – Work/Warm-up Schedule

Air Temperature - Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph wind		15 mph wind		20 mph wind	
°C (approx.)	°F (approx.)	Max Work Period	No. of Breaks	Max Work Period	No. of Breaks	Max Work Period	No. of Breaks	Max Work Period	No. of Breaks	Max Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm. Breaks)	1	(Norm. Breaks)	1	75 min	2	55 min	3	40 min	4
-29° to -31°	-20° to -24°	(Norm. Breaks)	1	75 min	2	55 min	3	40 min	4	30 min	5
-32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-Emergency Work Should Cease	
-35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-Emergency Work Should Cease			
-38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-Emergency Work Should Cease					
-40° to -42°	-40° to -44°	30 min	5	Non-Emergency Work Should Cease							
-43° & below	-45° & below	Non-Emergency Work Should Cease									

To guard against cold injuries, workers should wear appropriate clothing and use warm shelters for removing personal protective equipment. The personal decontamination trailer will be used as a warm shelter when required. The SSHO may periodically monitor workers' physical conditions, specifically checking for symptoms of frostbite.

For detailed Cold Stress prevention procedures, refer to SOP 26 – Heat and Cold Stress Management in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.10 Fires, Explosions, and Hot Work

If required the SSHO will establish areas approved for welding, cutting, and other hot work. Hot work (welding, burning, cutting, etc.) conducted on-site must comply with the following Hot Work Procedures. A Hot Work Permit shall be obtained from the SSHO, if required. Notification regarding hot work will be communicated to the Rome Fire Department. All personnel shall be protected from welding radiation, flashes, sparks, molten metal, and slag. All welding, burning, and cutting equipment shall be inspected daily by the operator. Defective equipment shall be tagged and removed from service, replaced or repaired, and re-inspected before again being placed in service. All welders shall be properly trained in the safe operation of their equipment, safe welding/cutting practices, and welding/cutting respiratory and fire protection.

Cutting or welding shall NOT be permitted in the presence of explosive atmospheres (mixtures of flammable/combustible gases, vapors, liquids, or dusts with air), or explosive atmospheres that may develop inside un-cleaned or improperly prepared drums, tanks, or other containers, and equipment which has previously contained such materials.

Where practical, all combustible material shall be relocated at least 35 feet away from the hot work site. Where relocation is impractical, combustibles shall be protected with flame proofed covers or otherwise shielded. At a minimum, two fully charged and operable fire extinguishers, appropriate for the type of possible fire (10-ABC), shall be available at the work area. A fire watch shall be required whenever hot work is performed and a minimum of 30 minutes after hot work is complete.

A hot work permit will be completed by the SSHO, reviewed with personnel who will perform the hot work, and posted near the work area. The hot work permit is good only for the date issued and is valid only for the eight-hour shift for which it is issued. If at any time during the hot work operation a change in conditions at the work site is suspected, such as a release of flammable gases or vapors in the work area, work shall be stopped immediately and the SSHO shall be notified. Such work stoppage invalidates the hot work permit, and a new permit shall be completed after inspections and tests have been performed by the SSHO. ***Refer to Attachment 3 – Safety and Health Forms for the Hot Work Permit.***

For detailed Fire and Explosion prevention procedures, refer to SOP 21 Fire Prevention and Protection Procedures in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.1.11 Oxygen Deficiency

Oxygen deficiency may occur on-site during excavation operations or storage tank entry, due to displacement of oxygen by other gases in these areas. The oxygen content of ambient air is 20.9 percent. Physiological effects of oxygen deficiency are readily apparent when the oxygen concentration decreases below 16 percent. Oxygen-deficient conditions may be controlled by air monitoring areas for oxygen concentrations using an 02/LEL/CO Meter. Air monitoring will reduce risks by indicating when action levels have been exceeded. Supplied-air type respiratory protection shall be utilized in areas known to have oxygen concentrations below 19.5 percent. All operations shall cease and desist if oxygen concentrations exceed 21.5 percent.

3.2.1.12 Ordnance and Explosive /Unexploded Ordnance

Due to that nature of normal military operations, OE and OE-related scrap contamination may exist at the landfill. Based on pre-removal action investigation 10 areas of concern (OE clearance activities) were identified. The risk of Ordnance and Explosive /Unexploded Ordnance is low. Human Factor Applications, Inc.

performed an Ordnance and Explosive (OE) Removal Action at Griffiss Air Force Base (Final Removal Action Report, 30 October 1998). Landfill 7 was not identified as an area of concern.

A person's ability to recognize OE/UXO is the first and most important step in reducing the risk posed by a OE/UXO hazard. OE/UXO, whether present in an area by design or by accident, poses the risk of injury or death to anyone in the vicinity. To lessen the danger of UXO hazards and to help prevent placing others at future risk, certain precautions and steps should be taken by anyone who encounters UXO. ***"IF YOU DID NOT DROP IT, DO NOT PICK IT UP!"*** A person can lessen the danger of UXO hazards by being able to recognize the hazard and by adhering to the following basic safety guidelines:

- After identifying potential UXO, do not move any closer to it. Some types of ordnance have magnetic or motion-sensitive proximity fuzing that may detonate when they sense a target. Others may have self-destruct timers built in.
- Do not transmit any radio frequencies in the vicinity of a suspected UXO hazard. Signals transmitted from items such as walkie-talkies, short-wave radios, citizens' band (CB) radios, or other communication and navigation devices may detonate the UXO.
- Do not attempt to remove any object on, attached to, or near a UXO. Some fuzes are motion-sensitive, and the UXO may explode.
- Do not move or disturb a UXO because the motion could activate the fuze, causing the UXO to explode.
- If possible, mark the UXO hazard with a standard UXO marker or with other suitable materials, such as engineer tape, colored cloth, or colored ribbon. Attach the marker to an object so that it is about 3 feet off the ground and visible from all approaches. Place the marker no closer than the point where you first recognized the UXO hazard.
- Leave the UXO hazard area.
- Any UXO discovered in the field should be immediately reported to site Explosive Ordnance Disposal (EOD) personnel
- Stay away from areas of known or suspected UXO. This is the best way to prevent accidental injury or death.

3.2.1.13 Underground Utilities

Before any material handling activities (top soil stripping and site grading) begins, Conti will determine the location of underground utilities (sewer, telephone, fuel, electric, water lines, or any other underground installations) that may be encountered during remedial activities. To protect these underground utilities (electrical, gas, water, telephone, etc.) during intrusive activities Conti will request a Work Clearance from for the USACE Contracting Officer Representative using the *AFBCA Work Clearance Request Form.* The Contracting Officer will coordinate with the AFBCA for processing and approval. ***Refer to Attachment 3 – Safety and Health Forms for the AFBCA Work Clearance Request Form.***

3.2.1.14 Drum Removal

Handling drums and other hazardous waste containers present a multitude of hazards. These hazards include detonations, fires, explosions, vapor generation, and physical injury. Physical injury can result from moving heavy containers by hand and working around stacked drums, heavy equipment and deteriorated drums. While these hazards are always present, proper work practices - such as minimizing handling and using equipment and procedures that isolate workers from hazardous substances - can minimize the risk to hazardous waste site personnel.

For detailed Drum Handling, Opening, Sampling and Storage Procedures, refer to SOP 19 Drum handling Procedures in the Conti Safety, Health and Environmental Program and Procedures Manual.

3.2.2 Chemical Hazards

Landfill 7 was operational from 1950 to 1954. The sources of contamination at Landfill 7 consist of domestic refuse, liquid wastes, petroleum products, and miscellaneous base operations waste such as airplane parts, which were placed into four trenches in the landfill area and subsequently burned. Based on the activities to be performed during Landfill 7 Cover Improvements the chemical hazards are associated with landfill gasses and soil contamination, sediments and surface and ground water contamination exposure is not anticipated.

Twenty-three passive soil gas samples were collected from Landfill 7. Nine contaminants were detected (Acetone, Benzene, 2-Butanone, Carbon disulfide, Ethylbenzene, Styrene, Tetrachloroethylene, Toluene and Xylene). Surface soil samples were used to determine the presence or absence of chemicals at Landfill 7. The eighteen contaminants identified in surface soil include eleven semi-volatiles (Anthracene, Benzo (a) anthracene, Benzo (a) pyrene, Benzo (b) fluoranthene, Benzo (k) fluoranthene, Chrysene, Dibenzofuran, Fluoranthene, Hexachlorobenzene, Phenanthrene and Pyrene), four OP-pesticides (beta-Endosulfan, Endrin aldehyde, Fensulfothion, and Methoxychlor), and three metals (Beryllium, Hexavalent Chromium, and Molybdenum). Refer to ***"Attachment 2- Material Safety Data Sheets"*** for specific chemical information.

The greatest potential for exposure to the chemicals of concern will be during intrusive activities (i.e. soil stripping and subgrade preparation). It is not anticipated that any movement and/or consolidation of landfill waste material will occur. In the event any waste/debris is uncovered during construction, it will cover with common fill material prior to placement of the cover soil.

3.2.2.1 Exposure Route

A primary exposure route of concern at the site is inhalation of vapors during excavation. Air monitoring, using direct reading instruments, for volatile organic compounds and particulate shall be performed during work activities.

Direct contact of the skin and eyes with contaminated material is another important route of exposure. To protect workers against dermal contact, they will wear specified protective clothing, respirators and safety glasses for operations involving potential exposure to hazardous materials. Proper personal decontamination procedures will be emphasized during remedial construction activities.

Although ingestion should be the least significant route of exposure, employees will be made aware of ways in which this type of exposure can occur and methods to avoid such exposure. Deliberate ingestion of chemicals is unlikely. Personal hygiene habits that provide a route of entry for chemicals will be restricted. Proper decontamination procedures will reduce/eliminate potential of ingesting hazardous materials. Site personnel will wash their hands, face and other exposed parts of their skin before eating or smoking.

3.2.2.2 Operational Chemicals/Hazard Communication Program

Operational chemicals may be brought to the project-site for use in activities supporting the remedial activities. These chemicals are used for fuels in operating heavy equipment, glues for welding pipes, painting, etc. The use of operational chemicals is regulated by OSHA under the Hazard Communication Standard (29 CFR 1910.1200). MSDSs for operational chemicals are kept on file in the project office trailer. An inventory list of the anticipated operational chemicals (Hazardous Chemical Inventory List) for use at the former Griffiss Air Force Base project will be maintained at the site and updated as new material is received.

3.2.3 Biological Hazards

There is a potential for encountering biological hazards such as bites from ticks, rodents, snakes and exposure to poison ivy and oak. Biological hazards and controls are presented below.

3.2.4.1 Ticks

Working in tall grass, especially in or at the edge of wooded areas, increases the potential for ticks to affect workers. Ticks are vectors of many different diseases including; Rocky Mountain spotted fever, Q fever, tularemia, Colorado tick fever, and Lyme disease. They attach to their host's skin and intravenously feed on its blood creating an opportunity for disease transmission. Covering exposed areas of the body and the use of commercially prepared tick repellent, such as N, N-Diethyl-m-toluamide (DEET), help prevent tick bites. Please note that there are some concerns with the use of DEET on skin and associated potential adverse health affects. Periodically during the workday, employees working in tall grass will inspect themselves for the presence of ticks. Notify the SSHO of any tick bites as soon as possible

3.2.4.2 Rodents and Wildlife

During site operations, animals such as woodchuck, rabbits, deer, coyotes, mice, and rodents may be encountered. Workers will use discretion and avoid all contact with animals. If these animals are interfering with site operations, or if dead animals are observed, the SSHO should be contacted immediately for assistance and advice.

Hanta virus Pulmonary Syndrome (HPS) is a disease that may be contracted when a person comes into contact with Hanta virus-infected rodents, their nesting materials, droppings, urine, or saliva. HPS may develop when virus particles are inhaled, absorbed through broken skin or the eyes, or when bitten by an infected animal. The majority of HPS cases have been reported in the Southwest, however, there is the potential for Hanta virus transmission in most regions with rodent populations. Risk to workers at the site is considered to be low; however, the severity of disease is high. Therefore, field personnel should be aware of the potential for exposure and should avoid coming into contact with rodents or their burrows or dens.

Rabies is an acute, infectious, often fatal viral disease transmitted to humans by the bite of warm-blooded infected animals. This disease affects the central nervous system of humans. A rabid animal may be recognized by signs of raging, uncontrollable movement and possible foaming near or at the mouth. The best control method is avoidance of animals that could be rabid. If bitten by a potentially rabid animal, contact the SSHO immediately. The animal in question must be capture or trap the animal so that it can be tested for rabies. The bitten individual shall seek medical attention immediately.

3.2.4.3 Poisonous Plants

Poison ivy, poison oak, and poison sumac are identified by three or five leaves radiating from a stem. Poison ivy is in the form of a vine while oak and sumac are bush-like. All of these plants can produce a delayed allergic reaction. The plant tissues have an oleoresin, which is active in live, dead, and dried parts. The oleoresin may be carried through smoke, dust, contaminated articles, and the hair of animals. Symptoms usually occur 24 to 48 hours after exposure resulting in rashes that itch and blister. Should exposure to any of these plants occur, wash the affected area with a mild soap and water within one-half hour, but do not scrub the area. The best preventative measure for poisonous plants is recognition and avoidance.

3.2.4.4 Snakes

The degree of toxicity resulting from snakebites depends on the potency of the venom, the amount of venom injected, and the size of the person bitten. Poisoning may occur from injection or absorption of venom through cuts or scratches. The most effective way to prevent snakebites is to avoid snakes in the first place. Personnel should avoid walking at night or in high grass and underbrush. Visual inspection of work areas should be performed prior to activities taking place. The use of leather boots and long pants will be required, since more than half of all bites are on the lower part of the leg. No attempts at killing snakes should be made; many people are bitten in such an attempt. Personnel shall not put their hands in areas where they cannot be seen.

3.2.4.5 Flying Insects

Flying insects such as mosquitoes, wasps, hornets, and bees may be encountered while project activities occur. Mosquito bites can be effectively prevented by the use of insect repellants containing DEET. Please note that there are some concerns with the use of DEET on skin and associated potential adverse health affects. Treatment for insect bites and bee stings can be effected by the use of commercially prepared ointments. Personnel who are allergic to bee stings shall notify the SSHO prior to working on the project.

3.2.4.6 Spiders

Personnel shall be alert to the potential for spider bites. Spiders sometimes establish residence in stored clothing and PPE. It is advisable for personnel to inspect clothing and PPE for spiders prior to donning. Immediate reporting and medical evaluation is necessary if personnel suspect being bitten by the Brown Recluse spider. If a spider bite is sustained, personnel shall report it to the SSHO.

3.3 Engineering Controls

The use of engineering controls for the protection of personnel is the first means of mitigation. This involves the elimination of hazards and the isolation of the workers from the hazards. Implementation of engineering controls can reduce the need for personal protective equipment by separating the worker from the contaminated material. During remedial activities dust and vapors may be generated. The Site Superintendent and SSHO will be constantly alert to the possibility of unacceptable dust and vapor levels.

Control measures will be implemented for all operations where dust is likely to be generated. Potential dust concentrations will be reduced primarily by careful planning and implementation of controls. There are a number of specific construction practices, which will reduce levels of airborne particulates. These include:

- Providing for a misting spray during excavation activities
- Applying water on and sweeping haul roads.
- Wetting and smashing equipment and building faces.
- Spraying mist on buckets during material handling and dumping.
- Hauling materials in properly tarped or watertight containers.
- Reducing the active work area surface and limiting the number of concurrent operations.
- Regular washing of contaminated equipment.

4.0 SAFETY AND HEALTH TRAINING

Consistent with OSHA's 29 CFR 1910.120 regulation covering Hazardous Waste Operations and Emergency Response, all Site personnel who will be performing remedial activities, intrusive sampling, emergency

response operations, or come in contact with contaminated material are required to be trained in accordance with the standard.

4.1 General Hazardous Waste Operation Training

Prior to arrival on-site, Conti will be responsible for certifying that the employees meet the requirements of preassignment training, consistent with OSHA 29 CFR 1910.120 paragraph (e)(3). Conti will provide documentation certifying that each general Site worker has received a minimum of 40 hours of instruction off site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor. All personnel must also receive 8 hours of refresher training annually. At no time should anyone be working on-site without the minimum training requirements. Consistent with OSHA 29 CFR 1910.120 paragraph (e)(4), individuals designated as Site Supervisors require an additional 8 hours of training. A certificate of Worker/Visitor Acknowledgement will be completed and submitted for each site worker and visitor who will enter the contamination reduction zone, and/or exclusion zone.

4.2 Preparatory Meetings

Preparatory meetings will be conducted by the SSHO for site personnel prior to their initiating any new or differing site activities. At the Preparatory meetings, the SSHO will ensure that site personnel are knowledgeable of the SSHP and understand the hazards and controls of the activity to be performed (review Activity Hazard Analysis).

4.3 Site-Specific Training

All personnel working at the Site during remedial activities will review this SSHP with the SSHO. Personnel will sign an acknowledgment form to document their review and agreement to comply with the provisions of the SSHP. All visitors must sign the visitor's log and wait in the Conti field office for a briefing before entering the Site.

The SSHO will be responsible for training Site visitors in the hazard associated with the Site, to explain emergency procedures and instruct them in the use of protective gear required during the visit. Visitors meeting requirements of HAZWOPER may be allowed in the Exclusion Zone if conditions permit and if escorted by the SSHO.

4.3.1 Initial Session

Prior to commencement of onsite field activities, all site employees will attend a site-specific safety and health training session. This session will be conducted by the Site Safety and Health Officer to ensure that personnel are familiar with the requirements of this Site-Specific Safety and Health Plan. The initial session will consist of the contents of this SSHP and specific procedures developed for the project. The SSHO shall also provide initial site-specific training for replacement employees.

As a minimum the site-specific training will include:

- Explanation of the Overall Site HASP.
- Health and Safety Personnel and Organization.
- Special attention to signs and symptoms of overexposure to known and suspected site contaminants.
- Health effects of site contaminants.
- Air monitoring description.

- Physical hazards associated with the project.
- Selection, use, and limitations of available safety equipment and proper procedures for its use.
- Personal hygiene and decontamination.
- Respirator facepiece fit testing.
- PPE fitting to determine proper size for individuals.
- Site rules and regulations.
- Work zone establishment and markings.
- Site communication and the "Buddy System".
- Emergency preparedness procedures.
- Equipment decontamination.
- Medical monitoring procedures.
- Review applicable Conti Standard Operating Procedures.
- Site Specific Hazard Communication.
- Unexploded Ordnance Recognition and Safety Orientation

4.3.2 Periodic Sessions

Periodic training will be provided at least weekly and prior to each change of operation. The training shall address safety and health procedures, work practices, any changes to SSHP, review activity hazard analysis, work task or schedule, results of previous week's air monitoring, review of safety discrepancies and accidents.

4.4 Safety Meetings

A well-ordered flow of information is essential to a good safety program. Conti, through a program of safety meetings at all levels, intends to accomplish the goals of safety awareness, education, and participation.

The SSHO shall conduct daily safety meetings with ALL on-site personnel. An opportunity shall be provided for employees to voice safety-related concerns. The SSHO will submit a synopsis of each meeting including topics covered, safety-related concerns, action items to be addressed, status of previous items and a signed attendance list.

4.5 Monthly Supervisor Safety Meeting

Monthly Supervisor Safety Meeting will be conducted by the SSHO to review past activities, incidents, lessons learned, plan for new or changed operations, review pertinent aspects of appropriate activity hazard analyses, establish safe working procedures for anticipated hazards, and provide pertinent safety and health training and motivation.

4.6 Hazard Communication Training

OSHA's standard for hazard communication requires that all workers be informed of potentially hazardous materials used in their work area. Conti provides employees with information and training on hazardous chemicals at their work site at the time of their initial assignment, annually, and whenever a new chemical is introduced into their work site that could present a potential hazard. Personnel are briefed on the general requirements of the OSHA hazard communication standard and duty-specific hazards by their immediate supervisor before they begin any duties on the work site. Personnel transferred from another site are also briefed on the duty-specific hazards by their immediate supervisor before they begin any duties on the work site.

4.7 Excavation/Trenching Competent Person

Supervisory and other essential personnel engaged in excavation activities are required to complete Competent Person Training. This training provides knowledge about soil analysis and classification, use of protective systems and the requirements of the OSHA Excavation Standard 29 CFR 1926.650 – 652, Subpart P.

4.8 First Aid/CPR Training

At least to site personnel will be required to complete first aid and cardiopulmonary resuscitation (CPR) training and receive the appropriate certification. CPR certification is renewed annually; first aid certification is renewed every three years. All first aid/CPR training is American Red Cross-approved or in accordance with OSHA standards. Additionally First Aid/CPR qualified personnel received bloodborne pathogen training as required by 29 CFR 1910.1030.

4.9 Unexploded Ordnance (UXO) Recognition and Safety

As part as the site-specific training, project personnel will receive Unexploded Ordnance Recognition and Safety training. Training will include a review of the Removal Action Report (Human Factors Application, Inc), UXO terms and definitions, Ordnance identification, and reporting and specific safety procedures.

5.0 MEDICAL SURVEILLANCE PROGRAM

The Medical Surveillance Program is designed to track the physical condition of employees on a regular basis as well as survey pre-employment or baseline conditions prior to potential exposures. The Medical Surveillance Program is a part of the overall Conti Safety and Health program.

5.1 Baseline Medical Monitoring

Each employee must receive a baseline physical, which can be part of an annual medical monitoring program, prior to being permitted to enter the Exclusion Zone or Contamination Reduction Zone. The content of the physical has been determined by Conti's Occupational Physician as suggested by NIOSH/OSHA/USCG/EPA's Occupational Safety & Health Guidance Manual for Hazardous Waste Site Activities. The minimum medical monitoring requirements for work at the Site is as follows:

- Complete medical and work histories
- Physical examination
- Pulmonary function tests (FVC and FEV1)
- Blood chemistry (CBC & SMAC 24)
- Urinalysis with microscopic examination.
- Audiometric Testing
- Eye examination and visual acuity
- Chest X-Ray (as directed by the Occupational Physician)
- Electrocardiogram (as directed by the Occupational Physician)
- Other Biological testing as prescribed by the Occupation Physician
- Serum Lead
- Zinc Protoporphyrin
- Polychlorinated Biphenyl
- In Vitro Monitoring (Bioassay), where applicable

The medical surveillance provided to the employee includes a judgment by the medical examiner of the ability of the employee to use either positive- or negative-pressure respiratory protection equipment. Any employee found to have a medical condition, which could directly or indirectly be aggravated by exposure to these site contaminants, or by the use of respiratory equipment, will not be employed for the project. A copy of the medical examination is provided at the employee's request.

The employees will be informed of any medical conditions that would result in work restriction or that would prevent them from working at hazardous waste sites. A certificate of Worker/Visitor Acknowledgement will be completed and submitted for each site worker and visitor who will enter the contamination reduction zone, and/or exclusion zone.

5.2 Periodic Monitoring

In addition to a baseline physical, all employees require a physical every 12 months unless the advising physician believes a shorter interval is appropriate. The Occupational Physician has prescribed an adequate medical evaluation, which fulfills OSHA 29 CFR 1910.120 requirements. The preassignment medical outlined above is applicable.

All personnel working on the Site that enter an active Exclusion or Contamination Reduction Zone will verify currency (within 12 months) with respect to medical monitoring. Conti will obtain a copy of the physician's written opinion detailing the employee's ability to perform hazardous waste site work.

At termination of employment or reassignment to an activity or location that does not represent a risk of exposure to hazardous substances, an employee may be required to take an exit physical. If his/her last physical was within the last 6 months, the advising medical consultant has the right to determine adequacy and necessity of an exit exam.

5.3 Exposure/Injury/Medical Support

As a follow-up to an injury or possible exposure above established exposure limits, all employees are entitled to and encouraged to seek medical attention and physical testing. Depending upon the type of exposure, it is critical to perform follow-up testing within 24-48 hours. It will be up to the occupation physician to advise the type of test required to accurately monitor for exposure effects.

Any employee, who develops a time loss illness exceeding one working day, or injury during the period of the contract, must be evaluated by the occupational physician. A written statement indicating the employee's fitness, signed by the occupational physician must be submitted prior to the employee entering the work site.

5.4 Medical Records

The results of medical testing and full medical records will be maintained in accordance with 29 CFR Part 1910.20. A copy of the medical certification will be kept on the Site for each person entering the Contamination Reduction Zone and Exclusion Zone.

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

This section provides an outline of the PPE and guidelines that will be implemented to minimize chemical, physical, and biological exposures and accidents during remedial activities. Where engineering controls and job hazard analyses do not eliminate all job hazards, employees will (where appropriate) wear PPE.

These include items such as, hard hats, face shields, safety goggles, glasses, hearing protection, foot guards, gloves etc. The SSHO will ensure that equipment selected will meet the following requirements:

- It will be appropriate for the particular hazard.
- It will be maintained in good condition.
- It will be properly stored when not in use, to prevent damage or loss.
- It will be kept clean, fully functional and sanitary.
- Must meet all applicable ANSI standards.

Personal clothing and jewelry can present additional safety hazards. Supervisors will ensure that workers wear appropriate clothing, which will not interfere with the PPE. All PPE will be selected in accordance with 29 CFR 1910.132. Conti will provide proper PPE to all employees. All protective clothing will be properly used, stored, selected, and maintained.

Government personnel will be supplied with all required personal protective equipment (excluding air-purifying negative-pressure respirators and safety shoes, which will be provided by the individual visitors). Conti will provide basic training in the use and limitations of PPE to government personnel.

6.1 PPE Hazard Assessment

Selection of the appropriate PPE is a complex process, which should take into consideration a variety of factors. Key factors involved in this process are identification of the hazards, or suspected hazards, routes of potential exposure to employees (inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE materials (and clothing seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases, the breakthrough time of the protective material should exceed the work duration.

Other factors in this selection process to be considered are matching the PPE to the employee's work requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks. The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits or equipment.

The following are guidelines, which Conti Environmental uses to select PPE. Based on the site characterization and analysis performed during the remedial activities, a combination of PPE has been selected from the different protection levels (i.e., A, B, C, D Modified or D) as being suitable to the hazards of the work to be performed. Section 3.0 of this plan characterizes and analyzes, the chemical and physical hazards, specific tasks/operations, routes of exposure, and concentrations of contaminants. Characteristics, capabilities and limitations are summarized in this section.

- **Level A:** The highest level of skin, eye, and respiratory protection (Level A PPE is not anticipated on this project).

- **Level B:** Should be worn when the highest level of respiratory protection is needed, but a lower level of skin protection is needed, compared to that of level A (Level B PPE is not anticipated on this project).
- **Level C:** Should be worn when the criteria for using air-purifying respirators are met, and a lesser or the same level of skin protection is needed, compared to that of level B.
- **Level D Modified:** Should be worn when respiratory protection is not warranted but minimal dermal protection is necessary.
- **Level D:** Level D provides minimal protection against chemical hazards. A work uniform consisting of coveralls and/or long pants and sleeves may be worn in any area without the potential for significant respiratory or skin contact hazards.

Personal Protective Equipment alone should not be relied on to provide protection against hazards, but should be used in conjunction with guards, engineering controls, and sound work practices.

6.1.1 Head Protection

All personnel shall wear a hard hat that meets the requirements and specifications in ANSI Safety Requirements for Industrial Head Protection Z89.1-1969. Exceptions to this requirement are personnel in the site office and rest and eating areas.

6.1.2 Hand Protection

Outer gloves used on the Site for remedial activities shall be either chemical resistant or general purpose. The appropriate glove shall be determined by the SSHO for a specific work task. Chemical resistant gloves shall be selected using appropriate chemical degradation guides. Cotton work gloves will be worn when work activities require the handling of sharp and rough-surfaced objects.

Welder's gloves or any other special type of gloves are considered outer gloves and are to be worn over inner gloves. These special outer gloves shall be stored on-site and shall be disposed of properly as PPE waste. Inner gloves shall always be chemical resistant, shall be selected using appropriate chemical degradation guides and shall be disposed of as PPE waste.

6.1.3 Eye/Face Protection

No contact lenses are allowed in the Exclusion Zone (EZ) and Contamination Reduction Zone (CRZ). Eye/Face protection shall be worn by all personnel in the CRZ and EZ. Double eye protection will be required when power-washing equipment during decontamination. All eye/face protection provided shall be ANSI Z87-1989 approved.

6.1.4 Footwear

Footwear will be steel-toed safety boots. Chemical-resistant outer boot covers are to be worn in the Exclusion Zone, Contamination Reduction Zone. Boot racks will be provided in the CRZ for drying of outer boots.

6.1.5 Respiratory Protection

To control and or minimize the threat of occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective of this program shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control

measures (for example, dust suppression). When effective engineering controls are not feasible, or while they are being instituted, appropriate respiratory protection shall be used. A respiratory protection program will be implemented that is compliant to the requirements of 29 CFR 1910.134 "Respiratory Protection." Respiratory protection equipment shall be NIOSH-approved and respirator use will conform to American National Standards Institute (ANSI) Z88.2.

Respirators shall be provided when such equipment is necessary to protect the health of the employee. Conti shall:

- Provide the respirators to Conti personnel, which are applicable and suitable for the purpose intended.
- Be responsible for the maintaining a written Respiratory Protective Program, in accordance with 29 CFR 1910.134 The employee shall use the provided respiratory protection in accordance with instructions and training received.
- Respirators shall be selected on the basis of hazards to which the worker is exposed.
- The user shall be instructed and trained in the proper use of respirators and their limitations.
- Respirators shall be regularly cleaned and disinfected.
- Respirators shall be stored in a convenient, clean, and sanitary location.
- Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use, such as self-contained devices, shall be thoroughly inspected at least once a month and after each use.
- Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.
- There shall be regular inspections and evaluations to determine the continued effectiveness of the program.
- Employees will not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. A physician shall determine whether an individual is physically fit to wear a respirator. The physician's clearance allows the worker to don a respirator and work in conditions of high ambient temperatures. Heat stress will be closely monitored by the SSHO.

Each respirator shall be individually assigned and not interchanged between workers without cleaning and sanitizing. The cartridges/filters shall be changed at the first sign of breakthrough based on contaminant warning properties or if the user experiences excessive breathing resistance. The SSHO will make final determination of the frequency of respirator cartridge/filter change-out. Respirators shall be cleaned and stored in an uncontaminated atmosphere after each use. Used cartridges will be disposed of with spent PPE. Self-contained breathing apparatus/supplied-air respirators shall be inspected before and after use and at least once monthly, if in storage for emergency use.

All employees working at the Site during remedial activities who have the potential of wearing a respirator shall be fit-tested to ensure they utilize the proper size respirator. Conti shall arrange for fit testing. Sub-contractors will provide the SSHO with fit-test documentation. The fit test is conducted according to the manufacturer's suggestions. The test shall consist of a taste and odorous vapor qualitative test. As per OSHA regulations, personnel that are unable to pass a fit test shall not enter a work area when respiratory protection is required. In addition, facial hair is prohibited from the respirator seal area. Any person with facial hair will not be permitted to enter a work area where respiratory protection is required, regardless of the fit test results. Documentation of the fit testing will be maintained on-site.

6.2 Levels of Protection

The level of protection must correspond to the level of hazards known or suspected for the specific work activity.

6.2.1 Level B

Level B equipment, used as appropriate, is as follows:

- Positive pressure, full facepiece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA (NIOSH-approved)
- Disposable coverall (Tyvek, Polycoated Tyvek or Saranex)
- Outer gloves: neoprene or nitrile
- Inner gloves: latex or nitrile
- Chemical resistant or disposable overboots.
- Steel-toed safety boots
- Hard hat

6.2.2 Level C

Level C equipment, used as appropriate, is as follows:

- Full-face, air purifying, cartridge-equipped respirators (NIOSH-approved) utilizing Organic Vapor/Acid Gas and HEPA filters (half-face if approved by SSHO). Cartridges and/or filters must be replaced as needed and, as a minimum, changed weekly.
- Disposable coverall (Tyvek, Polycoated Tyvek or Saranex).
- Outer gloves: leather, cotton, neoprene or nitrile
- Inner gloves: latex or nitrile
- Chemical resistant or disposable overboots
- Steel-toed safety boots
- Hard hat
- Safety glasses (if half-mask is utilized)
- Splash guards (worn during high pressure washing activities)

6.2.3 Modified Level D

Modified Level D equipment, used as appropriate, is as follows:

- Regular Tyvek coveralls (Polycoated Tyvek as required)
- Outer gloves: leather, cotton, neoprene or nitrile
- Inner gloves: latex or nitrile (doubled)
- Chemical resistant or disposable overboots
- Steel-toed safety boots
- Hard hat
- Safety glasses
- Splash guards (worn during high pressure washing activities)

6.2.4 Level D

Level D equipment, used as appropriate, is as follows:

- Work uniform (Long pants and Shirt)
- Hard hat
- Steel-toed safety boots (with disposable overboots, as required)

- Safety glasses
- Leather or heavy cloth gloves (as needed)

6.3 Initial Levels of Protection

Based upon the nature of the remedial activities to be performed at the Site, the initial levels of protection to be used are outlined in ***Table 7, "Initial Levels of Protection"***. This table lists each work task and the initial level of protection. The initial level of protection is defined as that level in which work commences.

Once the need for PPE is established, a careful evaluation of the hazards is necessary so that a selection can be made that minimizes the risk to the user. For chemical situations, knowing the hazard includes being aware of: the type of chemical, the physical state (liquid, solid or gas), and the physiological effect (toxic, corrosive, etc.). Knowing the level of exposure is also important when selecting protective clothing and equipment. After the appropriate level of PPE has been determined, the choice of Chemical Protective Clothing (CPC) material must be considered. Among the most important factor in selecting the appropriate CPC is chemical resistance. ***Table 7, "Initial Level of Protection"*** identifies the CPC as they relate to each task.

Table 7 – Initial Levels of Protection

Task	CPC	Level of PPE
Site Preparation/Mobilization	None	Level D
Erosion and Sediment	Reg. Tyvek	Level D/Level D Modified
Clearing	Reg. Tyvek	Level D/Level D Modified
Site Surveying	None	Level D
Topsoil Stripping and Stockpiling	Reg. Tyvek	Level D/Level D Modified
Site Grading (Cut/Fills)	Reg. Tyvek	Level D/Level D Modified
Installation of Cover Fill	None	Level D
Equipment Decontamination	Reg. Tyvek	Level D Modified
Monitoring Well Decommissioning	Reg. Tyvek	Level D Modified
Site Restoration/Demobilization	None	Level D

Air monitoring using direct-reading instruments and personal air sampling will be performed to determine if an upgrade or downgrade from initial PPE levels is warranted. All decisions on the level of protection will be based upon a conservative interpretation by the SSHO of the information provided by air monitoring results, environmental results and other appropriate information.

7.0 AIR MONITORING PLAN

The air-monitoring plan will serve to outline procedures to identify and quantify airborne chemical contaminants during remedial activities at Landfill 7. Both real-time monitoring and air sampling will be conducted throughout the duration of the project to establish the maximum levels of personal protection required, as well as to verify that worker exposure levels and respiratory protection are adequate. Available site information indicates that the primary concerns with respect to contamination at the site are related to inhalation of petroleum hydrocarbon and direct contact with dust/particulates generated during contaminated material handling. As a result, engineering controls will be utilized to the maximum extent possible to control the production of dust/particulates during the project. Engineering controls may include the use of tarps or coverings, water misting or dust control additives. Air monitoring will be performed by the SSHO. Data will be reviewed by the Safety and Health Manager with consultation of the CIH, if needed.

7.1 Real-Time Air Monitoring

7.1.1 Organic Vapor Monitoring

During the remedial activities, organic vapor levels will be monitored during intrusive activities with a PID set at the appropriate span setting and equipped with an 10.2 eV probe or equivalent device (a copy of the PID Operator's Manual will be kept on-site). Real-time air monitoring equipment calibration will be performed in accordance with the manufacturer's recommendation prior to field use. Calibration information will be recorded on the Daily Air Monitoring Report. Maintenance and calibration procedures for all air monitoring devices will be maintained on site.

7.1.2 Combustible Gases/Carbon Monoxide/Oxygen Levels/Hydrogen Sulfide

A Gastech or MSA Portable Gas Monitor will be utilized to monitor for explosive and oxygen enriched/deficient atmospheres and concentrations of hydrogen sulfide during intrusive operations. A copy of the Operator's Manual will be kept on-site. The Portable Gas Monitor also will be utilized for all intrusive activities and activities where the potential for disruption of utilities exists. Calibration information will be recorded on the Daily Air Monitoring Report. Maintenance and calibration procedures for all air monitoring devices will be maintained on site.

7.1.3 Particulate Monitoring

Particulate (Real-time) air monitoring will be performed, , on a continuous basis, using a MIE Personal/Data RAM Particulate Monitor (RAM). A copy of the appropriate Operator's Manual will be kept on-site. Air monitoring results will be recorded on the Daily Air Monitoring Report.

SHSO and the superintendent will be constantly alert to the possibility of unacceptable dust levels being generated by remedial activities. Unacceptably high levels of airborne particulate, or excessive dust conditions, will trigger dust control measures. Should dust control measures prove ineffective and unacceptable levels of particulate are present for a sustained period, the SHSO may suspend work activities pending further evaluation of the situation.

7.1.4 Equipment Calibration

Real-time air monitoring equipment calibration will be performed in accordance with the manufacturer's recommendation prior to field use. Calibration information will be recorded on the Daily Air Monitoring Report. Maintenance and calibration procedures for all air monitoring devices will be maintained on site.

7.2 Operational Action Levels

A decision-making protocol for an upgrade in levels of protection and/or withdrawal of personnel from an area based on atmospheric hazards is outlined in ***Table 8 – "Operational Action Levels".***

7.3 Personal Air Sampling

In addition to the real-time monitoring performed during material handling activities (Site Grading), the personal air-monitoring program will provide for the determination of worker's airborne exposure levels. Such a determination will be made from laboratory analysis of air samples collected from workers during an 8- hour

work shift. The selection of the worker to be monitored for daily exposure will be done by the SSHO based on his professional judgment of the characteristics of the job and locations in each work area.

Table 8 – Operational Action Levels

Contaminants	Action Level	Action to Take
Volatile Organic Compounds	1 To 10 PPM Above Background At The Breathing Zone And Sustained For 1 Minute	Level D, Continuous Air Monitoring Quantify with Colorimetric Tubes.
	10 To 100 PPM Above Background At The Breathing Zone And Sustained For 1 Minute	Upgrade To Level C, Continuous Air Monitoring
	100 To 300 PPM Above Background At The Breathing Zone And Sustained For 1 Minute	Upgrade To Level B, Continuous Air Monitoring
	> 300 PPM Above Back Ground At The Breathing Zone And Sustained For 1 Minute	Stop Work, Evacuate Work Zone And Evaluate with Continuous Air Monitoring
Combustible Gas In Air	Less Than 10% LEL	Continue With Caution And Air Monitoring
	Greater Than 10% LEL	Stop Work, Immediate Withdrawal Of Personnel, and investigate
Oxygen In Air	Less Than 19.5%	Stop Work &Ventilate Or Upgrade To Level B
	19.5 To 23.5%	Level D, Continue Work With Air Monitoring
	Greater Than 23.5%	Stop Work, Immediate Withdrawal Personnel And Evaluate
Particulate in Air	0 to 100 ug/m^3	Level D No Action Taken
	100 ug/m^3 to 150 ug/m^3	Level D Initiate Dust Control
	2.5 mg/m^3 to 5 mg/m^3	Upgrade To Level C, Air Monitoring And Initiate Dust Control
	Greater than 5 mg/m^3	Stop Work and Investigate

Personal sampling will be conducted in a manner representative of exposure of workers at those locations or jobs where the potential for maximum exposure is predicted. Personal air monitoring results will be used to verify personnel exposure during the remedial project. Samples will be collected from representative workers during material handling activities. Refer to ***Table 9 – "Proposed Site Air Monitoring"***

Table 9 – Proposed Site Air Sampling

Contaminant	Task/Activity	Type of Sample	Sampling Method	Analysis Method
PAH Screen	Material Handling Activities	Breathing Zone	Personal Sample	NIOSH 5506
VOC Screen	Material Handling Activities	Breathing Zone	Personal Sample	NIOSH -Multiple
Dust/Metals	Material Handling Activities	Breathing Zone	Personal Sample	NIOSH 7300

The SSHO will designate two-crew members in an active work area to wear the sampling device. In general, samples will be collected from those workers and site conditions representing the highest potential for exposure. Initially, two workers will be monitored the first day of each activity at the site. If sampling results are above the Action Levels additional personal sampling will be performed.

7.4 Perimeter Air Monitoring

Perimeter air monitoring will be performed to ensure that remedial activities do not result in excessive airborne particulate emissions from the site. Real-time particulate monitoring will be collected to determine the concentrations of particulate at the perimeter of the work area.

Continuous real-time perimeter air monitoring for total particulate will be performed during material handling activities. The SSHO will select one downwind and one upwind air monitoring station at the start of each workday. Wind conditions will be monitored by the SSHO throughout the day and the location of the stations adjusted accordingly. Particulate monitoring will be performed using an MIE DataRam DR-2000 or equivalent (real-time air monitor). The particulate monitors will be fitted with a PM_{10} inlet and equipped with an alarm set at the action level 100 microgram per cubic meter. Measurements will be integrated over a period of 15 minutes for comparison with the pre established action level.

When an alarm is triggered, the SSHO will inform the Project Superintendent and visually verify the readings and monitor the unit to determine if the reading is sustained. Upon verification of a continual, sustained reading exceeding the action level, the SSHO, and Project Superintendent will evaluate the on-going activities to determine what mitigative actions are required. Should the sustained readings continue, operations will cease.

All of the real-time monitors will be equipped with dataloggers, which will continually record the readings throughout the course of the day's activities. Stored information includes time and date, average concentrations, maximum and minimum values over selected periods, STEL concentration, and tagging codes. These dataloggers will be downloaded at the end of the workday and reviewed by the Site Safety and Health Officer. The air monitoring report will be attached to the Daily Safety and Inspection Log and submitted daily to the Contracting Officer representative.

8.0 SAFETY PROCEDURES AND WORK PRACTICES

8.1 Emergency Phone Numbers, OSHA Posters, Hazards Warnings

(Reference Conti SOP 23, *Site Specific Health and Safety Requirement*)

Emergency telephone numbers and Route to the Area Hospital will be clearly posted and easily visible at all times. There should be OSHA posters prominently displayed and warning signs posted for any known or potential hazard(s) present. Material Safety Data Sheets (MSDS) must be available on the job site at all times.

8.2 First Aid Kits

(Reference Conti SOP 23, Medical and First Aid Equipment Requirements)

First-aid kits/stations and required contents are maintained in a serviceable condition. Unit-type kits have all items in the first-aid kit individually wrapped, sealed, and packaged in comparable sized packages. First-aid stations shall be located as close as practicable to the highest concentration of personnel. First-aid stations shall be well-marked and available to personnel during all working hours. First-aid stations shall be equipped with a first-aid kit, the size of which shall be dependent upon the number of personnel normally employed at the work site.

8.3 Personal Protective Equipment Clothing

(Reference Conti SOP 31, Personal Protective Equipment Procedures)

Where there is a danger of flying particles or corrosive materials, employees must wear protective goggles and/or face shields. Employees are required to wear safety glasses at all times in all non-office areas. Employees who need corrective lenses are required to wear only approved safety glasses, protective goggles, or other medically approved precautionary procedures when working in areas with harmful exposures, or risk of eye injury. Employees are required to wear protective gloves, aprons, shields and other means provided in areas where they may be subject to cuts, corrosive liquids and/or harmful chemicals. Hard hats must be worn in areas subject to falling objects, and at all times while at construction sites. Appropriate footwear including steel-toed shoes must be worn in an area where there is any risk of foot injuries from hot, corrosive, poisonous substances, falling objects, and crushing or penetrating action. When necessary, employees must use the approved respirators, which are provided for regular and emergency use. All safety equipment must be maintained in sanitary condition and ready for use. Report any defective equipment immediately. Food may not be eaten in work areas, or in places where there is any danger of exposure to toxic materials or other health hazards. In cases of cleaning toxic or hazardous materials, protective clothing provided must be worn.

8.4 Combustible Materials

(Reference Conti SOP 21, Fire Prevention and Protection Procedures)

All combustible scrap, debris and waste materials (oily rags, etc.) must be stored in covered metal receptacles and removed from the work site promptly. Proper storage to minimize the risk of fire, including spontaneous combustion must be practiced. Only approved containers are to be used for the storage and handling of flammable and combustible liquids. All connections on drums and combustible liquid piping, vapor and liquid must be kept tight. All flammable liquids should be kept in closed containers when not in use (e.g., parts-cleaning tanks, pans, etc.). Liquefied petroleum gas must be stored, handled, and used in accordance with safe practices and standards. No smoking signs must be posted. All solvent wastes and flammable liquids should be kept in covered containers until they are removed from the work site. Fuel gas cylinders and oxygen cylinders must be separated by distance, fire resistant barriers, etc., while in storage. Fire extinguishers will be 10 lb. ABC and placed in areas where they are to be used. Fire extinguishers must be located within 75 ft. of outside areas containing flammable liquids, and within 10 ft. of any inside storage area for such materials. "NO SMOKING" rules will be enforced in areas involving storage and use of hazardous materials. "NO SMOKING" signs have been posted where appropriate in areas where flammable or combustible materials are used and/or stored. Safety cans must be used for dispensing flammable or combustible liquids at point of use. All spills of flammable or combustible liquids must be reported and cleaned up promptly.

8.5 Hazardous Substances

(Reference Conti SOP 41, Hazard Communication Program)

When hazardous substances are used in the workplace, the hazard communication program dealing with Material Safety Data Sheets (MSDS), labeling and employee training will be in operation. MSDS materials will be readily available for each hazardous substance used. A training program plus regular question and answer sessions on dealing with hazardous materials will be given to keep employees informed. The program will include an explanation of what an MSDS is and how to use and obtain one; MSDS contents for each hazardous substance or class of substances; explanation of the "Right to Know"; identification of where employees can see the employer's written hazard communication program and where hazardous substances are present in their work area; the health hazards of substances in the work area, how to detect their presence, and specific protective measures to be used; as well as informing them of hazards of non-routine tasks and unlabeled pipes.

8.6 Work Areas

(Reference Conti SOP 23, Site Specific Health and Safety Requirement)

Work sites must be clean and orderly. Spills must be reported and cleaned up immediately. All combustible scrap, debris and waste must be stored safely and removed promptly. Waste containers must be covered. Oily and paint soaked rags are combustible and should be discarded in sealable metal containers only. Make sure all pits and floor openings are either covered or otherwise guarded. Fire extinguishers must remain accessible at all times. Work sites shall be kept free of debris, floor storage and electrical cords.

8.7 General Fire Safety

(Reference Conti SOP 21, Fire Prevention and Protection Procedures)

Portable fire extinguishers are provided in adequate number and type (10 lb. ABC) and are located throughout the site. Fire extinguishers are located in readily accessible locations. Fire extinguishers are recharged regularly and the date of last inspection noted on their tags. Extinguishers should be placed free from obstructions or blockage. All extinguishers must be fully charged and in their designated places unless in use. All employees are periodically instructed in the use of extinguishers and fire protection procedures. Fire Extinguishers will be located in the following areas:

- ***Support Zone (Field):*** (1) 10 lb ABC multipurpose dry chemical type fire extinguishers.
- ***Decontamination Reduction Zone:*** (2) 10 lb ABC multipurpose dry chemical type fire extinguishers.
- ***Exclusion Zone:*** (1) 10 lb ABC multipurpose dry chemical type fire extinguishers.
- ***Equipment:*** All of Conti's heavy equipment are supplied with ABC multipurpose dry chemical type fire extinguishers. ABC type fire extinguishers can also be found in all vehicles.

8.8 Fueling

(Reference Conti SOP 21, Fire Prevention and Protection Procedures)

Where flammable liquids are used, employees will be trained to deal with spillage during fueling operations, clean-up methods, the types and designs of fueling hoses and the specific types of fuel it can handle, whether fueling is being done with a nozzle that is a gravity flow system or self-closing, how to avoid spills and recognition that if a spill does occur, the safety of restarting an engine. Employees must be aware that an open flame or light near any fuel is prohibited when fueling or the transfer of fuel is occurring. "NO SMOKING" signs will be posted conspicuously. Vehicles/Equipment will be turned off during fueling.

8.9 Powder Actuated Tools

(Reference Conti SOP 25,Hand and Power Tools Operating Procedures)

The employees using powder-actuated tools must be properly trained. All powder-actuated tools must be left unloaded until they are actually ready to be used. Each day before using, each powder-actuated tool must be inspected for obstructions or defects. The powder-actuated tool operators must have and must use appropriate personal protective equipment such as hard hats, safety goggles, safety shoes and ear protectors whenever they are using the machines.

8.10 Confined Spaces

(Reference Conti SOP 15, Confined Space Entry Procedures)

Before entry into a confined space, all moving equipment contained in the confined space must be locked-out. Ventilation must be either natural or mechanically provided into the confined space. All confined spaces that contain inert, toxic, flammable or corrosive materials must be valved off, blanked, disconnected and separated. Atmospheric tests must be performed to check for oxygen content, toxicity and explosive concentration. Atmospheric tests must be performed on a regular basis in a confined area where entry is required. When personnel enter a confined area, assigned safety standby employees who are alert to the work being done, are able to sound an alarm if necessary and to render assistance. These standby employees must be trained to assist in handling lifelines, respiratory equipment, CPR, first aid, and be able to employ rescue equipment that will remove the individual from the confined area. Entrants, Attendant, Supervisors and rescuers involved in confined space activities will have the required training in accordance with OSHA regulations and the documentation will be available onsite. Confine space entry is not anticipated during remedial activities at Landfill 7.

8.11 Excavation/Trenching

(Reference Conti SOP 37, Trenching and Excavation Procedure)

Prior to excavation/trenching operations, all underground installations in the area shall be identified, located and marked so that when the approximate location of the utility is reached, the exact location can be determined. Employees shall not enter excavations/trenches deeper than 5 feet unless the excavation has been sloped or shored. Excavated spoils must be placed at least 2 ft back from the edge of excavations. The degree of sloping is dependent on the type of soil and the depth of excavation. Excavation work must always be under the immediate supervision of a competent person with authority and qualifications to modify the shoring system or work methods as necessary to provide greater safety. A ladder projecting 36 in. above ground surface must be provided for access and exit. Travel distance to the ladder must not exceed 25 ft. Excavation/trenches regardless of the depth or width shall be barricaded or covered. The use of raised berms, caution signs and caution tape will be used to protect both the public and other personnel on the site.

8.12 Machine Guarding

All equipment and machinery should be securely placed, and anchored when necessary, to prevent tipping or other movement that could result in personal injury. Electrical power to each machine shall be capable of being locked out for maintenance, repair or security. All manually operated valves and switches controlling the operation of equipment and machines must be clearly identified and readily accessible. All moving chains and gears must be properly guarded. The supervisor will instruct every employee in the work area on the methods provided to protect the operator and other employees in the machine area from hazards created by the operation of a machine, such as nip points, rotating parts, flying chips and sparks. The machinery guards must be secured and arranged so they do not present a hazard. All radial arm saws must be arranged so that the cutting head will gently return to the back of the table when released.

8.13 Lockout/Tagout Procedures

(Reference Conti SOP 28, Lockout/Tagout (Hazardous Energy) Procedures)

All machinery or equipment capable of movement must be de-energized or disengaged and blocked or locked out during cleaning, servicing, adjusting or setting up operations, whenever required. The lockout procedure requires that stored energy (i.e. mechanical, hydraulic, air) be released or blocked before equipment is locked out for repairs. Appropriate employees are provided with individually keyed personal safety locks. Employees

are required to keep personal control of their key(s) while they have safety locks in use. Employees must check the safety of the lockout by attempting a start up after making sure no one is exposed. Where the power disconnector does not also disconnect the electrical control circuit, the appropriate electrical enclosures must be identified. The control circuit can also be disconnected and locked out.

Temporary Electrical service installation and will be performed by a qualified electrician, work may only be performed on de-energized equipment. Lockout/Tagout procedures will be implemented to assure the safety of personnel during electrical work activities.

8.14 Electrical

(Reference Conti SOP 40, Electrical Procedures)

Equipment such as electrical tools or appliance must be grounded or of the double insulated type. Extension cords being used must have a grounding conductor. If ground-fault circuit interrupters are installed on each temporary AC circuit at locations where construction, or excavations are being performed, temporary circuits must be protected by suitable disconnecting switches or plug connectors with permanent wiring at the junction. Personnel must be aware of the following: Exposed wiring and cords with frayed or deteriorated insulation must be repaired or replaced. Flexible cords and cables must be free of splices or taps. Clamps or other securing means must be provided on flexible cords or cables at plugs, receptacles, tools, and equipment. The cord jacket must be held securely in place. All cord, cable and raceway connections must be intact and secure. In wet or damp locations, electrical tools and equipment must be appropriate for the use or location, or otherwise protected.

A significant hazard on construction jobsites is the accidental contact of moving equipment with live overhead power distribution and service lines. Where work must be done near live lines, the movement of all equipment such as cranes, excavators and other equipment must be guided by an observer who can observe the clearance of the equipment from energized lines and give timely warning to equipment operators. The minimum clearance between live lines and any jobsite equipment is 10 ft (3.0 m), and the clearance increases with increasing line voltages.

Underground electric lines shall be located and clearly marked. These utilities will be protected, removed or relocated as needed to do the work safely. The excavation work shall not be allowed to endanger the underground utility or the people doing the work. Barricades, shoring, or other supports as needed shall protect utilities left in place that are exposed by the excavation

8.15 Material Handling

(Reference Conti SOP 29, Material Handling, Storage, Use & Disposal Procedures)

In the handling of materials, employees must know the following: There must be safe clearance for equipment through aisles and doorways. Vehicles must be shut off and brakes must be set prior to loading or unloading. Containers of combustibles or flammable, when stacked while being moved, must be separated by dunnage sufficient to provide stability. Trucks and trailers will be secured from movement during loading and unloading operations. Hand trucks must be maintained in safe operating condition. Chutes must be equipped with sideboards of sufficient height to prevent the handled materials from falling off. At the delivery end of rollers or chutes, provisions must be made to brake the movement of the handled materials. Hooks with safety latches or other arrangements will be used when hoisting materials, so that slings or load attachments won't accidentally slip off the hoist hooks. Securing chains, ropes, chokers or slings must be adequate for the job to be performed. When hoisting material or equipment, provisions must be made to assure no one will be passing under the suspended loads.

8.16 Industrial Trucks/Forklifts

(Reference Conti SOP 30, Motor Vehicles and Mechanized Equipment)

When operating any industrial truck, substantial overhead protective equipment will be provided on high lift rider equipment. Each industrial truck must have a warning horn, or other device which can be clearly heard above the normal noise in the area where operated. Before using a forklift, check that the brakes on each industrial truck are capable of bringing the vehicle to a complete and safe stop when fully loaded. The parking brake must effectively prevent the vehicle from moving when unattended. Personnel operating forklifts will have the required training in accordance with OSHA regulations and the documentation will be available onsite.

8.17 Driving

(Reference Conti SOP 30, Motor Vehicles and Mechanized Equipment)

Drive safely. If vehicles are used during the workday, seat belts are to be worn at all times. Vehicles must be locked when unattended to avoid criminal misconduct. Do not exceed the speed limit. Vehicles must be parked in legal spaces and must not obstruct traffic. Defensive driving must be practiced by all employees. Employees should park their vehicles in well-lighted areas at/or near entrances to avoid criminal misconduct.

8.18 Portable Power Tools

(Reference Conti SOP 25, Hand and Power Tool Operating Procedures)

Portable power tools pose a special danger to employees because they are deceptively small and light, yet they can do great bodily harm if used improperly or poorly maintained. These rules apply to all power tools, but are especially important when handling portable saws, drills and power screwdrivers. Check your equipment before you use it. All grinders, saws and similar equipment should be equipped with appropriate safety guards. Power tools should not be used without the correct shield, guard, or attachment, recommended by the manufacturer. Portable circular saws must be equipped with guards above and below the base shoe. Circular saw guards should be checked periodically and before each use to assure they are not wedged up, thus leaving the lower portion of the blade unguarded. All rotating or moving parts of equipment should be guarded to prevent physical contact. All cord-connected, electrically operated tools and equipment should be effectively grounded or of the approved double insulated type. Effective guards must be in place over belts, pulleys, chains, sprockets, on equipment such as concrete mixers, air compressors, etc. If portable fans are provided, they must be equipped with full guards or screens having openings 1/2 inch or less. Do not attempt to lift heavy objects without proper equipment. Hoisting equipment will be made available for lifting heavy objects, with hoist ratings and characteristics appropriate for the task. Power tools are either battery operated or wired. If battery operated, don't under-estimate their power. A small electric drill or power screwdriver can cause a severe injury if it lands in the wrong place. Typically used with extension cords, the more powerful hard-wired equipment presents a double safety problem: the actual equipment plus its electrical power source. Ground-fault circuit interrupters must be provided on all temporary electrical 15 and 20-ampere circuits used during periods of construction. Pneumatic and hydraulic hoses on power-operated tools should be checked regularly for deterioration or damage.

Portable cord- and plug-connected equipment and flexible cord sets (extension cords) will be visually inspected before use for external defects and for evidence of possible damage such as kinked wire, cut insulation, or other damage that may prevent proper operation or cause a fire at the site. Defective or damaged items shall be removed from service until repaired.

8.19 Tool Maintenance

(Reference Conti SOP 25, Hand and Power Tool Operating Procedures)

Faulty or improperly used hand tools are a safety hazard. All employees shall be responsible for ensuring that tools and equipment (both company and employee-owned) used by them or other employees at their workplace are in good condition. Hand tools such as chisels, punches, etc., which develop mushroom heads during use, must be reconditioned or replaced as necessary. Broken or fractured handles on hammers, axes and similar equipment must be replaced promptly. Worn or bent wrenches should be replaced regularly. Appropriate handles must be used on files and similar tools. Check your tools often for wear or defect. Jacks must be checked periodically to assure they are in good operating condition. Tool handles must be wedged tightly into the heads of tools. Tool cutting edges should be kept sharp enough so the tool will move smoothly without binding or skipping. When not in use, tools should be stored in a dry, secure location.

8.20 Compressed Gas & Cylinders

(Reference Conti SOP14, Compressed Gas Cylinder(Welding and Cutting) Procedures)

Cylinders must be legibly marked to identify clearly the gas contained. Compressed gas cylinders should be stored only in areas, which are protected from external heat sources such as flame impingement, intense radiant heat, electric arcs or high temperature lines. Cylinders must be stored or transported in a manner to prevent them from creating a hazard by tipping, falling or rolling. Valve protectors must always be placed on cylinders when the cylinders are not in use or connected for use. All valves must be closed off before a cylinder is moved, when the cylinder is empty, and at the completion of each job.

8.21 Welding and Cutting

(Reference Conti SOP14, Compressed Gas Cylinder (Welding and Cutting) Procedures)
(Reference Conti SOP 21, Fire Prevention and Protection Procedures)

Compressed gas cylinders should be regularly examined for obvious signs of defects, deep rusting, or leakage. Use care in handling and storing cylinders, safety valves, relief valves and the like, to prevent damage. Precaution must be taken to prevent mixture of air or oxygen with flammable gases, except at a burner or in a standard torch. Only approved apparatus (torches, regulators, pressure-reducing valves, acetylene generators, manifolds) may be used. Cylinders must be kept away from sources of heat. It is prohibited to use cylinders as rollers or supports. Cylinders, cylinder valves, couplings, regulators, hoses and apparatus must be kept free of oily or greasy substances. Care must be taken not to drop or strike cylinders. Unless secured on special trucks, all regulators must be removed and valve-protection caps put in place before moving cylinders. Before a regulator is removed, the valve must be closed and gas released from the regulator.

The open circuit (No Load) voltage of arc welding and cutting machines must be as low as possible and not in excess of the recommended limits. Under wet conditions, automatic controls for reducing no-load voltage must be used. Grounding of the machine frame and safety ground connections of portable machines must be checked periodically. Electrodes must be removed from the holders when not in use. All electric power to the welder must be shut off when no one is in attendance. Suitable fire extinguishing equipment must be available for immediate use before starting to ignite the welding torch. All connecting cable lengths must have adequate insulation. When the object to be welded cannot be moved and fire hazards cannot be removed, shields must be used to confine heat, sparks and slag.

The Hot Work Permit Procedures will be followed, as required. Fire watchers will be assigned when welding or cutting is performed in locations where a serious fire might develop. All combustible floors must be kept wet, or protected by fire-resistant shields. When floors are wet down, personnel should be protected from possible electrical shock. When welding is done on metal walls, precautions must be taken to protect

combustibles on the other side. Before hot work is begun, used drums, barrels, tanks and other containers must be so thoroughly cleaned that no substances remain that could explode, ignite or produce toxic vapors. Employees exposed to the hazards created by welding, cutting or brazing operations must be protected with personal protective equipment and clothing. Check for adequate ventilation where welding or cutting is performed. When working in confined spaces, environmental monitoring tests should be taken and means provided for quick removal of welders in case of emergency.

8.22 Scaffolds

(Reference Conti SOP 34, Scaffolds Procedures)

Scaffolds over six (6) feet in height will have guardrails 42" from the bottom platform with a midrail and toeboards 4" high. Screw jacks will be used to level the scaffold rather than objects such as concrete blocks, loose bricks, etc. Scaffold legs will be braced and tied to structure every 30' in length and 26' in height. Scaffolds should not have makeshift devices or ladders to increase height. Working level platforms will be fully planked between guardrails, and have a minimum of 12" overlap and extend 6" beyond supports. There should be guard netting around the scaffolding if there is a risk of materials falling from the scaffold onto someone below and/or barricades around the scaffolding to prevent anyone from being in the zone below it. The use of scaffolding is not anticipated during remedial activities at Landfill 7.

8.23 Ladders

(Reference Conti SOP 27, Stairway and Ladder Procedures)

Check ladders each and every time before you climb. Ladders should be maintained in good condition: joints between steps and side rails should be tight; hardware and fittings securely attached; and movable parts operating freely without binding or undue play. Non-slip safety feet are provided on each ladder. Ladder rungs and steps should be free of grease and oil. Employees are prohibited from using ladders that are broken, missing steps, rungs, or cleats, or that have broken side rails or other faulty equipment. It is prohibited to place a ladder in front of doors opening toward the ladder except when the door is blocked open, locked or guarded. It is prohibited to place ladders on boxes, barrels, or other unstable bases to obtain additional height. Face the ladder when ascending or descending. Be careful when you climb a ladder. When portable rung ladders are used to gain access to elevated platforms, roofs, etc., the ladder must always extend at least 3 feet above the elevated surface and secured. It is required that when portable rung or cleat type ladders are used, the base must be so placed that slipping will not occur, unless it is lashed or otherwise held in place. All portable metal ladders must be legibly marked with signs reading "CAUTION" - "Do Not Use Around Electrical Equipment." Only adjust extension ladders while standing at a base (not while standing on the ladder or from a position above the ladder). Metal ladders should be inspected for tears and signs of corrosion. Rungs of ladders should be uniformly spaced at 12 inches, center to center.

8.24 Floor and Wall Openings

(Reference Conti SOP 20, Fall Protection Program)
(Reference Conti SOP 36, Signs, Signaling, Tags and Barricade Procedures)

Be careful when working near floor and wall openings. All floor openings (holes) should be guarded by a cover, guardrail or equivalent barrier on all sides except at the entrance to stairways and ladders. Toe boards must be installed around the edges of a permanent floor opening. Before beginning work at a new location, inspect it to insure that all floor openings, which must remain open, such as floor drains, are covered with grates or similar covers.

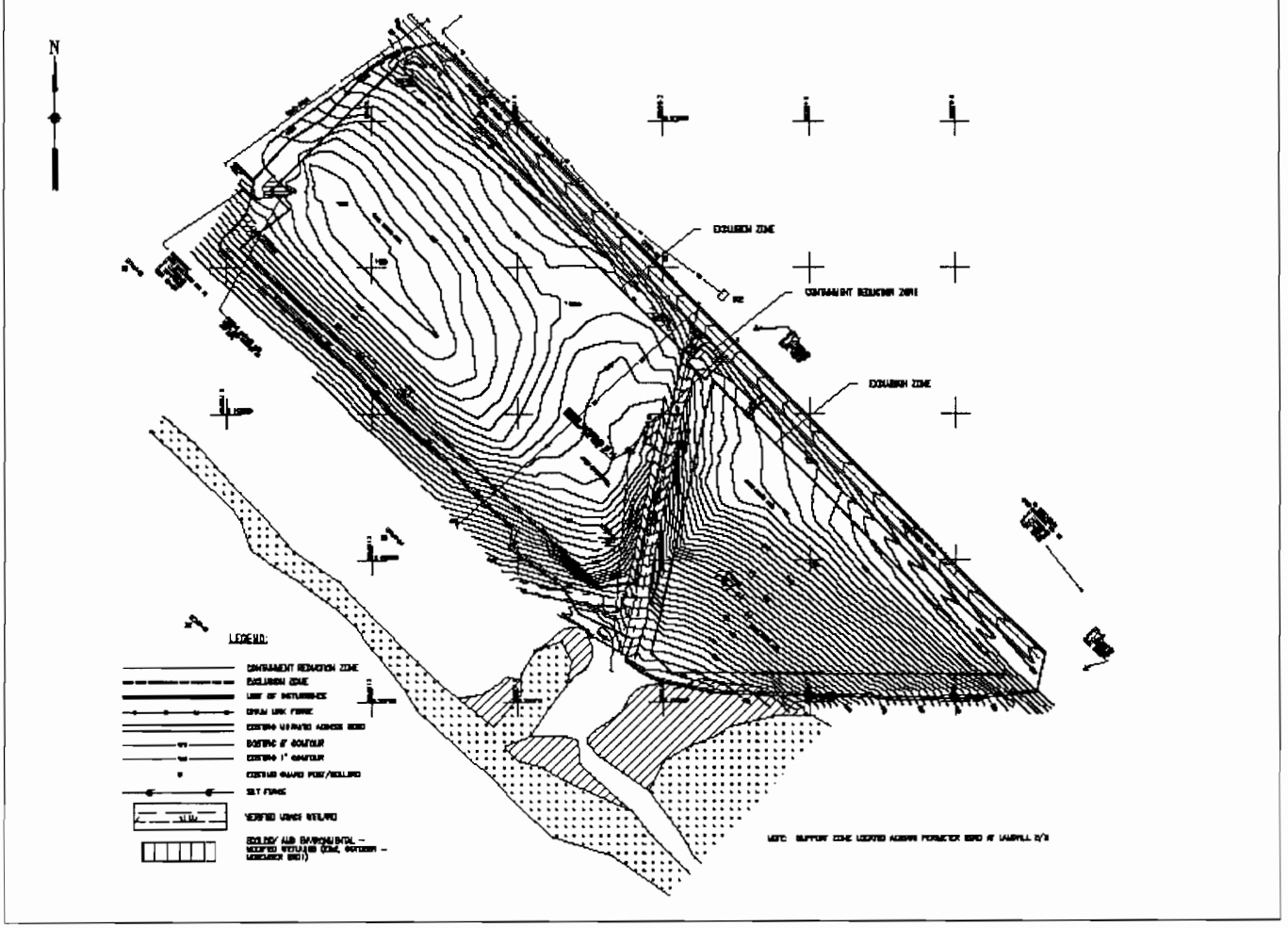
9.0 SITE CONTROL MEASURES

This section outlines site control measures to be implemented to minimize potential exposure to and accidental spread of hazardous substances during remedial activities. Listed below are the work zones that shall be established. The zone boundaries may be modified as necessary as new information becomes available.

9.1 Work Zones

The Site will be divided into Exclusion, Contamination Reduction and Support Zones. It should be recognized that the Site control zones will be modified continually. A map showing the work zones will be updated daily and posted in the Site office. The SSHO will review the location of work zones at the daily safety briefing. Refer to ***"Figure 3 – Site Layout Plan"***.

Figure 3 – Site Layout Plan



The SSHO and at least one person who has completed Supervisor's Training will be present at the Site whenever work is performed in the Exclusion Zone or Contamination Reduction Zone. Similarly, at least two First aid/CPR-trained individual will be present at the Site when work is performed in those zones.

9.1.1 Exclusion Zone (EZ)

This zone, commonly known as the Hot Zone, is where there will be direct contact with the potentially contaminated material. PPE shall be required in this zone. The SSHO shall enforce these requirements. The level of PPE required shall be based on hazard, Site condition and air monitoring performed. The outer boundary of the Exclusion Zone will be delineated with orange safety fence. The Exclusion Zone specifically consists of the perimeter of Landfill 7. Modification to the size and boundary of the Exclusion Zone will be made in the field by the SSHO based on operations and wind direction. The Exclusion Zone may be subdivided into different areas of contamination and different levels of PPE may be assigned based upon the expected type and degree of hazard.

All activities in exclusion zone will be conducted using the "buddy system". This involves a buddy who is able to provide his or her partner with assistance, observe for signs of chemical or heat exposure, check integrity of PPE and go for help when needed.

9.1.2 Contamination Reduction Zone (CRZ)

This zone, commonly known as the Warm Zone, is where workers and equipment shall be decontaminated. This shall minimize the spread of contaminants from the Exclusion Zone into clean areas. The Contamination Reduction Zone will consist of the area located in front of or next to the exclusion zone so that personnel or equipment exiting the EZ can be decontaminated and doff the PPE. Emergency equipment to be located in this area will include eye wash stations, fire extinguishers, first aid kits and other appropriate equipment. The Contamination Reduction Zones or personal decontamination stations will be established adjacent to the Exclusion Zones. These stations will provide a means for prompt removal of potentially contaminated outer PPE at a location convenient to operations.

9.1.3 Support Zone

This zone, commonly known as the Clean Zone, is considered to be uncontaminated. This area shall be used as a storage area for operations equipment and where break and toilet and shower facilities will be located.

9.2 Site Entry and Exit Control Log

All site personnel on this project will undergo safety orientation by the SSHO prior to starting work at the site. This training will include general site safety rules, hazardous locations, personal protective equipment guidelines, and onsite emergency procedures. All site personnel will satisfy the following requirements before initiating work onsite within the Exclusion or Contamination Reduction Zones:

- Receive and pass a physical examination, including certification of ability to wear respiratory protection.
- Receive adequate hazardous waste training according to 29 CFR 1910.120 or 29 CFR 1926.65.
- Receive a briefing on all aspects of the SSHP.
- Are properly dressed, equipped, and trained in accordance with all personal protective guidelines.
- Are thoroughly trained regarding decontamination procedures.
- All personnel performing tasks when respiratory protection is needed will comply with the requirements of this plan

All personnel entering and exiting the Exclusion and Contamination Reduction Zones will sign in and out through the Support Zone. The log will indicate the date and time entering and exiting, the location entered,

personal protective equipment utilized and decontamination procedures, refer to ***Attachment 3 – Safety and Health Forms for the Site Entry and Exit Log.***

10.0 PERSONAL HYGIENE AND DECONTAMINATION

Decontamination (Decon) is the process of removing or neutralizing potentially harmful contaminants that have accumulated on personnel and equipment in order to reduce the spread of contamination outside the work area. Decontamination is critical to the Safety and Health of Site workers and it protects the community by minimizing the off-site migration of contaminants. One of the most important aspects of controlling contaminated material migration is the prevention of the spread of contamination. Good contamination prevention will minimize employee and public exposure.

All personnel and equipment leaving the Exclusion Zone must be decontaminated in the Contamination Reduction Zone prior to entering the Support Zone. The decontamination process is composed of a series of steps performed in a specific sequence. The basic concept is that more heavily contaminated items will be decontaminated and removed first, followed by decontamination and removal of inner, less contaminated items.

During remedial activities at the Site, all items taken into the Exclusion Zone must be considered contaminated and must be carefully inspected and/or decontaminated before leaving the Site. All contaminated vehicles, equipment and material shall be cleaned and decontaminated to the satisfaction of the SSHO prior to leaving the Site. Decontamination procedures will be posted at every decontamination station throughout the project.

10.1 Personal Decontamination

Personnel exiting the Exclusion Zone during remedial activities at the Site shall follow the procedure below.

As the worker leaves the Exclusion Zone, he places his equipment and tools in the Exclusion Zone or Contamination Reduction Zone. After the worker places his equipment and tools down, gross contamination will be removed from outer clothing and boots. Workers will then remove their outer boots and outer gloves and place them in plastic garbage bag-lined containers.

Once outer gloves are removed, workers will remove all outer garments and place them in plastic garbage bag lined containers. Once workers are fully decontaminated and all garments are removed, workers will remove their respirators (applicable to level C) followed by removal of inner gloves. Used cartridges and inner gloves will be placed into plastic garbage bags.

All decontamination stations will be established on (2) - 6 mil. plastic sheets, covered with approximately 2 inches of stone. The stone will be replaced of as often as is deemed appropriate.

10.2 Respirator Decontamination

Respirators are to be decontaminated, cleaned and sanitized before reuse. Cartridges and/or filters must be replaced as needed and, as a minimum, changed daily. The respirators are then cleaned with cleaning and sanitizing solutions, wiped dry and placed into sanitary containers or bags and sealed closed.

10.3 Equipment Decontamination

Nearly all contractor hardware (not consumable) is considered to be recoverable. As such, they will be decontaminated using the proper equipment, i.e. brushes, sprayers, detergent and, if necessary, other appropriate solvents. Large heavy equipment will be decontaminated with pressure steam wash as required.

The decontamination area for vehicles and equipment leaving the Exclusion Zone will be located within the Contamination Reduction Zone. Equipment will be decontaminated over 2 layers of 6-mil plastic placed on the ground. Scrapers and brushes will be used to remove gross contamination prior to final decontamination. A pressure steam cleaner will be used for the final cleaning and decontamination of the equipment. The combination of dry removal with the brushes and use of the steam cleaner will minimize the generation of contaminated liquid. All solids and liquids will be collected for disposal. Efforts will be made to minimize soil (even non-contaminated soil) from being tracked off-site. Dirt and mud will be removed from trucks and vehicles leaving the Site to the extent practicable.

10.4 Decontamination Log

A decontamination log will be maintained and will list the equipment name and model number, the equipment I.D. number, the activities the equipment was used for, the method of decontamination, amount of decontamination, date and time of decontamination and names of personnel doing the decontamination. This log will be maintained by the SSHO and included in the Safety and Health Report. Refer to ***Attachment 3 – Safety and Health Forms for the Equipment Decontamination Log.***

10.5 Decontamination Residue

Decontamination residue consists of disposable PPE (such as Tyvek, gloves, tape and cartridges) and settled solids. Decontamination residue will be drummed and stored in the Exclusion Zone until subsequent disposal or shipment to a disposal facility.

10.6 Personal Hygiene and Sanitation

Hands and face shall be thoroughly washed before eating, smoking, drinking, chewing gum or tobacco.

When possible, avoid contact with contaminated materials.

Temporary support facilities such as wash facilities, eating areas, changing areas, and portable toilets will be located in the Support Zone. This area will remain "clean" and free of contamination.

An adequate supply of potable water will be provided to the employees working at the Site. Clearly labeled potable containers will be used to dispense drinking water. Containers will be cleaned at the beginning of each day. The containers will be equipped with taps to access the water. Clean disposable cups will be provided daily.

Portable toilet facilities will be provided on-site for employees and will be located in the Support Zone.

Eating, drinking, smoking, chewing gum or tobacco or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited during remedial activities except in designated eating or smoking areas outside the Exclusion and Contaminant Reduction Zones. Conti employees, subcontractor

employees, and service personnel are required to thoroughly decontaminate themselves prior to entering the Support Zone.

11.0 EMERGENCY CONTINGENCY PLAN

This section describes the emergency response plan that shall be implemented by Conti employees to handle emergencies. The nature of the project, the contaminants present and the activities planned for the site are such that there is little potential for an emergency, which would result in a significant release of hazardous substances, and in any way threaten the adjoining community. However, there is always the potential at any construction site for emergency situations to occur which threaten the on-site workers. Possible examples of emergency situations during remedial activities include equipment fires, or contact of equipment with overhead power lines. In all of these cases, procedures will be implemented to minimize the possibility of an emergency situation. The procedures outlined below are designed to ensure that the workforce reacts quickly and appropriately to emergency situations, thereby protecting the health and well being of the individual workers. It is expected that modifications may be necessary upon actual site set-up and conditions. Furthermore, Conti Environmental's Corporate Safety, Health and Environmental Program and Procedures Manual include Conti's Corporate Emergency Action Plan Policy and Guideline for Handling Emergencies.

11.1 Pre-Emergency Planning

During the site safety briefings held daily, all employees will be informed of the location of this plan, the procedures outlined in this plan, and the communication systems and evacuation routes to be used during an emergency.

On a continual basis, individual personnel should be constantly alert for indicators of potentially hazardous situations and for signs and symptoms in themselves and others that warn of hazardous conditions and exposures. Rapid recognition of dangerous situations can avert an emergency.

A coordination meeting with local emergency response agencies (fire, police, rescue and medical facility) will be conducted prior to work starting at the site. The site activities and potential hazards that may be encountered by responders will be reviewed during this meeting.

11.2 Personnel Responsibilities

All on-site employees have a role in mitigating an emergency incident. The Project Superintendent has primary responsibility for responding to and directing emergency response operations to correct emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public. He is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The SSHO shall assist and advise the Project Superintendent, and will direct any emergency medical responses.

The following is an outline of job titles and corresponding responsibilities during an emergency.

- The Site Superintendent directs emergency response activities; serves as liaison with appropriate Client and Client representatives personnel and subcontractors. In the event of an emergency the Project Superintendent will be the Incident Commander.

- The Site Safety and Health Officer recommends that work be stopped if any operation threatens worker or public health or safety. Advises Site Manager of emergency procedures if necessary. Provides emergency

medical care on site. Notifies emergency services. The SSHO will assume the responsibility of Incident Commander if the Project superintendent is off-site.

11.3 Evacuation Routes and Procedures

In the event of an emergency that necessitates an evacuation of the site, on-site personnel shall be notified by hand-held or mobile two-way radios to leave the area by immediate emergency exit. An alternate method of communication will be the use of a portable air horn sounded in regularly spaced, repeated blasts.

During an evacuation, all non-emergency radio transmissions shall cease. The SSHO, in conjunction with the Project Superintendent, shall control the scene until the appropriate municipal and state agencies arrive and a site specific Incident Command System (ICS) should be implemented. Since site conditions, i.e., wind direction, precipitation, and work location, change often, the SSHO will determine the appropriate evacuation procedures.

All personnel shall assemble/muster at the Contamination Reduction Zone (CRZ) or Support Zone. Access to the site will be restricted. All non-emergency radio transmissions shall cease.

11.4 Emergency Decontamination Procedures

Decontamination of an injured or exposed worker will be performed if decontamination does not interfere with essential treatment. The objective is to successfully administer first aid without exposing rescue workers and the victim to contaminants. Project personnel will meet with the local hospital to discuss the possibility of having to treat injured personnel from the site.

If the hazards are low and decontamination can be performed, then a wash, rinse and removal of protective clothing will be performed.

If the hazards are high and decontamination cannot be done, then the following procedures will be performed:

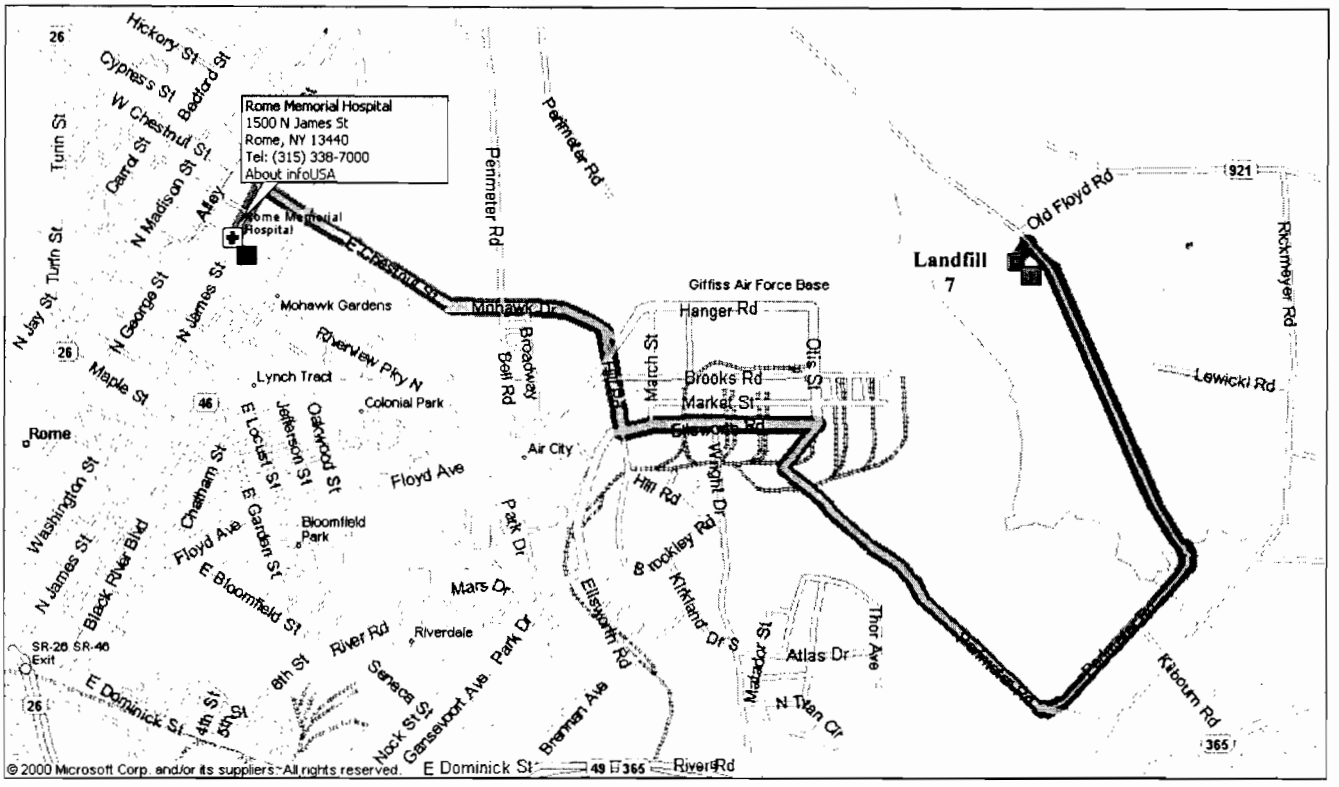
- Wrap the victim in blankets or plastic sheeting to reduce contamination of rescue workers or other personnel.
- Alert emergency and medical personnel to potential contamination. Emergency entry into the exclusion zone will be controlled by the SSHO. The SSHO will determine if the victim can be moved from the exclusion zone. If entrance into the exclusion zone is required, the SSHO will ensure that the emergency workers don the proper PPE.
- If required, arrange to have the SSHO, who is familiar with the site to accompany the victim to the hospital if required.

11.5 Medical Treatment/First Aid

Both the Site Superintendent and the Site Safety and health Officer are trained in CPR and First Aid and have first aid kits for use in a medical emergency. First Aid Kits will be located in the main support area, Contamination Reduction Zone and at the work activity locations. Eyewash stations will be available at the Contamination Reduction Zone. Eyewash stations will be of the pressurized, 15-minute discharge type. On-site employees have a basic knowledge of first aid and will assist the Site Superintendent and SSHO. Community emergency services (EMS, Fire, and Police) shall be notified immediately if their resources are needed on site.

If necessary, the injured or sick party shall be taken to Rome Memorial Hospital– Please refer to ***Figure 3 – "Route to Hospital Map" and Attachment 3–Safety and Health Forms*** for directions to the area hospital. Route to the area hospital will be posted and easily visible at all times.

Figure 4 - Route to Hospital Map



Direction to Rome Memorial Hospital: Turn RIGHT onto Perimeter Rd, Turn RIGHT onto Perimeter Rd, LEFT (West) onto Ellsworth Rd, Turn RIGHT (North) onto Hill Rd, Bear LEFT (North-West) onto Mohawk Dr, Bear RIGHT (West) onto E Chestnut St, Turn LEFT (South) onto N James St, and Arrive Rome Memorial Hospital [1500 N James St, Rome, NY 13440, Tel: (315) 338-7000]

11.6 Emergency Alarms/Notifications and Procedures

When any emergency occurs on-site, the on-site SSHO and Project Superintendent shall be notified immediately. The Project Superintendent or the SSHO shall notify the client and his representatives. Please refer to the ***Table 10 – "Emergency Telephone Numbers" and Attachment 3 – Safety and Health Forms*** for emergency telephones. Emergency Telephones will be posted and easily visible at all times.

To notify any site workers of an emergency, workers can be signaled by way of hand held or mobile two-way radios or as a backup, the use of an emergency alarm (portable air horn). Any audible pattern of blasts from a portable air horn becomes difficult to interpret due to distance and the inhibitory effects of a respirator.

All emergency communications will flow through the radio network. Outside emergency services will be notified, as necessary. The site evacuation alarm consists of one long blast on a horn, every 10 seconds. Any time the alarm system is activated; on site personnel will be notified immediately. Personnel will extinguish any nearby ignition source and prepare for emergency response activities. This alarm will also be used to alert personnel of a sudden release of hazardous materials.

Table 10 – Emergency Telephone Numbers

Police Department:	
Emergency	911
Rome Police Department	315-339-3311
Fire Department:	
Emergency	911
Rome Fire Department	315-339-7784
Ambulance Services:	
Emergency	911
Amcare Ambulance Service	315 339-5600
HAZMAT Team:	
Emergency	911
Rome Fire Department (HAZMAT TEAM)	315-339-5600
Hospital:	
Rome Memorial Hospital 1500 N James St, Rome, NY	315 338-7000
Occupational Physician:	
Environmental Occupational Specialist (EOSI) Dr. Robert MacMillan	508-698-0444
Conti Environmental, Inc.:	908-561-9025
James Stewart, V.P. of Operations	908-307-1527 (Cell) / 732-363-9417 (Home)
John Czapor, V.P. of Environmental Services	732-989-3314 (Pager) / 732-972-3326 (Home)
Aldo M. Gonzalez, Safety and Health Manager	908-403-6237 (Cell) /212-929-8683
Tom Hernon, Project Manager	732-873-3015 (Home)
Richard Hamlin, Project Superintendent	
Kenneth Shultz, Site Safety and Health Officer	716-737-7579 (Cell) 732-916-6521 (Pager
SCI UXO/OE Services (UXO Support) Leo Carden PE, Project Engineer Doug Lamothe, Director Of Services Cheryl Riordan, Safety Manager	256) 864-0018
US Army Corp of Engineers	
Joseph Wojnas, Project Engineer	315-330-7368
William G. Ebersbach, Resident Engineer	315-772-4103
Phil Rosewicz, Project Manager (Kansas City District)	816-938-3902
Griffiss Air Force Base	
Mike Wojnas, Environmental Engineer (AFBCA)	315-330-2275
Cathy Jerrard, Environmental Engineer (AFBCA)	315-330-2275
NYS Department of Environmental Conservation	
Emergency Spill Hotline Phone Number	800-457-7362
National Response Center	800-424-8802
CHEMTREC	800-424-9300

The observer of the emergency condition will brief the responding personnel as to the nature and location of the incident. When they have assessed the situation, a decision whether or not to implement these procedures will be made. If these Emergency Contingency Procedures are not implemented, the "All Clear" will be given verbally by supervisory personnel. The "All Clear" will be used to indicate a return to normal (non-emergency) conditions following emergency response activities. The alarm signals will be prominently posted at the site. The audible alarm system will be discussed with each resident within hearing range of the alarm system.

11.7 Implementation Of The Plan

There is a logical sequence of steps to follow in responding to emergencies, which should be followed by site personnel. This sequence involves identifying the emergency, investigating the extent of the emergency, deciding on the proper initial course of action, taking corrective action to rectify the situation, and following up with a post-emergency investigation.

Equipment breakdowns, power failures, injuries and natural disasters are usually rather dramatic and will capture the individual's attention immediately upon occurrence. In other cases, the individual may have prior warning of impending emergencies through weather reports in the case of natural disasters and trends in equipment performance in the case of some breakdowns.

Some emergency situations exist long before the operator is aware that an emergency exists. These cases may produce situations, which then become immediate and obvious. For example, unattended equipment may have minor breakdowns which go unnoticed; further operation thus leading to complete breakdown of the equipment resulting in possible injury to the unwary bystander.

In the event of a fire, explosion, accidental material release, or any other emergency, response activities will be initiated following the evaluation of the event. An assessment of the situation will be performed by the SSHO immediately upon notification. The Superintendent/SSHO is authorized to commit resources to the extent detailed in this plan. If it is determined that an emergency situation exists, he will then implement the appropriate emergency response activities.

In the event that a medical emergency or accident occurs in the Exclusion Zone, all personnel responding to the emergency should be outfitted in the Personal Protective Equipment appropriate for the situation. As a general rule, personnel should not enter the Exclusion Zone without donning the minimal level of PPE required. In the event that a worker is overcome or disabled for an unknown reason, the Superintendent/SSHO must make a determination as to the level of respiratory protection, which is appropriate. Specifically, a determination must be made as to whether Supplied Air Respirators are necessary for the protection of the responders.

11.7.1 Conditions for Implementation

The contingency plan will be activated by the Superintendent/SSHO immediately, in the event of a fire or explosion, or emissions of toxic chemicals in excess of limits set forth by Federal, State, and local agencies. In the event of a spill or material release, it will be up to the Superintendent/SSHO to make a determination as to when emergency conditions exist, as opposed to routine maintenance of the site. His determination will depend upon the location of the spill, the size of the spill, weather conditions and the proximity of the release to workers, the community and environmental receptors.

Once it becomes apparent that an emergency situation exists or that a disaster is impending, the Project Superintendent or his designee should immediately be notified and an immediate investigation conducted. Assessment of the emergency should include assessing the severity of the situation and collecting enough information to make an initial action decision.

Assessing the emergency should include identifying injured persons (if any), damage to buildings and equipment, noting potential impending damage if corrective action is not taken immediately, and itemizing resources required to correct the situation.

11.7.1.1 Fire or Explosion

Although the potential for fire or explosion is minimal, sources of risk do exist. These sources include welding gases, gasoline for portable equipment, diesel fuel for the heavy equipment and combustible debris. In the event of an explosion, possible emergency conditions would exist. Unless extinguished immediately, a fire or explosion will trigger implementation of these procedures.

11.7.1.2 Material Spills

Material Spills could occur during truck loading and from vehicle accidents. Additionally, equipment fueling operations could produce spills. Ultimately, a spill could contaminate receiving surface water or cause a release of vapors to the air. A spill of fuel could also ignite. A small spill should be cleaned up immediately, but should not trigger activation of these procedures. Should an on site spill occur, the immediate response will include closing off the source of the spill, if possible, application of the sorbent material or sand bagging, and street sweeping, as appropriate. Any spill that results in a discharge to off site surface water will be contained with sorbent booms as needed. All spills will be investigated, and a written report will be provided to the regulatory agencies in accordance with applicable regulations.

11.7.1.3 Severe Weather

In the event of severe weather, the Site Superintendent and/or the HSO have the authority to stop operations and direct evacuation procedures, if conditions warrant. All equipment will be secured and grounded. After the storm, a visual inspection will be performed by the Superintendent and/or the HSO to check for damage and hazards. These will be performed before any work is resumed. If damage or hazards are noted, the designated or other Conti personnel will evaluate the conditions and implement corrective actions to repair the damage or eliminate the hazard. These actions will begin as soon as possible and will take precedence over other site activities.

11.7.2 Initial Action

Once the extent of the emergency is known, the Superintendent and the SSHO will make an immediate decision as to what initial steps should be taken to remedy the emergency situation. This first action, in the case of large-scale emergencies, usually consists of notifying responsible authorities and/or calling for the necessary assistance in order of priority.

The individual(s) should not unduly endanger him or herself or others by attempting tasks for which the proper equipment is not available or with which he or she is unfamiliar. In all cases, if in doubt, wait until qualified help arrives before taking action.

11.7.3 Corrective Action

When help arrives, the site superintendent/SSHO should immediately inform those called of the pertinent details of the situation. Corrective action should be continued until the situation is either under control or completely rectified. If corrective actions will take considerable time, a long-term effort to complete the task should be developed.

11.7.4 Follow-through

After the situation is corrected, the cause of the emergency event is to be determined and review of the corrective actions taken, etc. In the case of equipment failure, if negligence was not a factor, then revising maintenance procedures would be the most likely first preventive step. For natural disasters that cannot be prevented from recurring, the procedures followed in dealing with them can be reviewed to develop more effective action plans. The entire event, along with all of the responses, will be thoroughly documented for review by management and project supervisory personnel.

11.8 Spill Response and Control Plan

The purpose of this section is to define practices and procedures for the prevention, containment and cleanup of accidental discharges of hazardous substances during the project. These substances include both the contaminated material managed as a result of the remedial project, such as contaminated soils and decontamination liquids, and construction materials typically found on any construction site, such as lubricating fluids, diesel fuel, gasoline, etc.

Spill prevention applies to all types of spills and can be described as the first and simplest approach to spill control. Human error is a major contributing factor to spills and releases. An awareness of spill consequences, preventive measures and countermeasures will greatly reduce spill occurrences. A sound prevention program includes careful work practices, constant inspection, and immediate notification and correction of deficiencies. In the event that a spill does occur, proper containment and cleanup procedures must then be followed in order to reduce the effect of the spill.

11.8.1 Prevention

Prevention of unnecessary spills is of first priority. Prevention measures include:

- Operators and drivers will exercise extreme caution when transporting material around the site.
- When removing hoses from machines an appropriate and adequate supply of absorbents will be on hand. A supply of the following absorbents will be kept on-site: oil sorbent booms, rolls and pillows, universal towels and sheets and vermiculite.
- Hoses will be capped when not connected to their appropriate fitting.
- All containers will be inspected daily for decay. No open container shall be exposed to rainfall, snowfall, etc. without being emptied and cleaned of residue.
- All equipment will be inspected for leaks before and after service.
- Storage of material such as fuels, oils, and solvents on-site will be limited to the minimum required. All fluids will be stored in individual fluid containers appropriate and approved for the material. Most of the individual fluids containers will be further secured by storage in large, locked tool and equipment storage containers. Drums or other containers too large to be stored in containers will be stored raised off the ground on a liner and covered by plastic.

11.8.2 Reporting

All spills will be reported immediately to appropriate field and office management personnel. The sequence of reporting will be as follows:

- Notification by workers to the Project Superintendent or Site Safety and Health Officer.
- The Project Superintendent or Safety and Health Officer will immediately notify the Contracting Officer Representative regardless of the size of the spill.
- Conti Environmental, and the Contracting Officer Representative will jointly determine the nature of the spill, its size, direction of travel, if anyone has been injured as a result of the spill and whether it requires immediate notification to regulatory agencies.
- The Contracting Officer Representative will have primary responsibility for notifying the regulatory agencies. Conti will have follow-up responsibility to verify that the notification is made in a timely manner.
- If a reportable spill occurs and the COR (or AFBCA) cannot be immediately reached, Conti will primary responsibility to report the spill to the regulators (reportable spills will be called into the NYSDEC spill hotline within two hours of the incident and a spill number obtained).

- A full list of emergency contacts and telephone numbers is included this plan. This list includes Conti personnel as well as federal, state and local authorities. This list will be posted in all trailers on-site.

Upon notification of a spill, all project activity will be immediately suspended and all necessary equipment and personnel will be diverted to spill control and containment. In the event of a spill, and regardless of the size, a Spill Incident Report will be submitted to the Contracting Officer Representative with a copy to the USEPA and NYSDEC within 48 hours of the incident.

11.8.3 Spill Response Equipment

Given the nature of this project, all the necessary equipment and personnel necessary to deal with a release of hazardous substances will be available on site. In addition to the heavy equipment and personal protective equipment, which is critical to spill control, Conti will have on hand an ample amount of sorbent materials, UN1A2 open top drums and overpacks.

11.8.4 Confinement and Containment

Prior to entering a spill area, all workers must be protected from any adverse effects of the spilled material. No one will enter any spill area alone. The Site Safety and Health Officer will determine the level of protection required for response activities. To the extent practicable, the area will immediately be cordoned off and, if appropriate, exclusion, contamination reduction and support zones will be established.

The decision to use confinement techniques such as diversion, diking and retention, are generally based on time, personnel, equipment and supplies. As mentioned above, all necessary resources will be available on-site at all times. To the extent the nature of the material is known, the decision should be made based upon a review of the harmful effects of the material. In the event of a large migrating spill, an unlikely circumstance, diversion techniques, such as placing a soil wall or absorbent boom ahead of the spill, shall be implemented first. Subsequently, diking techniques, such as using material such as sand covered with liner material (PVC, hypalon) should be implemented.

11.8.5 Cleanup

Once a spill has been contained and the source of the spill corrected and controlled, cleanup can begin. Spill cleanup can proceed at the same time as containment if feasible. Supervisory personnel will determine the appropriate cleanup methods. The Site Safety and Health Officer will determine the appropriate level of protection depending upon the nature of the material.

- The first action will be to absorb free liquids with absorbent pads, booms, pillows, or clay. The absorbent material will be placed in drums and moved to an appropriate storage location. Subsequent to the removal of free liquids, soil believed to be contaminated will be excavated and containerized in drums or stockpiled on poly sheeting and covered for further testing.
- Dry spills, while posing less of a risk of migration, will still require appropriate and immediate action. The nature of the spilled material will be ascertained. The spilled material will be recovered for reuse if appropriate. Material which cannot be recovered and residual contaminated soil will be shoveled into 55-gallon drums, placed in the drum storage area and sampled and analyzed for waste characterization and disposal.
- Once containerized, Conti Environmental will provide for the appropriate sampling and analysis for waste characterization and disposal facility acceptance. Results of waste characterization analysis, waste profiles and manifests will be provided to the Construction Representative for review.

- All spilled material and visually contaminated soil will be excavated and containerized in the initial spill response. If there appears to be a possibility that contaminants have migrated into the surrounding soil, post-remedial sampling will be initiated. Soil samples will be taken from the areas of suspected contamination and analyzed for the compounds, which were released.

Personnel Decontamination - In general, all spill response operations will be performed in accordance with the provisions of the approved Site Safety and Health Plan.

11.9 Report/Review

A written report shall be made within 24 hours of incident resolution. The Contracting Officer Representative will be provided with a copy. In addition, all key personnel will have a meeting within 48 hours of the incident to discuss and critique all of the aspects of the Emergency Contingency Plan according to new site conditions and lessons learned.

12.0 INSPECTION AND REPORTING

12.1 Safety and Health Inspections

Safety and Health inspections will be conducted to discover, through specific, methodical auditing, checking, or inspection procedures, conditions and work practice that lead to job accidents and illnesses.

The Health And Safety Manager shall be responsible for ensuring that inspections are conducted at the frequency stated; reviewing the Daily Safety and Inspection Logs for completeness, thoroughness, and trends; performing bi-monthly project inspections; and training site personnel on proper inspection techniques. The Health and Safety Officer shall be responsible for ensuring that daily inspections are conducted; reviewing the inspections findings and corrective actions for applicability and thoroughness; and providing the site management personnel with a summary of inspection findings each month.

The Site Safety and Health Officer will develop a safety report based on the deficient inspection items noted during the inspection and conveying the deficiencies to the CQCSM via a Non-compliance Identification / Corrective Action (NICA) Report (refer to Appendix H of the Quality Control Plan). The CQCSM will enter the deficiencies a master deficiency-tracking log. The CQCSM and the SSHO will discusses the existence of the deficiency with the appropriate work force individual(s) responsible for its correction. A corrective plan of action is developed and implemented following USACE approval, if needed. Deficiencies are tracked in accordance with the Quality Control Plan.

12.2 Daily Safety and Inspections Log

The SSHO shall insure that all aspects of the SSHP are complied with on a daily basis. Only one warning shall be given to individuals not complying with the SSHP. The SSHO has the authority to shut the work down and ban any individual from the Site. If deficiencies are noted, they will be recorded on the Daily Safety and Inspection Log and will be corrected immediately. The Daily Safety and Inspection Log will be attached to the Daily Quality Control Report. The Daily Safety and Inspection Log will include the date, work area, employees present at the work area, PPE and work equipment in each area, specific safety and health issues and notes and the signature of the preparer. Refer to ***Attachment 3 – Safety and Health Forms for the Daily Safety and Inspection Log.***

12.3 Certification of Worker/Visitor Acknowledgment

A Certification of Worker/Visitor Acknowledgment will be submitted to the Contracting Officer prior to initial entry onto the Site. The certification/acknowledgment will include both formal, field and site-specific training received, personal protective equipment supplied and trained in use, and medical certification. Certificates and Medical certification will be kept on file at the site. Refer to ***Attachment 3 – Safety and Health Forms for the Certificate of Worker/Visitor Acknowledgement.***

12.4 Incident Reports

Incident reporting will ensure an immediate report on all incident/accidents and to provide an effective follow-up for corrective action in order to eliminate unsafe practices and unsafe conditions. An **Incident/Accident Form** must be completed within 24 hours of the Incident/Accident. This report is utilized in the event of injuries, off-site releases, utility breaks, or accidents. Immediately following the incident/accident, the Site Superintendent and the Site Safety and Health Officer will initiate and Incident/Accident Investigation. An Accident Report shall be completed on ENG Form 3394 ands submitted to the Contracting Officer with in 2 days. ***Refer to Attachment 3 – Safety and Health Forms for the Incident/Accident Form and USACE ENG-3394 Accident Report.***

"Near misses" will be documented by the Site Safety and Health Officer and discussed at the morning safety briefings to educate the work force to potentially hazardous operations or practices.

Copies of Conti Environmental's OSHA 300 Log, that summarizes recordable injuries and lost-time accidents, will be submitted to the Contracting Officer monthly. ***Refer to Attachment 3 – Safety and Health Forms for the OSHA 200 Log.***

12.5 Daily Air Monitoring Report

The Daily Air Monitoring Report will be prepared by the SSHO. The Report will include all air monitoring data collected including real-time monitoring, personal monitoring within the Exclusion Zone, and perimeter monitoring. **Refer to *Attachment 3 – Safety and Health Forms for the Daily Air Monitoring Report***

12.6 Weekly Safety Meeting/Daily Tool Box Talks

As part of Conti Environmental's Corporate Safety and Health Program, a Weekly Safety Meeting is conducted on Monday mornings and Daily toolbox Talks. This safety meeting outlines current industry safety issues and allows for discussion of job-specific issues. In addition, a daily site briefing will be held to discuss current work activities and hazards for the day along with the air monitoring results from the previous day. The SSHO/Superintendent will conduct Daily Tool Box Talks and Weekly Safety Meetings with ALL on-site personnel Refer to ***Attachment 3 – Safety and Health Forms for Daily Toolbox Talks and Weekly Safety Meetings.***

In addition to the daily toolbox talks and the weekly safety meeting, Conti will conduct monthly project management safety meetings. All site management, including sub-contractor personnel, are required to attend. Topics of discussion will include: hazards identified and abated during the previous month, any outstanding action, new tasks to be performed, site concerns etc. The SSHO will submit a synopsis of each meeting including topics covered, safety-related concerns, action items to be addressed, status of previous items and a signed attendance list.

12.7 Monthly Exposure Report

A Monthly Exposure Report will be prepared by the Safety and Health Manager and submitted to the Contracting Officer Representative. This report will include a compilation of manhours worked each month for the project (both Conti and subcontractors), the number of accidents, severity, class of accident and lost time for each month.

12.8 Safety and Health Phase-Out Report

The Safety and Health Phase-Out Report will be submitted within 10 days following completion of the work. The following information will be included:

- Summary of the overall performance of safety and health (accidents or incidents including near misses, unusual events, lessons learned, etc.).
- Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and on site.
- Summary of exposure monitoring and air sampling accomplished during the project.

ATTACHMENT 1
ACTIVITY HAZARD ANALYSIS

ACTIVITY HAZARD ANALYSIS

Project:	**Griffiss AFB – Landfill 7**	DATE:	**November 1, 2001**
Activity:	**Mobilization/Site Preparation**	AHA NUMBER:	**GAFB-001**

Potential Safety/Health Hazard	Recommended Controls
Biological (i.e. Plants, Insects, Snake, and Infectious Material)	Avoid insect nest or likely habitats of snakes and Use tick and insect repellant--Check skin and clothing for tick periodically throughout the day
Chemical Spill during refueling operations or general equipment maintenance	Good Housekeeping Practices--Maintain Spill Response Equipment--Practice Spill Prevention at ALL Times--Proper Chemical Storage--Spill Control And Countermeasures Plan In Place For Spills Encountered During Work Activities
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Contact With Underground Utilities	Contact Local Mark-Out Authority to Identify And Mark Underground Utilities--Keep Heavy Equipment At Least 10 Feet From Power Lines--When An Unknown Hazard Has Been Encountered, Work Will Stop Until Hazards And Controls Are Identified And In Place
Electrical Shock	Electrical Work Performed By Qualified Person--Use Ground Fault Interrupter Circuits (GFIC)--Inspect and replace damaged Electrical Cords And Tools--Follow Lockout/Tagout Procedures as required--Keep Heavy Equipment At Least 10 Feet From Power Lines
Exposed To Vehicle Traffic	Develop, Implement and Follow Traffic Control Plan--Flaggers/Spotters Assigned Where Necessary--Use Safety Reflective Vest When Working Around Active Traffic
Exposure To High Noise Levels	Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)--Instruct Personnel On Use Of Hearing Protection--Employees On Hearing Conservation Program
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Use Correct Tool For The Job--Make Use Of All Safety Devices And Ensure They Are Functioning
Handling Heavy Objects/Material	Use Proper Lifting Techniques--Utilize Proper Hoisting/Material Handling Techniques and/or Equipment--Use Buddy System For Heavy, Awkward Loads--Distribute Loads Evenly
Struck By/Against Heavy Equipment	Only Qualified employees will be authorized to a operate Heavy equipment--Approach Equipment Within The Operators View--Equipped With Back-Up Alarm/Seatbelt--Inspect Equipment Regularly--Hand Signal By DESIGNATED Worker
Walking/Working Surface	Good Housekeeping Practices--Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Level D PPE Hand/Power Tools Trucks	Daily Safety Inspection Inspect tools/equipment before use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project:	**Griffiss AFB – Landfill 7**	DATE:	**November 1, 2001**
Activity:	**Erosion And Sediment Control**	AHA NUMBER:	**GAFB-002**

Potential Safety/Health Hazard	Recommended Controls
Biological (i.e. Plant/Insect/Snake/Infectious Material)	Avoid insect nest or likely habitats of snakes and Use tick and insect repellant--Check skin and clothing for tick periodically throughout the day--Wear Appropriate Personal Protection Equipment
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Exposure To High Noise Levels	Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)--Instruct Personnel On Use Of Hearing Protection--Employees On Hearing Conservation Program
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature
Flying Debris	Ensure guards are installed and working on tools/equipment--Initiate Dust Control Measures--Wear Appropriate Personal Protection Equipment (I.E., Safety glasses/goggles/face shields)
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Make Use Of All Safety Devices And Ensure They Are Functioning--Store Tools In Proper Place--Use Correct Tool For The Job
Handling Heavy Objects/Material	Distribute Loads Evenly--Use Buddy System For Heavy, Awkward Loads--Use Proper Lifting Techniques--Utilize Proper Hoisting/Material Handling Techniques and/or Equipment--Wear appropriate PPE And Keep Guards In Place
Struck By/Against Heavy Equipment	Equipped With Back-Up Alarm/Seatbelt--Inspect Equipment Regularly--Only Qualified employees will be authorized to a operate Heavy equipment--Restrict Pedestrian Traffic--Approach Equipment Within The Operators View
Walking/Working Surface	Good Housekeeping Practices--Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Level D PPE Hand/Power Tools	Daily Safety Inspection Inspect tools/equipment before use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Site Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project:	**Griffiss AFB – Landfill 7**	DATE:	**November 1, 2001**
Activity:	**Clearing and Grubbing**	AHA NUMBER:	**GAFB-003**

Potential Safety/Health Hazard	Recommended Controls
Biological (i.e. Plant/Insect/Snake/Infectious Material)	Avoid insect nest or likely habitats of snakes and Use tick and insect repellant--Check skin and clothing for tick periodically throughout the day--Wear Appropriate Personal Protection Equipment
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Ordinance and Explosive/Unexploded Ordnance	***IF YOU DID NOT DROP IT, DO NOT PICK IT UP!*** - After identifying potential UXO, do not move any closer to it - Do not attempt to remove any object on, attached to, or near a UXO - If possible, mark the UXO hazard -- Leave the UXO hazard area - immediately reported to SSHO
Chemical Spill during refueling operations or general equipment maintenance	Good Housekeeping Practices--Maintain Spill Response Equipment--Practice Spill Prevention at ALL Times--Proper Chemical Storage--Spill Control And Countermeasures Plan In Place For Spills Encountered During Work Activities
Exposure To High Noise Levels	Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)--Instruct Personnel On Use Of Hearing Protection--Employees On Hearing Conservation Program
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature
Flying Debris	Ensure guards are installed and working on tools/equipment--Initiate Dust Control Measures--Wear Appropriate Personal Protection Equipment (I.E., Safety glasses/goggles/face shields)
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Make Use Of All Safety Devices And Ensure They Are Functioning--Store Tools In Proper Place--Use Correct Tool For The Job
Handling Heavy Objects/Material	Distribute Loads Evenly--Use Buddy System For Heavy, Awkward Loads--Use Proper Lifting Techniques--Utilize Proper Hoisting/Material Handling Techniques and/or Equipment--Wear appropriate PPE And Keep Guards In Place
Struck By/Against Heavy Equipment	Equipped With Back-Up Alarm/Seatbelt--Inspect Equipment Regularly--Only Qualified employees will be authorized to a operate Heavy equipment--Restrict Pedestrian Traffic--Approach Equipment Within The Operators View
Walking/Working Surface	Good Housekeeping Practices--Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Air Monitoring instrument Level D PPE Hand/Power Tools Chain Saw Chaps	Daily Safety Inspection Inspect tools/equipment before use Calibrate air monitoring instrument before/after use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Site Specific Training First Aid/CPR Training (as required) PPE Training (specialized equipment)

ACTIVITY HAZARD ANALYSIS

Project:	**Griffiss AFB – Landfill 7**	DATE:	**November 1, 2001**
Activity:	**Site Surveying**	AHA NUMBER:	**GAFB-004**

Potential Safety/Health Hazard	Recommended Controls
Biological (i.e. Plants, Insects, Snake, and Infectious Material)	Avoid insect nest or likely habitats of snakes and Use tick and insect repellant--Check skin and clothing for tick periodically throughout the day
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Make Use Of All Safety Devices And Ensure They Are Functioning--Store Tools In Proper Place--Use Correct Tool For The Job
Handling Heavy Objects/Material	Distribute Loads Evenly--Use Buddy System For Heavy, Awkward Loads--Use Proper Lifting Techniques--Utilize Proper Hoisting/Material Handling Techniques and/or Equipment--Wear appropriate PPE And Keep Guards In Place
Walking/Working Surface	Good Housekeeping Practices--Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes
Caught In/Between Moving Parts	Backup Alarm On Moving/Swinging Equipment--Identify Or Post Areas Where Guarding Is Not Feasible--Inspect and Ensure All Guards Are In Place--Swing Radius Of equipment Identified and Barricaded

Equipment Used	Inspection requirements	Training Requirements
Level D PPE Hand/Power Tools	Daily Safety Inspection Inspect tools/equipment before use Inspect PPE before use.	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Site Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project: **Griffiss AFB – Landfill 7** DATE: **November 1, 2001**

Activity: **Topsoil Stripping & Stockpiling** AHA NUMBER: **GAFB-005**

Potential Safety/Health Hazard	Recommended Controls
Chemical Spill during refueling operations or general equipment maintenance	Good Housekeeping Practices--Maintain Spill Response Equipment--Practice Spill Prevention at ALL Times--Proper Chemical Storage--Spill Control And Countermeasures Plan In Place For Spills Encountered During Work Activities
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Ordinance and Explosive/Unexploded Ordnance	***IF YOU DID NOT DROP IT, DO NOT PICK IT UP!*** - After identifying potential UXO, do not move any closer to it - Do not attempt to remove any object on, attached to, or near a UXO - If possible, mark the UXO hazard -- Leave the UXO hazard area - immediately reported to SSHO
Exposure To High Noise Levels	Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)--Instruct Personnel On Use Of Hearing Protection--Employees On Hearing Conservation Program
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature--Monitor Work And Adjust Work-Rest Regimen--Physiological Monitoring Of Workers
Inhalation/Contact With Hazardous Material	Ensure site personnel have the appropriate HAZWOPER, Medical Clearance and Site Specific Training--Follow Decontamination Procedures--Follow Emergency Contingency Procedures--Implement Site Controls Areas--Perform Dust/Vapor Suppression--Perform Real-Time Air Monitoring--Review Material Safety data Sheet--Wear appropriate PPE for Task/Activity Performed
Struck By/Against Heavy Equipment	Approach Equipment Within The Operators View--Equipment Properly Secured When Not In Use--Equipped With Back-Up Alarm/Seatbelt--Flaggers/Spotters Assigned Where Necessary--Hand Signal By DESIGNATED Worker--Inspect Equipment Regularly--Keep Heavy Equipment At Least 10 Feet From Power Lines--Only Qualified employees will be authorized to a operate Heavy equipment--Restrict Pedestrian Traffic--Swing Radius Roped Off Or Guarded--Use Safety Reflective Vest When Working Around Equipment
Walking/Working Surface	Avoid Walking On Spoils Pile and Watch Footing When Entering Excavation--Good Housekeeping Practices--Barricade Open Excavations--Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Air Monitoring instrument Level D Hand/Power Tools Excavators/Dozer	Daily Safety Inspection Inspect tools/equipment before use Calibrate air monitoring instrument before/after use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Site Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project: **Griffiss AFB – Landfill 7** DATE: **November 1, 2001**

Activity: **Site Grading (Cut/Fill)** AHA NUMBER: **GAFB-006**

Potential Safety/Health Hazard	Recommended Controls
Chemical Spill during refueling operations or general equipment maintenance	Good Housekeeping Practices--Maintain Spill Response Equipment--Practice Spill Prevention at ALL Times--Proper Chemical Storage--Spill Control And Countermeasures Plan In Place For Spills Encountered During Work Activities
Ordinance and Explosive/Unexploded Ordnance	***IF YOU DID NOT DROP IT, DO NOT PICK IT UP!*** - After identifying potential UXO, do not move any closer to it - Do not attempt to remove any object on, attached to, or near a UXO - If possible, mark the UXO hazard -- Leave the UXO hazard area - immediately reported to SSHO
Inhalation/Contact With Hazardous Material	Ensure site personnel have the appropriate HAZWOPER, Medical Clearance and Site Specific Training--Follow Decontamination Procedures--Follow Emergency Contingency Procedures--Implement Site Controls Areas--Perform Dust/Vapor Suppression--Perform Real-Time Air Monitoring--Review Material Safety data Sheet--Wear appropriate PPE for Task/Activity Performed
Exposure To High Noise Levels	Employees On Hearing Conservation Program--Instruct Personnel On Use Of Hearing Protection--Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature--Monitor Work And Adjust Work-Rest Regimen--Physiological Monitoring Of Workers
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Make Use Of All Safety Devices And Ensure They Are Functioning--Store Tools In Proper Place--Use Correct Tool For The Job
Struck By/Against Heavy Equipment	Approach Equipment Within The Operators View--Equipment Properly Secured When Not In Use--Equipped With Back-Up Alarm/Seatbelt--Flaggers/Spotters Assigned Where Necessary--Hand Signal By DESIGNATED Worker--Inspect Equipment Regularly--Keep Heavy Equipment At Least 10 Feet From Power Lines--Only Qualified employees will be authorized to a operate Heavy equipment--Restrict Pedestrian Traffic--Swing Radius Roped Off Or Guarded--Use Safety Reflective Vest When Working Around Equipment
Walking/Working Surface	Avoid Walking On Spoils Pile and Watch Footing When Entering Excavation----Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Air Monitoring instrument Level D PPE Hand/Power Tools	Daily Safety Inspection Inspect tools/equipment before use Calibrate air monitoring instrument before/after use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Site Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project:	**Griffiss AFB – Landfill 7**	DATE:	**November 1, 2001**
Activity:	**Installation of Cover Fill**	AHA NUMBER:	**GAFB-007**

Potential Safety/Health Hazard	Recommended Controls
Chemical Spill during refueling operations or general equipment maintenance	Good Housekeeping Practices--Maintain Spill Response Equipment--Practice Spill Prevention at ALL Times--Proper Chemical Storage--Spill Control And Countermeasures Plan In Place For Spills Encountered During Work Activities
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Exposed To Vehicle Traffic	Develop, Implement and Follow Traffic Control Plan--Flaggers/Spotters Assigned Where Necessary--Use Safety Reflective Vest When Working Around Active Traffic
Exposure To High Noise Levels	Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)--Instruct Personnel On Use Of Hearing Protection--Employees On Hearing Conservation Program
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature--Monitor Work And Adjust Work-Rest Regimen--Physiological Monitoring Of Workers
Inhalation/Contact With Hazardous Material	Ensure site personnel have the appropriate HAZWOPER, Medical Clearance and Site Specific Training--Follow Decontamination Procedures--Follow Emergency Contingency Procedures--Implement Site Controls Areas--Perform Dust/Vapor Suppression--Perform Real-Time Air Monitoring--Review Material Safety data Sheet--Wear appropriate PPE for Task/Activity Performed
Struck By/Against Heavy Equipment	Approach Equipment Within The Operators View--Equipment Properly Secured When Not In Use--Equipped With Back-Up Alarm/Seatbelt--Flaggers/Spotters Assigned Where Necessary--Hand Signal By DESIGNATED Worker--Inspect Equipment Regularly--Keep Heavy Equipment At Least 10 Feet From Power Lines--Only Qualified employees will be authorized to a operate Heavy equipment--Restrict Pedestrian Traffic--Swing Radius Roped Off Or Guarded--Use Safety Reflective Vest When Working Around Equipment
Walking/Working Surface	Avoid Walking On Spoils Pile and Watch Footing When Entering Excavation--Good Housekeeping Practices--Barricade Open Excavations--Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Air Monitoring instrument Level D Hand/Power Tools Excavators/Dozer	Daily Safety Inspection Inspect tools/equipment before use Calibrate air monitoring instrument before/after use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Site Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project: **Griffiss AFB – Landfill 7** DATE: **November 1, 2001**

Activity: **Equipment Decontamination** AHA NUMBER: **GAFB-008**

Potential Safety/Health Hazard	Recommended Controls
Caught In/Between Moving Parts	Backup Alarm On Moving/Swinging Equipment--Identify Or Post Areas Where Guarding Is Not Feasible--Inspect and Ensure All Guards Are In Place--Swing Radius Of equipment Identified and Barricaded
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Inhalation/Contact With Hazardous Material	Ensure site personnel have the appropriate HAZWOPER, Medical Clearance and Site Specific Training--Follow Decontamination Procedures--Follow Emergency Contingency Procedures--Implement Site Controls Areas--Perform Dust/Vapor Suppression--Perform Real-Time Air Monitoring--Review Material Safety data Sheet--Wear appropriate PPE for Task/Activity Performed
Exposure To High Noise Levels	Employees On Hearing Conservation Program--Instruct Personnel On Use Of Hearing Protection--Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature--Monitor Work And Adjust Work-Rest Regimen--Physiological Monitoring Of Workers
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Make Use Of All Safety Devices And Ensure They Are Functioning--Store Tools In Proper Place--Use Correct Tool For The Job
Handling Heavy Objects/Material	Distribute Loads Evenly--Plan Ahead When Moving Materials/Items--Use Buddy System For Heavy, Awkward Loads--Use Proper Lifting Techniques--Utilize Proper Hoisting/Material Handling Techniques and/or Equipment--Wear appropriate PPE And Keep Guards In Place

Equipment Used	Inspection requirements	Training Requirements
Level D PPE Modified Hand/Power Tools	Daily Safety Inspection Inspect tools/equipment before use Calibrate air monitoring instrument before/after use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Site Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project: **Griffiss AFB – Landfill 7** DATE: **November 1, 2001**

Activity: **Monitoring Well Decommissioning** AHA NUMBER: **GAFB-009**

Potential Safety/Health Hazard	Recommended Controls
Caught In/Between Moving Parts	Backup Alarm On Moving/Swinging Equipment--Identify Or Post Areas Where Guarding Is Not Feasible--Inspect and Ensure All Guards Are In Place--Swing Radius Of equipment Identified and Barricaded
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Inhalation/Contact With Hazardous Material	Ensure site personnel have the appropriate HAZWOPER, Medical Clearance and Site Specific Training--Follow Decontamination Procedures--Follow Emergency Contingency Procedures--Implement Site Controls Areas--Perform Dust/Vapor Suppression--Perform Real-Time Air Monitoring--Review Material Safety data Sheet--Wear appropriate PPE for Task/Activity Performed
Exposure To High Noise Levels	Employees On Hearing Conservation Program--Instruct Personnel On Use Of Hearing Protection--Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature--Monitor Work And Adjust Work-Rest Regimen--Physiological Monitoring Of Workers
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Make Use Of All Safety Devices And Ensure They Are Functioning--Store Tools In Proper Place--Use Correct Tool For The Job
Handling Heavy Objects/Material	Distribute Loads Evenly--Plan Ahead When Moving Materials/Items--Use Buddy System For Heavy, Awkward Loads--Use Proper Lifting Techniques--Utilize Proper Hoisting/Material Handling Techniques and/or Equipment--Wear appropriate PPE And Keep Guards In Place
Walking/Working Surface	Avoid Walking On Spoils Pile and Watch Footing When Entering Excavation----Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Level D PPE Modified Hand/Power Tools	Daily Safety Inspection Inspect tools/equipment before use Calibrate air monitoring instrument before/after use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Site Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project: **Griffiss AFB – Landfill 7** DATE: **November 1, 2001**

Activity: **Site Restoration/Demobilization** AHA NUMBER: **GAFB-010**

Potential Safety/Health Hazard	Recommended Controls
Caught In/Between Moving Parts	Swing Radius Roped Off Or Guarded--Restrict Pedestrian Traffic--Backup Alarm On Moving/Swinging Equipment--Identify Or Post Areas Where Guarding Is Not Feasible--Inspect and Ensure All Guards Are In Place
Chemical Spill during refueling operations or general equipment maintenance	Good Housekeeping Practices--Maintain Spill Response Equipment--Practice Spill Prevention at ALL Times--Proper Chemical Storage--Spill Control And Countermeasures Plan In Place For Spills Encountered During Work Activities
Contact With Sharp Objects/Material	Identify And Guard Sharp/Protruding Objects (I.E., Rebar Caps)--Use Caution And Be Aware Whenever Working Around Sharp Objects--Wear Appropriate Personal Protection Equipment (I.E., Gloves)
Exposed To Vehicle Traffic	Develop, Implement and Follow Traffic Control Plan--Flaggers/Spotters Assigned Where Necessary--Use Safety Reflective Vest When Working Around Active Traffic
Exposure To High Noise Levels	Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)--Instruct Personnel On Use Of Hearing Protection--Employees On Hearing Conservation Program
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Use Correct Tool For The Job--Make Use Of All Safety Devices And Ensure They Are Functioning
Handling Heavy Objects/Material	Use Proper Lifting Techniques--Utilize Proper Hoisting/Material Handling Techniques and/or Equipment--Use Buddy System For Heavy, Awkward Loads--Distribute Loads Evenly
Struck By/Against Heavy Equipment	Only Qualified employees will be authorized to a operate Heavy equipment--Approach Equipment Within The Operators View--Equipped With Back-Up Alarm/Seatbelt--Inspect Equipment Regularly--Hand Signal By DESIGNATED Worker
Walking/Working Surface	Good Housekeeping Practices--Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Air Monitoring instrument Level D PPE Hand/Power Tools Ladders Trucks	Daily Safety Inspection Inspect tools/equipment before use Calibrate air monitoring instrument before/after use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) FT. Indiantown Gap Site Specific Training First Aid/CPR Training (as required)

ACTIVITY HAZARD ANALYSIS

Project: **Griffiss AFB – Landfill 7** DATE: **December 12, 2001**

Activity: **Transformer Relocation** AHA NUMBER: **GAFB-011**

Potential Safety/Health Hazard	Recommended Controls
Contact With Underground Utilities	Contact Local Mark-Out Authority to Identify And Mark Underground Utilities--Keep Heavy Equipment At Least 10 Feet From Power Lines--When An Unknown Hazard Has Been Encountered, Work Will Stop Until Hazards And Controls Are Identified And In Place
Electrical Shock	Electrical Work Performed By Qualified Person--Use Ground Fault Interrupter Circuits (GFIC)--Inspect and replace damaged Electrical Cords And Tools--Follow Lockout/Tagout Procedures as required--Keep Heavy Equipment At Least 10 Feet From Power Lines
Exposed To Vehicle Traffic	Develop, Implement and Follow Traffic Control Plan--Flaggers/Spotters Assigned Where Necessary--Use Safety Reflective Vest When Working Around Active Traffic
Exposure To High Noise Levels	Wear Appropriate Personal Protection Equipment (I.E., Ear Plugs/Muffs)--Instruct Personnel On Use Of Hearing Protection--Employees On Hearing Conservation Program
Exposure To High/Low Ambient Temperatures	Discuss Signs/Symptoms Of Heat/Cold Stress--Drink Cool/Warm Liquids, As Appropriate--Monitor Temperature
Hand/Power Tools	Ensure Personnel Are Trained On Specific Tools--Inspect Tools Before Each Use--Use Correct Tool For The Job--Make Use Of All Safety Devices And Ensure They Are Functioning
Handling Heavy Objects/Material	Use Proper Lifting Techniques--Utilize Proper Hoisting/Material Handling Techniques and/or Equipment--Use Buddy System For Heavy, Awkward Loads--Distribute Loads Evenly
Struck By/Against Heavy Equipment	Only Qualified employees will be authorized to a operate Heavy equipment--Approach Equipment Within The Operators View--Equipped With Back-Up Alarm/Seatbelt--Inspect Equipment Regularly--Hand Signal By DESIGNATED Worker
Ordinance and Explosive/Unexploded Ordnance	***IF YOU DID NOT DROP IT, DO NOT PICK IT UP!*** - After identifying potential UXO, do not move any closer to it - Do not attempt to remove any object on, attached to, or near a UXO - If possible, mark the UXO hazard -- Leave the UXO hazard area - immediately reported to SSHO
Fire/Explosion	Fire Extinguisher Inspected And In Place--Fire Watch during and after Hot Work procedures--Follow Hot Work Permit Procedures--Good Housekeeping Practices--Ignition Sources Eliminated Or Protected
Chemical Spill	Good Housekeeping Practices--Maintain Spill Response Equipment--Practice Spill Prevention at ALL Times--Proper Chemical Storage--Spill Control And Countermeasures Plan In Place For Spills Encountered During Work Activities
Excavation Cave-In	Barricade Open Excavations--Be Aware Of Cave-In Potential--**Competent Person** On Site During Activity--Contact Local Mark-Out Authority to Identify And Mark Underground Utilities--Keep Vehicles/Equipment At Sufficient Distance From Edge Of Excavation--Maintain Proper Slope For Soil Classification--Maintain Spoils 2 Ft From Edge Of Excavation--Perform Daily Excavation/Trench Inspection--Provide Access/Egress To Excavation--When An Unknown Hazard Has Been Encountered, Work Will Stop Until Hazards And Controls Are Identified And In Place
Inhalation/Contact With Hazardous Material	Ensure site personnel have the appropriate HAZWOPER, Medical Clearance and Site Specific Training--Follow Decontamination Procedures--Follow Emergency Contingency Procedures--Implement Site Controls Areas--Perform Dust/Vapor Suppression--Perform Real-Time Air Monitoring--Review Material Safety data Sheet--Wear appropriate PPE for Task/Activity Performed

Caught In/Between Moving Parts	Backup Alarm On Moving/Swinging Equipment--Identify Or Post Areas Where Guarding Is Not Feasible--Inspect and Ensure All Guards Are In Place--Swing Radius Of equipment Identified and Barricaded
Walking/Working Surface	Good Housekeeping Practices--Keep Walkways And Work Areas Clear Of Hoses, Cords, And Clutter--Restrict Site To Essential Personnel--Wear Appropriate Safety Shoes

Equipment Used	Inspection requirements	Training Requirements
Level D PPE Hand/Power Tools Trucks	Daily Safety Inspection Inspect tools/equipment before use Inspect PPE before use	40-Hour HAZWOPER Training 8-Hour HAZWOPER Supervisor (as required) Project Specific Training First Aid/CPR Training (as required) UXO Recognition and Safety Orientation

ATTACHMENT 2
MATERIAL SAFETY DATA SHEETS

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

Issue Date: 2000-07

Methyl Ethyl Ketone
MSDS 303
BUT2330

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Methyl Ethyl Ketone **CAS Number:** 78-93-3
Chemical Formula: C_4H_8O
Structural Chemical Formula: $CH_3COCH_2CH_3$
Synonyms: ACETONE,METHYL-; AETHYLMETHYLKETON; 2-BUTANONE; 3-BUTANONE; BUTANONE; BUTANONE 2; EPA PESTICIDE CHEMICAL CODE 044103; ETHYL METHYL CETONE; ETHYL METHYL KETONE; ETHYLMETHYLCETONE; ETHYLMETHYLKETON; KETONE,ETHYL METHYL; MEETCO; MEK; METHYL ACETONE; METHYL ETHYL KETONE; METILETILCETONA; METILETILCHETONE; METYLOETYLOKETON
General Use: As a solvent in lacquers, thinners, solvent cements, adhesives, glues, in paint removers, nail polish removers, nail polish and cleaning solvents.
In the manufacture of smokeless gunpowder and colorless synthetic resins.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
methyl ethyl ketone	78-93-3	>99

OSHA PEL
TWA: 200 ppm; 590 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 200 ppm; 590 mg/m^3;
STEL: 300 ppm; 885 mg/m^3.

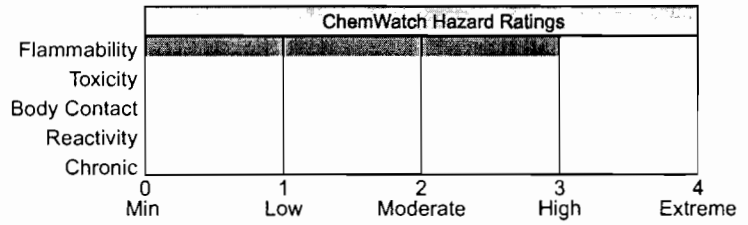
ACGIH TLV
TWA: 200 ppm; 590 mg/m^3.

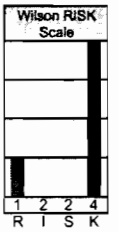
NIOSH REL
TWA: 200 ppm; 590 mg/m^3.
STEL: 300 ppm; 885 mg/m^3.

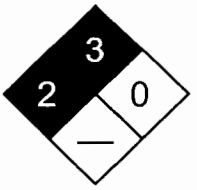
IDLH Level
3000 ppm.

DFG (Germany) MAK
TWA: 200 ppm; 590 mg/m^3.

Section 3 - Hazards Identification







Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; sweet mint odor. Irritating to eyes/respiratory tract. Also causes: corneal injury; inhalation may cause dizziness or vomiting. Chronic: dry skin, dermatitis. Flammable. Can form explosive mixtures in air.

Potential Health Effects

Primary Entry Routes: inhalation, eyes, skin contact/absorption
Target Organs: respiratory system, central nervous system (CNS), skin, eyes
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

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

Easy odor recognition and irritant properties means that high vapor levels are readily detected and should be avoided by application of control measures; however odor fatigue may occur with loss of warning of exposure.

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

Eye: The liquid is highly discomforting to the eyes if exposure is prolonged and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is highly discomforting to the eyes if exposure is prolonged.

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

Skin: The liquid is highly discomforting to the skin, it is absorbed by the skin and may cause drying of the skin, which may lead to dermatitis.

Toxic effects may result from skin absorption.

The material may accentuate any pre-existing skin condition.

Material on the skin evaporates rapidly and may cause tingling, chilling and even temporary numbness.

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

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

The liquid is highly discomforting if swallowed and toxic if swallowed in large quantity.

Ingestion may result in nausea, abdominal irritation, pain and vomiting.

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

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

The material is considered to have a low order of toxicity; however Methyl ethyl ketone is often used in combination with other solvents and the toxic effects of mix may be greater than either solvent alone.

Combinations of n-hexane with methyl ethyl ketone and also methyl n-butyl ketone with methyl ethyl ketone show increase in peripheral neuropathy, a progressive disorder of nerves of extremities.

Combinations with chloroform show increase in toxicity.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

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

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

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

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

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

Seek medical attention in event of irritation.

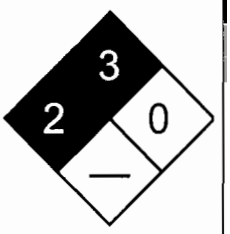
Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: -9 °C Closed Cup
Autoignition Temperature: 404 °C
LEL: 1.4% v/v
UEL: 11.4% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result. Attacks, softens and may dissolve rubber, many plastics, paints and coatings.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.

Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. NIOSH-approved respirator (supplied air type) may be required in special circumstances. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment

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

Hands/Feet: Barrier cream with polyethylene gloves or Butyl rubber gloves.
Safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >200 to 1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1000 to <3000 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range 3000 to unlimited ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face; Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls or Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.

Glove Selection Index:

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

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Thin colorless highly flammable liquid. Penetrating, sharp smell. Very volatile and vapor is heavier than air. Mixes with alcohol, ether and hydrocarbon solvents, petrol, turps etc. Attacks, softens and may dissolve rubber, many plastics, paints and coatings.

Physical State: Liquid
Vapor Pressure (kPa): 9.5 at 20 °C
Vapor Density (Air=1): 2.4 at 20 °C
Formula Weight: 72.12
Specific Gravity (H_2O=1, at 4 °C): 0.81 at 20 °C
Water Solubility: 353 g/L water at 10 °C
Evaporation Rate: 5.7 Fast (BuAc=1)
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 79.6 °C (175 °F)
Freezing/Melting Point Range: -86.3 °C (-123.34 °F)

Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers hypochlorites, e.g. pool chlorine, bleaches and. strong bases and chloroform.

Section 11 - Toxicological Information

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

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

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

See NIOSH, *RTECS* EL 6475000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When discharged into water, it will be lost by evaporation (half-life 3-12 days) or be slowly biodegraded. When released to the atmosphere, it will photodegrade at a moderate rate (half-life 2.3 days or less). It would not be expected to bioconcentrate into aquatic organisms.
Ecotoxicity: LC_{50} Pimephales promelas (fathead minnow) 3220 mg/l/96 hr (confidence limit 3130-3320 mg/l) /Conditions of bioassay not specified; Toxicity Threshold (Cell Multiplication Inhibition Test) Scenedesmus quadricauda (green algae) 4300 mg/l /Conditions of bioassay not specified; Toxicity Threshold (Cell Multiplication Inhibition Test) Entosiphon sulcatum (protoza) 190 mg/l /Conditions of bioassay not specified
Henry's Law Constant: 2.4×10^{-5}
BCF: not significant
Biochemical Oxygen Demand (BOD): 214%, 5 days
Octanol/Water Partition Coefficient: log K_{ow} = 0.26 to 0.29

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHYL METHYL KETONE (METHYL ETHYL KETONE)
Hazard Class: 3.1
ID No.: 1193
Packing Group: II
Label: Flammable Liquid[3]
Additional Shipping Information: METHYL ETHYL KETONE

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U159 Toxic Waste; Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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Material Safety Data Sheet Collection
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(518) 842-4111

Issue Date: 2000-07

Benzene
MSDS 316
BEN2200

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Benzene **CAS Number:** 71-43-2
Chemical Formula: C_6H_6
Structural Chemical Formula: C_6H_6
Synonyms: (6)ANNULENE; BENZEEN; BENZEN; BENZENE; BENZIN; BENZINE; BENZOL; BENZOL 90; BENZOLE; BENZOLENE; BENZOLO; BICARBURET OF HYDROGEN; CARBON OIL; COAL NAPHTHA; CYCLOHEXATRIENE; EPA PESTICIDE CHEMICAL CODE 008801; FENZEN; MINERAL NAPHTHA; MOTOR BENZOL; NITRATION BENZENE; PHENE; PHENYL HYDRIDE; POLYSTREAM; PYROBENZOL; PYROBENZOLE
General Use: Manufacture of chemicals including styrene, dyes, and many other organic chemicals. Has been used in artificial leather, linoleum, oil cloth, airplane dopes, lacquers; as solvent for waxes, resins, oils etc.
May also be a minor component of gasoline, petrol.
Exposure should be minimized by use in closed systems.
Handling procedures and control measures should be evaluated for exposure before commencement of use in plant operations.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
benzene	71-43-2	99.9

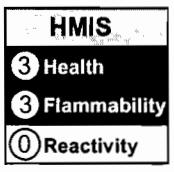
OSHA PEL
TWA: 1 ppm; 3 mg/m^3; STEL: 5 ppm; 15 mg/m^3; from Table Z-2.

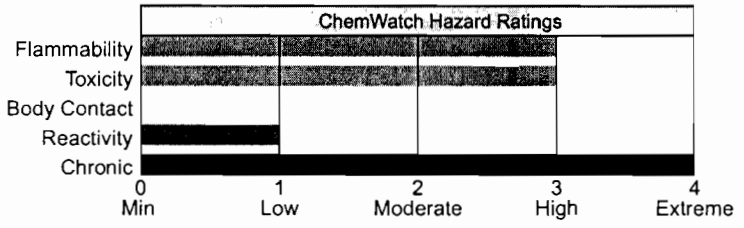
ACGIH TLV
TWA: 10 ppm; 32 mg/m^3.

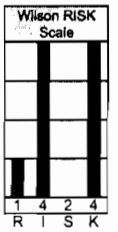
NIOSH REL
TWA: 0.1 ppm. STEL: 1 ppm.

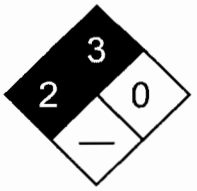
IDLH Level
500 ppm.

Section 3 - Hazards Identification









Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Toxic. Also causes: headache, dizziness, drowsiness. Absorbed through the skin. Chronic: dermatitis, leukemia, bone marrow damage. Carcinogen. Reproductive effects. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact
Target Organs: blood, central nervous system (CNS), bone marrow, eyes, upper respiratory system, skin
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and lungs and may be harmful if inhaled. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

Inhalation hazard is increased at higher temperatures.

The symptoms of acute exposure to high vapor concentrations include confusion, dizziness, tightening of the leg muscles and pressure over the forehead followed by a period of excitement. If exposure continues the casualty quickly becomes stupefied and lapses into a coma with narcosis.

Effects of inhalation may include nausea, vomiting headache, dizziness, drowsiness, weakness, sometimes preceded by brief periods of exhilaration, or euphoria, irritability, malaise, confusion, ataxia, staggering, weak and rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips and tinnitus. Severe exposures may produce blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis and coma characterized by motor restlessness, tremors and hyperreflexia (occasionally preceded by convulsions). Polyneuritis and persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia and agitation may also occur. Two-three weeks after the exposure, nervous irritability, breathlessness and unsteady gait may still persist; cardiac distress and an unusual dicoloration of the skin may be evident for up to four weeks.

Hemotoxicity is not normally a feature of acute exposures although anemia, thrombocytopenia, petechial hemorrhage, and spontaneous internal bleeding have been reported. Fatal exposures may result from asphyxia, central nervous system depression, cardiac and respiratory failure and circulatory collapse; sudden ventricular fibrillation may also be fatal.

Death may be sudden or may be delayed for 24 hours. Central nervous system, respiratory or hemorrhagic complications may occur up to five days after the exposure and may be lethal; pathological findings include respiratory inflammation with edema, and lung hemorrhage, renal congestion, cerebral edema and extensive petechial hemorrhage in the brain, pleurae, pericardium, urinary tract, mucous membrane and skin.

Exposure to toxic levels has also produced chromosome damage.

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

The vapor is moderately discomforting to the eyes.

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

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

Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.

Toxic effects may result from skin absorption.

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

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

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Liquid is an irritant and may cause burning and blistering of skin on prolonged exposure.

Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes.

Benzene is a myelotoxicant known to suppress bone-marrow cell proliferation and to induce hematologic disorders in humans and animals.

Signs of benzene-induced aplastic anemia include suppression off leukocytes (leukopenia), red cells (anemia), platelets (thromocytopenia) or all three cell types (pancytopenia). Classic symptoms include weakness, purpura, and hemorrhage. The most significant toxic effect is insidious and often irreversible injury to the blood forming tissue. Leukemia may develop.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

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

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

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

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

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

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

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

Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.

2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.

3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.

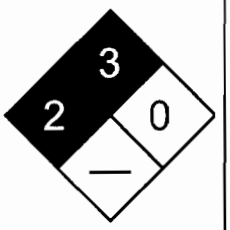
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.

5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.
Consider complete blood count. Evaluate history of exposure.

Section 5 - Fire-Fighting Measures

Flash Point: -11 °C Closed Cup
Autoignition Temperature: 562 °C
LEL: 1.3% v/v
UEL: 7.1% v/v



Fire Diamond

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

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

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

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

Section 6 - Accidental Release Measures

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

Large Spills: Pollutant - contain spillage. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Storage Requirements: Store in original containers in approved flame-proof area.
No smoking, bare lights, heat or ignition sources.
DO NOT store in pits, depressions, basements or areas where vapors may be trapped. Keep containers securely sealed.
Store away from incompatible materials in a cool, dry well ventilated area.
Protect containers against physical damage and check regularly for leaks.
Observe manufacturer's storing and handling recommendations.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Nitrile gloves; Neoprene gloves.
Safety footwear.
Do NOT use this product to clean the skin.
Respiratory Protection:
Exposure Range >1 to 10 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to 1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Note: must change cartridge at beginning of each shift
Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.
Glove Selection Index:

PE/EVAL/PE	A
PVA	A
TEFLON	A
VITON	A
VITON/NEOPRENE	A
NITRILE+PVC	C

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

BUTYL.....C
NITRILE.....C
NEOPRENE.....C
PVC.....C
NATURAL RUBBER C
BUTYL/NEOPRENE C

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, highly flammable liquid; floats on water. Characteristic aromatic odor. Highly volatile. Mixes with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone and oils.

Physical State: Liquid
Vapor Pressure (kPa): 9.95 at 20 °C
Vapor Density (Air=1): 2.77
Formula Weight: 78.12
Specific Gravity (H_2O=1, at 4 °C): 0.879 at 20 °C
Water Solubility: 0.18 g/100 g of water at 25 °C
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 80.1 °C (176 °F)
Freezing/Melting Point Range: 5.5 °C (41.9 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

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

TOXICITY
Oral (man) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 930 mg/kg
Inhalation (rat) LC_{50}: 10000 ppm/7h
Inhalation (human) LC_{Lo}: 2000 ppm/5m
Inhalation (man) TC_{Lo}: 150 ppm/1y - 1
Inhalation (human) TC_{Lo}: 100 ppm
Reproductive effector in rats

IRRITATION
Skin (rabbit): 20 mg/24 hr - mod
Eye (rabbit): 2 mg/24 hr - SEVERE

See NIOSH, *RTECS* CY 1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be subject to rapid volatilization near the surface and that which does not evaporate will be highly to very highly mobile in the soil and may leach to groundwater. It may be subject to biodegradation based on reported biodegradation of 24% and 47% of the initial 20 ppm in a base-rich para-brownish soil in 1 and 10 weeks, respectively. It may be subject to biodegradation in shallow, aerobic groundwaters, but probably not under anaerobic conditions. If released to water, it will be subject to rapid volatilization; the half-life for evaporation in a wind-wave tank with a moderate wind speed of 7.09 m/sec was 5.23 hours; the estimated half-life for volatilization from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec is estimated to be 2.7 hours at 20 °C. It will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms or hydrolyze. It may be subject to biodegradation based on a reported biodegradation half-life of 16 days in an aerobic river die-away test. In a marine ecosystem biodegradation occurred in 2 days after an acclimation period of 2 days and 2 weeks in the summer and spring, respectively, whereas no degradation occurred in winter. According to one experiment, it has a half-life of 17 days due to photodegradation which could contribute to removal in situations of cold water, poor nutrients, or other conditions less conductive to microbial degradation. If released to the atmosphere, it will exist predominantly in the vapor phase. Gas-phase will not be subject to direct photolysis but it will react with photochemically produced hydroxyl radicals with a half-life of 13.4 days calculated using an experimental rate constant for the reaction. The reaction time in polluted atmospheres which contain nitrogen oxides or sulfur dioxide is accelerated with the half-life being reported as 4-6 hours. Products of photooxidation include phenol, nitrophenols, nitrobenzene, formic acid, and peroxyacetyl nitrate. It is fairly soluble in water and is removed from the atmosphere in rain.

Ecotoxicity: LC_{50} Clawed toad (3-4 wk after hatching) 190 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 5.8 to 10.9 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 63 ppm/14 days /Conditions of bioassay not specified; LC_{50} Salmo trutta (brown trout yearlings) 12 mg/l/1 hr (static bioassay); LD_{50} Lepomis macrochirus (bluegill sunfish) 20 mg/l/24 to 48 hr /Conditions of bioassay not specified; LC_{100} Tetrahymena pyriformis (ciliate) 12.8 mmole/l/24 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae) stage 1, 108 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 20 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 5.3×10^{-3}

BCF: eels 3.5

Biochemical Oxygen Demand (BOD): 1.2 lb/lb, 10 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 2.13$

Soil Sorption Partition Coefficient: K_{oc} = woodburn silt loam 31 to 143

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: BENZENE
Hazard Class: 3.1
ID No.: 1114
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information:

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U019 Toxic Waste; Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per RCRA Section 3001; per CWA Section 307(a); per CAA Section 112 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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Material Safety Data Sheet Collection
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Issue Date: 2000-07

Carbon Disulfide
MSDS 350
CAR4990

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Carbon Disulfide **CAS Number:** 75-15-0
Chemical Formula: CS_2
Structural Chemical Formula: S=C=S
Synonyms: CARBON BISULFIDE; CARBON BISULPHIDE; CARBON DISULFIDE; CARBON DISULPHIDE; CARBON SULFIDE; CARBON SULPHIDE; CARBONE (SUFURE DE); CARBONE (SULFURE DE); CARBONIO (SOLFURO DI); DITHIOCARBONIC ANHYDRIDE; EPA PESTICIDE CHEMICAL CODE 016401; KOHLENDISULFID (SCHWEFELKOHLENSTOFF); KOOLSTOFDISULFIDE; SCHWEFELKOHLENSTOFF; SOLFURO DI CARBONIO; SULPHOCARBONIC ANHYDRIDE; SULPHURET OF CARBON; WEEVILTOX; WEGLA DWUSIARCZEK
General Use: Used in manufacture of rayon, carbon tetrachloride, xanthogenates, soil disinfectants, electronic vacuum tubes; solvent for phosphorus, sulfur, selenium, bromine, iodine, fats, resins, rubbers.
Also used as solvent in gas chromatography.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
carbon disulfide	75-15-0	>99

OSHA PEL
TWA: 20 ppm; STEL: 30 ppm; from Table Z-2. Other Values: 100 mg/m^3; 30 min peak 8hr ppm.

OSHA PEL Vacated 1989 Limits
TWA: 4 ppm; 12 mg/m^3; STEL: 12 ppm; 36 mg/m^3.

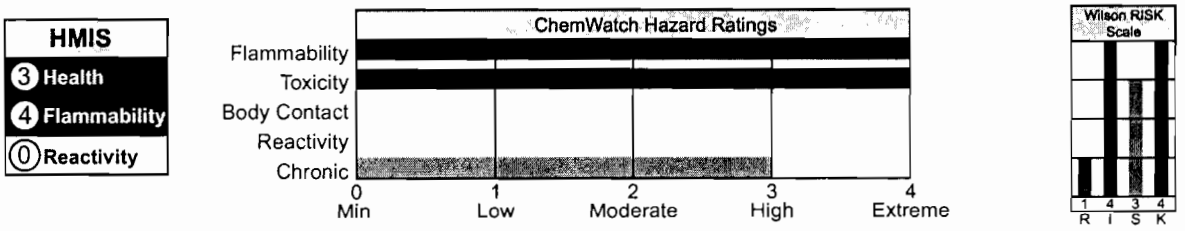
ACGIH TLV
TWA: 10 ppm; 31 mg/m^3.

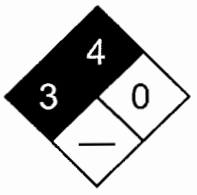
NIOSH REL
TWA: 1 ppm; 3 mg/m^3. STEL: 10 ppm; 30 mg/m^3; skin.

IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 10 ppm; 30 mg/m^3.

Section 3 - Hazards Identification





Fire Diamond

ANSI Signal Word
Danger!


Corrosive Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; chloroform-like odor. Corrosive. Also causes: cardiac/CNS damage, headache, dizziness, convulsions. Chronic: pyschosis, liver damage, eye effects, peripheral neuropathies, gastric disturbances, reproductive effects. Highly flammable!

Potential Health Effects

Primary Entry Routes: inhalation, skin contact/absorption
Target Organs: skin, central nervous system (CNS), peripheral nervous system, cardiovascular system, eyes, liver, kidneys

Acute Effects

Inhalation: The vapor is highly discomforting to the upper respiratory tract and lungs and may be harmful if inhaled. The material may accentuate any pre-existing skin condition.

Acute inhalation produces rapid onset of both local irritation and central nervous system symptoms ranging from pharyngitis, nausea, vomiting, dizziness, fatigue, headache, mood changes, lethargy and blurred vision, to agitation, uncontrollable anger, suicidal tendencies, delirium, hallucinations, convulsions, coma and death.

Eye: The liquid is extremely discomforting to the eyes and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

Skin: The liquid is extremely discomforting to the skin and is capable of causing allergic skin reactions. Toxic effects may result from skin absorption.

Concentrated solutions of carbon disulfide may cause skin pain, erythema, and exfoliation. Several minutes of contact may cause blistering with second and third degree burns. May be directly toxic to the cutaneous nerves. Skin sensitization may occur.

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

Ingestion of small amounts may result in numbness of the lips, nausea, vomiting, dyspnea, dizziness, spasmodic tremor, hyperactive tendon reflexes, hyperesthesia, cardiac arrhythmias, hallucinations, prostration, peripheral, vascular collapse, hypothermia, cyanosis, mydriasis, convulsions, coma, and death within a few hours from respiratory paralysis. Non-fatal exposures may produce delayed effects including motor agitation, disorientation, pyschic disturbances, narcosis, delirium, areflexia, mydriasis, and permanent damage to the central and peripheral nervous systems.

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

Chronic Effects: Long-term exposure has caused serious damage to the central nervous system (degeneration of the peripheral nerves).

Concentrations as low as 20 ppm may produce neurological damage - women are apparently more susceptible to the neurological effects of carbon disulfide. Neurological effects may include headache, apprehension, lethargy, sleepiness, hearing and position sense loss, paresthesias, muscle pain, tremors, ataxia, staggering gait, weakness, loss of lower extremity reflexes, and paralysis. Visual disturbances include decreased visual acuity, impaired recognition of red and green, nystagmus, diplopia, disturbed pupillary reaction to light - optic nerve atrophy may also occur.

A decrease in corneal reflex may be an early indication of chronic intoxication.

Psychiatric symptoms may include loss of memory, nightmares leading to loss of sleep, mental deterioration, acoustic and visual hallucinations, rapid mood changes ranging from irritability to manic-depressive pyschoses, suicidal tendencies. Disturbances to the libido and impotence (with effects on sperm) have also been recorded. Menstrual and ovarian function disorders and an increased risk of spontaneous abortion may also occur.

Liver damage may be indicated by palpable, tender liver and minor derangement of liver function. Chronic renal dysfunction may occur at concentrations not sufficiently great to produce neurological damage.

Gastric or duodenal ulcers may also be produced as a result of chronic exposure.

Coronary heart disease has been significantly linked to exposure to carbon disulfide. A series of studies performed in Finland showed a significant excess mortality from cardiovascular heart disease in workers exposed to carbon disulfide for at least 5 years to concentrations estimate to range from 20-40 ppm in the 1950s and 10-30 ppm in the 1960s. Most workers however had been exposed repeatedly to far higher concentrations at various times.

Nutritional factors may account for variations in response shown amongst workers. Experimental rabbit diets reinforced with a high mineral mixture, especially copper and zinc, permitted daily exposures at 1100 ppm CS_2 without the observed effects seen in controls (body weight loss, serum lipoprotein and total cholesterol increase, adrenal hypertrophy and pathological changes in the brain and spinal cord).

A daily 4-hour exposure at concentrations exceeding 150 ppm produces chronic intoxication after a few months; 100-150 ppm is thought to produce chronic poisoning after a year or more whilst 50-100 ppm produce sporadic cases of mild intoxication.

Personnel with pre-existing central nervous system, gastrointestinal tract, liver, kidneys, skin and blood diseases may be potentially more susceptible to symptom of exposure and should be excluded from exposure.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

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

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

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

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

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

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

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

Note to Physicians:
1. Carbon disulfide intoxication results in severe debilitating CNS symptoms (irritability, mania, hallucinations, tremors, memory loss).
2. Chronic industrial exposures may cause neuropsychiatric changes, peripheral neuropathies and accelerated atherogenic changes.
3. Peak blood concentrations appear 2 hours after inhalation. Plasma elimination half-life is about 1 hour. Metabolic products seen in urine include thiourea, 2-mercapto-2-thiazolin-5-one and 2-thiazolidine-4- carboxylic acid (TTCA). The iodine-azide test identifies these.
4. Initial management of severe inhalation poisoning requires careful attention to airway, breathing and circulation. Treatment involves symptomatic care.

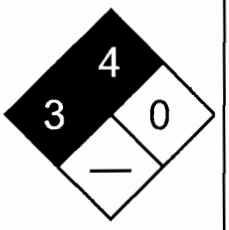
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
2-thiothiazolidine 4-carboxylic acid	5 mg/gm creatinine.	End of shift	

NOTE: Preplacement and periodic medical examinations should be concerned especially with skin, eyes, central and peripheral nervous system, cardio-vascular disease, as well as liver and kidney function. Electrocardiograms should be taken.

Section 5 - Fire-Fighting Measures

Flash Point: 30 °C Closed Cup
Autoignition Temperature: 90 °C
LEL: 1.3% v/v
UEL: 50% v/v
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.
Note: Water may be ineffective except as a blanket. Foam is ineffective.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include sulfur oxides (SO_x).
WARNING: Vapors may be ignited by contact with an ordinary light bulb, a warm steam pipe or a hot exhaust pipe.

Fire Incompatibility: WARNING: May decompose violently or explosively on contact with other substances.
This substance is one of the relatively few compounds which are described as "endothermic" i.e. heat is absorbed into the compound, rather than released from it, during its formation.
The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation.
Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds.
Explosively reactive with azides or organic amines.
Reacts with zinc with incandescence.
Avoid contact with chemically active metals (sodium, potassium, aluminum, magnesium) and strong oxidizers.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Cool fire-exposed containers with water spray from a protected location.
Do not approach containers suspected to be hot.

Avoid spraying water onto liquid pools.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Environmental hazard - contain spillage. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Shut off all possible sources of ignition and increase ventilation.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Allow absorbed spillage to evaporate in an open top container, away from habitation.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Shut off all possible sources of ignition and increase ventilation.
No smoking or bare lights within area.
Stop leak if safe to do so.
Use extreme caution to avoid a violent reaction.
Any electric cleaning equipment must be explosion proof.
Absorb or cover spill with sand, earth, inert material or vermiculite.
Water spray or fog may be used to disperse vapor.
Collect recoverable product into labeled containers for recycling.
Collect, using a spark-free shovel, and seal in labeled drums for disposal.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked to ensure safe working conditions are maintained.
Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes. Wear protective clothing when risk of exposure occurs. Avoid smoking, bare lights or ignition sources. Avoid generation of static electricity.
Avoid thermal shock (wait for surfaces to cool).
Use in a well-ventilated area. Local exhaust ventilation usually required.
Vapor may travel a considerable distance to source of ignition.
Use spark-free tools when handling. Ground all lines and equipment.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces where vapor may have collected.
Avoid contact with incompatible materials. Avoid physical damage to containers. Keep containers securely sealed.
Always wash hands with soap and water after handling. Work clothes should laundered separately.
Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Glass container.
Steel drum.
Metal can.
Store in metal drums or safety cans.
Plastic containers may only be used if approved for flammable liquids.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Impervious, gauntlet length gloves; Viton gloves.
PVA gloves.
PVC boots.
Safety footwear.

Respiratory Protection:
Exposure Range >20 to 200 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >200 to <500 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.

Glove Selection Index:

PE/EVAL/PE	A
PVA	A
VITON/CHLOROBUTYL	A
VITON	A
TEFLON-FEP	A
NITRILE	C
CPE	C
NEOPRENE	C
BUTYL	C

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to yellow, mobile liquid with a strong disagreeable odor; nearly odorless when pure. Miscible with anhydrous methanol, ethanol, ether, benzene, chloroform, carbon tetrachloride, oils.

Physical State: Liquid
Vapor Pressure (kPa): 40 at 20 °C
Vapor Density (Air=1): 2.67
Formula Weight: 76.14
Specific Gravity (H_2O=1, at 4 °C): 1.26 at 20 °C
Water Solubility: 0.3% by weight
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 46.5 °C (116 °F) at 760 mm Hg
Freezing/Melting Point Range: -111.5 °C (-168.7 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Long term storage.
Presence of heat source and ignition source.
Stable under normal storage conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: WARNING: May decompose violently or explosively on contact with other substances.
This substance is one of the relatively few compounds which are described as "endothermic" i.e. heat is absorbed into the compound, rather than released from it, during its formation.
The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation.
Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds.
Avoid reaction with oxidizing agents.
Segregate from, azides, organic amines and chemically active metals.

Section 11 - Toxicological Information

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

TOXICITY
Oral (human) LD_{Lo}: 14 mg/kg
Oral (human) TC_{Lo}: 40 mg/m^3
Oral (rat) LD_{50}: 3188 mg/kg
Inhalation (human) LC_{Lo}: 4000 ppm/30 min
Inhalation (human) LC_{Lo}: 2000 ppm/5 min
Inhalation (rat) LC_{50}: 25000 mg/m^3/2 h
Fatty liver degeneration, paternal effects, effects on fertility, fetotoxicity, effects on newborn recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA. Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

IRRITATION
Nil reported

See NIOSH, *RTECS* FF 6650000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on land, it will be primarily lost by volatilization. It may also readily leach into the ground where it may biodegrade. If released into water, it will be primarily lost due to volatilization (half-life 2.6 hr in a model river). Adsorption to sediment and bioconcentration in fish should not be significant. In the atmosphere it degrades by reacting with atomic oxygen and photochemically produced hydroxyl radicals (half-life 6-9 days). The soil may be a natural sink for the chemical by adsorbing and subsequently biodegrading it.
Ecotoxicity: TLm Mosquitofish 162-135 mg/l/24-96 hr /Conditions of bioassay not specified
Henry's Law Constant: 1.44×10^{-2}
BCF: estimated at 7.9
Octanol/Water Partition Coefficient: $\log K_{ow} = 0.852$
Soil Sorption Partition Coefficient: K_{oc} = estimated at 63

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Evaporate or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.
Ensure damaged or non-returnable drums are gas-free before disposal.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: CARBON DISULFIDE **Additional Shipping Information:** CARBON SULPHIDE
Hazard Class: 3.1
ID No.: 1131
Packing Group: I
Label: Flammable Liquid[3],Poison

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed P022 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per RCRA Section 3001 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed 10000 lb
SARA EHS 40 CFR 355: Listed 100 lb
TSCA: Listed

Section 16 - Other Information

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

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Issue Date: 2000-07

Styrene
MSDS 351
STY3000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Styrene **CAS Number:** 100-42-5
Chemical Formula: C_8H_8
Structural Chemical Formula: $C_6H_5CH=CH_2$
Synonyms: BENZENE,ETHENYL-; BENZENE,VINYL-; CINNAMENE; CINNAMENOL; CINNAMOL; DIAREX HF 77; ETHENYL BENZENE; ETHENYLBENZENE; ETHYLENE,PHENYL-; PHENETHYLENE; PHENYLETHENE; PHENYLETHYLENE; STIROLO; STYREEN; STYREN; STYRENE; STYRENE MONOMER; STYRENE MONOMER,INHIBITED; STYRENE,MONOMER; STYROL; STYROLE; STYROLENE; STYRON; STYROPOL; STYROPOR; VINYL BENZENE; VINYLBENZEN; VINYLBENZENE; VINYLBENZOL
General Use: Widely used in polymer manufacture: polystyrene; SBR, ABS, SAN resins and rubber modified polystyrene for plastics; styrene-butadiene rubber latex.
Styrene polyesters for GRP, FRP molding resins; styrene copolymer resins for coatings; chemical intermediate.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
styrene	100-42-5	>99

OSHA PEL
TWA: 100 ppm; STEL: 200 ppm; from Table Z-2. Other Values: 600 mg/m^3; 5 min peak 8hr ppm.

OSHA PEL Vacated 1989 Limits
TWA: 50 ppm; 215 mg/m^3; STEL: 100 ppm; 425 mg/m^3.

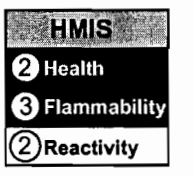
ACGIH TLV
TWA: 50 ppm; 213 mg/m^3; STEL: 100 ppm; 426 mg/m^3.

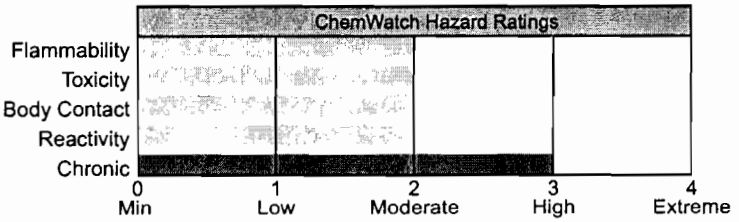
NIOSH REL
TWA: 50 ppm; 215 mg/m^3. STEL: 100 ppm; 425 mg/m^3.

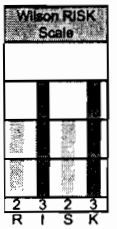
IDLH Level
700 ppm.

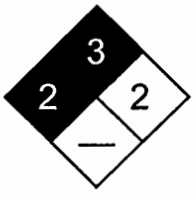
DFG (Germany) MAK
TWA: 20 ppm; 85 mg/m^3.

Section 3 - Hazards Identification









Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless-yellow, oily liquid; sweet odor. Irritating. Also causes: difficulty breathing, dizziness. Chronic: dermatitis, nervous system disorders, blood/liver damage, reproductive/teratogenic effects (animal studies). Possible cancer hazard. Flammable.

Potential Health Effects

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

Acute Effects

Inhalation: The vapor is highly discomforting to the upper respiratory tract if inhaled and may be harmful if exposure is prolonged.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high vapor concentrations may be chest and nasal irritation with coughing, sneezing, headache and even nausea.
If exposure to highly concentrated vapor atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma, and unless resuscitated, death.
Central nervous system (CNS) depression is seen at styrene exposures exceeding 50 ppm, whilst headache, fatigue, nausea and dizziness are reported consistently at exposures of 100 ppm.
Evidence exists that 5% to 10% reductions in sensory nerve conduction occur at 100 ppm and that slowed reaction times occur after exposure to 50 ppm.
Exposure at 376 ppm produces unpleasant subjective symptoms and signs of neurological impairment.
High vapor concentrations may have toxic and anesthetic effects, which may lead to unconsciousness or death.
Exposure at 1000 ppm can rapidly lead to unconsciousness.
Exposure at 10000 ppm may cause death in less than one hour.
Simple reaction times were increased and coordination decreased amongst volunteers inhaling 350 ppm (via mouth tube) for 30 minutes. Controlled inhalation studies with 300 ppm (via mouth tube) for 1 hour found reduced ocular tracking abilities but no changes in balance or coordination.

Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The vapor is highly discomforting to the eyes if exposure is prolonged.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.
The vapor when concentrated has pronounced eye irritation; this gives some warning of high vapor concentrations. If eye irritation occurs seek to reduce exposure with available control measures, or evacuate area.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is highly discomforting to the skin if exposure is prolonged and may cause drying of the skin, which may lead to dermatitis.
Toxic effects may result from skin absorption.
Bare unprotected skin should not be exposed to this material.
The material may accentuate any pre-existing dermatitis condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is extremely discomforting and moderately toxic if swallowed.
Ingestion may result in nausea, abdominal irritation, pain and vomiting.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Neuro-optic pathways have been shown to be particularly vulnerable to organic solvent exposure and studies support the proposition that styrene exposure can induce a dose dependent color vision loss.
Chromosomal abnormalities (micronuclei, chromosome gaps or breaks, nuclear bridges and unscheduled DNA synthesis in peripheral lymphocytes) have been recorded in workers exposed to styrene. Such aberrations however are not always apparent in epidemilogical studies and the status of styrene as DNA effector is equivocal.
Deaths due to cancers among workers exposed to styrene is statistically unremarkable.
The dominant first metabolite of styrene is styrene-7,8-oxide which binds covalently to DNA and shows activity in various in-vitro and in-vivo assays for genetic effects where it induces dose-related responses of chromosomal damage at low concentrations. Styrene-7,8-oxide is detected in the blood of workers exposed to styrene. Adducts in hemoglobin and DNA, DNA single-strand breaks/ alkali-labile sites as well as significant increases in the frequency of chromosomal damage has been found in workers exposed to styrene in the reinforced plastics industry.
Exposure to styrene may aggravate C.N.S. disorders, chronic respiratory disease, skin disease, kidney disease and liver disease.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: Quickly but gently, wipe material off skin with a dry, clean cloth.
Immediately remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.
Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: For acute or short-term repeated exposures to styrene:
INHALATION:
1. Severe exposures should have cardiac monitoring to detect arrhythmia.
2. Catecholamines, especially epinephrine (adrenalin) should be used cautiously (if at all).
3.Aminophylline and inhaled & beta-two selective bronchodilators (e.g. salbutamol) are the drugs of choice for treatment of bronchospasm.
INGESTION:
1. Ipecac syrup should be given for ingestions exceeding 3 mL (styrene)/kg.
2. For patients at risk of aspiration because of obtundation, intubation should precede lavage.
3. Pneumonitis is a significant risk. Watch the patient closely in an upright (alert patient) or left lateral head-down position (obtunded patient) to reduce aspiration potential.

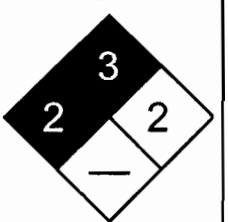
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker who has been exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Mandelic acid in Urine	800 mg/gm creatinine	End of shift	NS
	300 mg/gm creatinine	Prior to next shift	NS
Phenylglyoxylic acid in urine	240 mg/gm creatinine	End of shift	B,NS
	100 mg/gm creatinine	Prior to next shift	
Styrene in venous Blood	0.55 mg/L	End of shift	SQ
	0.02 mg/L	Prior to next shift	SQ

NS: Non-specific determinant; also seen after exposure to other materials.
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.
B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: 34.4 °C Tag Closed Cup
Autoignition Temperature: 490 °C
LEL: 1.1% v/v
UEL: 7.0% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.



Fire Diamond

Fire Incompatibility: WARNING: May decompose violently or explosively on contact with other substances.
This substance is one of the relatively few compounds which are described as "endothermic" i.e. heat is absorbed into the compound, rather than released from it, during its formation.
The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation.
Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds.
Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous.
Contamination with polymerization catalysts - peroxides, persulfates, oxidizing agents - also strong acids, strong alkalies, will cause polymerization with exotherm - generation of heat.
Polymerization of large quantities may be violent - even explosive.
Polymerization may occur at elevated temperatures.
Polymerization may be accompanied by generation of heat as exotherm.
Process is self accelerating as heating causes more rapid polymerization.
Exotherm may cause boiling with generation of acrid, toxic and flammable vapor.
Polymerization and exotherm may be violent if contamination with strong acids, amines or catalysts occurs.
Polymerization and exotherm of material in bulk may be uncontrollable and result in rupture of storage tanks.
Polymerization may occur if stabilizing inhibitor becomes depleted by aging.
Stabilizing inhibitor requires dissolved oxygen to be present in liquid for effective action.
Specific storage requirements must be met for stability on ageing and transport.
Contact with alkali solutions or glycols will remove inhibitor and render material unstable on storage.

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

Section 6 - Accidental Release Measures

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

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

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

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.

Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Butyl rubber gloves. Safety footwear.
Respiratory Protection:
Exposure Range >100 to <700 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 700 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Barrier cream. Skin cleansing cream.
Impervious apron.
Overalls.
Eyewash unit.
Ensure there is ready access to a safety shower.
Glove Selection Index:

PE/EVAL/PE	A
PVA	A
TEFLON	A
SARANEX-23	C
NITRILE	C
NITRILE+PVC	C
NATURAL RUBBER	C
PVC	C

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless flammable liquid; floats on water. Soluble in alcohol and hydrocarbons. Contains stabilizing Inhibitor. Sweet aromatic odor at low concentrations. Sharp, penetrating odor at high concentrations.

Physical State: Liquid
Vapor Pressure (kPa): 1.27 at 30 °C
Vapor Density (Air=1): 3.6
Formula Weight: 104.16
Specific Gravity (H_2O=1, at 4 °C): 0.99 at 25 °C
Water Solubility: Sparingly soluble in water
Evaporation Rate: 0.49 (BuAc=1)
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 145 °C (293 °F)
Freezing/Melting Point Range: -31 °C (-23.8 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Material contains a stabilizer/polymerization inhibitor system that provides workable but not indefinite shelf life.
Storage at higher temperatures and long term storage may result in polymerization with solidification. In larger quantities, e.g. 200 liter drums, this may result in generation of heat (exotherm); which may release highly irritating hot styrene vapor. Do not open hot exotherming drums - cool externally with water to avoid vapor release.
Polymerization may occur at elevated temperatures. Polymerization may be accompanied by generation of heat as exotherm. Process is self accelerating as heating causes more rapid polymerization. Exotherm may cause boiling with generation of acrid, toxic and flammable vapor.

Polymerization and exotherm may be violent if contamination with strong acids, amines or catalysts occurs.
Polymerization and exotherm of material in bulk may be uncontrollable and result in rupture of storage tanks.
Polymerization may occur if stabilizing inhibitor becomes depleted by aging.
Stabilizing inhibitor requires dissolved oxygen to be present in liquid for effective action.
Specific storage requirements must be met for stability on ageing and transport.

Storage Incompatibilities: WARNING: May decompose violently or explosively on contact with other substances.
This substance is one of the relatively few compounds which are described as "endothermic" i.e. heat is absorbed into the compound, rather than released from it, during its formation.
The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation. Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds. Segregate from strong oxidizers and acids.
DO NOT USE brass or copper containers/stirrers.
Attacks, softens and may dissolve rubber, many plastics, paints and coatings.

Section 11 - Toxicological Information

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

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

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

See NIOSH, *RTECS* WL 3765000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it will react rapidly with both hydroxyl radicals and ozone with a combined, calculated half-life of about 5 hours. In night-time air, it will degrade rapidly by reaction with atmospheric nitrate radicals. If released to environmental bodies of water, it will volatilize relatively rapidly and biodegrade, but is not expected to hydrolyze. If released to soil it will biodegrade and have a low soil mobility.

Ecotoxicity: TLm Lepomis macrochirus (bluegill) 25.1 mg/l/96 hr in water hardness of 20 mg/l calcium carbonate /Static bioassay; LC_{50} Cyprinodon variegatus (sheepshead minnow) 9.1 mg/l/96 hr, ambient salinity from 10-30 parts per trillion and temp from 25-31 °C /Static bioassay; TLm Artemia salina (Brine shrimp) 68 mg/l/24 hr; 52 mg/l/48 hr /Conditions of bioassay not specified

Henry's Law Constant: 0.00275

BCF: not expected

Biochemical Oxygen Demand (BOD): theoretical 18%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.95

Soil Sorption Partition Coefficient: K_{oc} = estimated at 550 to 555

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.
BEWARE: Empty solvent, paint, lacquer and flammable liquid drums present a severe explosion hazard if cut by flame torch or welded. Even when thoroughly cleaned or reconditioned the drum seams may retain sufficient solvent to generate an explosive atmosphere in the drum.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: STYRENE MONOMER, INHIBITED
Additional Shipping Information: VINYLBENZENE
Hazard Class: 3.2
ID No.: 2055
Packing Group: III
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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Issue Date: 2000-07

Xylene
MSDS 318
XYL2260

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Xylene **CAS Number:** 1330-20-7
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
Synonyms: BENZENE,DIMETHYL-; COMPONENT 1 (83%): XYLENES; COMPONENT 2 (17%): ETHYL BENZENE; DIMETHYLBENZENE; DIMETHYLBENZENES; EPA PESTICIDE CHEMICAL CODE 086802; KSYLEN; METHYL TOLUENE; METHYLTOLUENE; VIOLET 3; XILOLI; XYLENE; XYLENEN; XYLOL; XYLOLE
General Use: A strong solvent for general use in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
xylene	1330-20-7	> 95

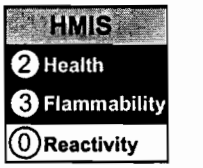
OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

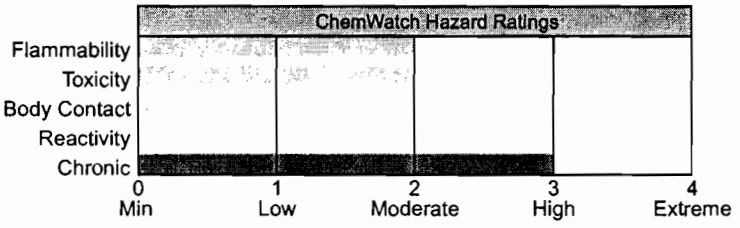
ACGIH TLV
TWA: 100 ppm; 434 mg/m^3;
STEL: 150 ppm; 651 mg/m^3.

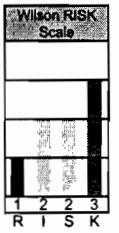
NIOSH REL
TWA: 100 ppm; 435 mg/m^3.
STEL: 150 ppm; 655 mg/m^3.

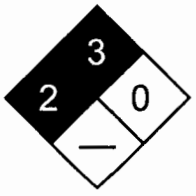
DFG (Germany) MAK
TWA: 100 ppm; 440 mg/m^3.

Section 3 - Hazards Identification









Fire Diamond

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to the eyes/skin/respiratory tract. Also causes: dizziness, nausea, and drowsiness. Chronic: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects based on animal data. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.

Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

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

The vapor is highly discomforting to the eyes.

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

Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.

Toxic effects may result from skin absorption.

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

The material may accentuate any pre-existing skin condition.

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

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

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

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

Small excess risks of spontaneous abortion and congenital malformation was reported amongst women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.

Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

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

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

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

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

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

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

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

1.Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended. The use of charcoal and cathartics is equivocal.
2.Pulmonary absorption is rapid with about 60-65% retained at rest.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

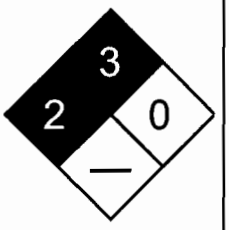
BIOLOGICAL EXPOSURE INDEX - BEI

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

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures

Flash Point: 25.6 °C
Autoignition Temperature: 241 °C
LEL: 1.0% v/v
UEL: 7.0% v/v
Extinguishing Media: Alcohol stable foam; dry chemical powder; carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.

Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.
Do NOT use this product to clean the skin.
Other: Overalls. Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.
Glove Selection Index:

PE/EVAL/PE	A
PVA	A
VITON	A
TEFLON	A
PVDC/PE/PVDC	C
NATURAL+NEOPRENE	C
NEOPRENE/NATURAL	C
NITRILE+PVC	C
HYPALON	C
NAT+NEOPR+NITRILE	C
BUTYL	C
BUTYL/NEOPRENE	C
NITRILE	C
NEOPRENE	C

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

PVC.....C

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear colorless flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Water Solubility: Practically insoluble in water
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable

pH (1% Solution): Not applicable.
Boiling Point Range: 137 °C (279 °F) to 140 °C (284 °F)
Freezing/Melting Point Range: -47 °C (-53 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

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

TOXICITY
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 4300 mg/kg
Inhalation (human) TC_{Lo}: 200 ppm
Inhalation (man) LC_{Lo}: 10000 ppm/6h
Inhalation (rat) LC_{50}: 5000 ppm/4h
Reproductive effector in rats

IRRITATION
Skin (rabbit):500 mg/24h moderate
Eye (human): 200 ppm irritant
Eye (rabbit): 87 mg mild
Eye (rabbit): 5 mg/24h SEVERE

See NIOSH, *RTECS* ZE 2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most of the xylenes are released into the atmosphere where they may photochemically degrade by reaction with hydroxyl radicals (half-life 1-18 hr). The dominant removal process in water is volatilization. Xylenes are moderately mobile in soil and may leach into groundwater where they are known to persist for several years, despite some evidence that they biodegrade in both soil and groundwater. Bioconcentration is not expected to be significant.
Ecotoxicity: LC_{50} Rainbow trout 13.5 mg/l/96 hr /Conditions of bioassay not specified; LD_{50} Goldfish 13 mg/l/24 hr /Conditions of bioassay not specified
Henry's Law Constant: 0.22
BCF: estimated at 2.14 to 2.20
Octanol/Water Partition Coefficient: log K_{ow} = 3.12 to 3.20
Soil Sorption Partition Coefficient: K_{oc} = 48 to 68

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: XYLENES
Additional Shipping Information: XYLOLS
Hazard Class: 3.2
ID No.: 1307
Packing Group: III
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U239 Toxic Waste; Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per RCRA Section 3001 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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Material Safety Data Sheet Collection

Anthracene **MSDS No. 917**

Date of Preparation: 6/94

Section 1 - Chemical Product and Company Identification 44

Product/Chemical Name: Anthracene
Chemical Formula: $(C_6H_4CH)_2$
CAS No.: 120-12-7
Synonyms: anthracin, green oil, paranaphthalene, Tetra Olive N2G
Derivation: Occurs naturally in smoke (gasoline, coal, cigarette, etc.), charbroiled foods, and coal tar pitch volatiles. Obtained by distilling crude anthracene oil with alkali carbonate in iron retorts (phenanthrene is removed via carbon disulfide) *or* by salting out from crude anthracene oil and draining; the crude salts are then purified by pressing and the use of various solvents (phen-anthrene and carbazole are removed).
General Use: Used in chemical manufacture (phenanthrene, carbazole, anthraquinone), in calico printing; as a component of dyes, scintillation fluid, smoke screens; and in organic semi-conductor research.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Anthracene, ca 90 to 95 %wt (commercial grade); 90 to 98 %wt (technical grade)
Trace Impurities: Include phenanthrene, carbazole, chrysene, pyridine (0.2%), iron (0.03%)

OSHA PEL*	NIOSH REL†	DFG (Germany) MAK
8-hr TWA: 0.2 mg/m^3	10-hr TWA: 0.1 mg/m^3	None established
ACGIH TLV*	**IDLH Level**	
TWA: 0.2 mg/m^3	Ca, 700 mg/m^3	

*Coal tar pitch volatiles (benzene soluble). OSHA defines *coal tar pitch volatiles* as the fused polycyclic hydrocarbons that volatilize from the distillation residues of coal, petroleum, wood, and other organic matter, and *includes anthracene.*
†Coal tar products (cyclohexane extractable fraction), including anthracene.

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Anthracene is a polyaromatic hydrocarbon present in coal tar pitch volatiles. It exists as colorless crystals with a violet fluorescence when pure and as yellow crystals with a green fluorescence. Anthracene is irritating to the eyes, skin, and respiratory tract. Exposure to the sun can aggravate skin irritation and cause dermatitis. It is combustible.

Wilson Risk Scale	
R	1
I	3
S	2*
K	1

*Skin absorption

HMIS	
H	1†
F	1
R	0

† Chronic Effects
PPE‡
‡ Sec. 8

Potential Health Effects

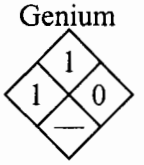
Primary Entry Routes: Inhalation, skin/eye contact
Target Organs: Eyes, skin, respiratory and digestive tracts.
Acute Effects
Inhalation: Symptoms include irritation of the respiratory tract, headache, nausea and vomiting, loss of appetite, slowed reactions, and adynamia (lack or loss of strength due to disease or other outside agent).
Eye: Irritation of the conjunctiva with burning, itching and watering.
Skin: Irritation with burning, itching, and edema (fluid build-up). Volunteers with a 2% crude tar solution applied to the skin showed anthracene absorption via blood tests.
Ingestion: Gastrointestinal tract irritation.
Carcinogenicity: *Coal tar pitch volatiles* (in general) are considered to be carcinogens by the NTP, IARC, DFG, NIOSH, and ACGIH. However, *anthracene* has been specifically evaluated by IARC and designated as Class 3 (*unclassifiable* as to carcinogenicity with no human evidence and limited animal evidence).
Medical Conditions Aggravated by Long-Term Exposure: Dermatitis.
Chronic Effects: Repeated skin contact can cause pigmentation of the skin with cornification of surface layers and telangioectasis (an abnormal dilatation of capillary vessels that often form small, raised, red, wart-like spots). Sensitization (including photo-sensitization) may also occur.
Other: Acute symptoms disappear within several days of last exposure. Anthracene appears to concentrate in the fat and liver.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult an ophthalmologist if pain and irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. Vomiting may be spontaneous.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures



Flash Point: 250 °F (121 °C)
Flash Point Method: CC
Autoignition Temperature: 1004 °F (540 °C)
LEL: 0.6% v/v
UEL: Not reported.
Flammability Classification: Combustible
Extinguishing Media: Use water spray, carbon dioxide, dry chemical, or foam.
Unusual Fire or Explosion Hazards: May explode in air.
Hazardous Combustion Products: Include carbon oxide(s) and irritating, acrid smoke.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against inhalation and skin/eye contact.
Small Spills: Carefully scoop up or vacuum (with appropriate filter) and place in suitable containers for disposal.
Large Spills
Containment: Use water to flush large spills to containment area for later disposal. Do not release into sewers or waterways.
Cleanup: Damp mop any residue.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: *Do not* use near heat or flame. Wear appropriate PPE.
Storage Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10).

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond equipment used with and around anthracene. Enclosure of equipment and mechanization of processes will aid in exposure control.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable concentration, use a SCBA or supplied-air respirator with a full facepiece and operated in pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment: Limit work in sunlight as much as possible to prevent photosensitization. Photoprotective creams or pastes must be applied to bare skin regions. Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyvinyl chloride is a suitable material for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
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 and place in closed containers until laundered. Remove anthracene from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using anthracene, especially before eating, drinking, smoking, using the toilet, or applying cosmetics. Skin cleansers (ex. 55% kaolin, 25% neutral soap, 20% bran) are recommended.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: Colorless crystals with a violet fluorescence (pure), yellow crystals with a green fluorescence (due to tetracene and naphthacene)
Vapor Pressure: 1mm Hg at 293 °F (145 °C)
Formula Weight: 178.22
Density (H_2O=1, at 4 °C): 1.25 g/cm^3 at 80.6 °F (27 °C)
Octanol/Water Partition Coefficient: log Kow = 4.45 (calc.)
Water Solubility: 1.29 mg/L at 77 °F/25 °C (*distilled water*), 0.6 mg/L at 77 °F/25 °C (*salt water*)
Other Solubilities: 1 g in 67 mL absolute alcohol, 70 mL methanol, 62 mL benzene, 85 mL chloroform, 200 mL ether, 31 mL carbon disulfide, 86 mL carbon tetrachloride, and 125 mL toluene. Also soluble in acetone.
Boiling Point: 644 °F (340 °C)
Melting Point: 423 °F (217 °C)

Section 10 - Stability and Reactivity

Stability: Anthracene darkens upon exposure to sunlight (transformed to *para*-anthracene).
Polymerization: Hazardous polymerization *does not* occur.
Chemical Incompatibilities: Include calcium hypochlorite (exothermic), fluorine (explodes), chromic acid, and calcium oxychloride.
Conditions to Avoid: Exposure to heat, ignition sources, sunlight, and incompatibles.
Hazardous Decomposition Products: Thermal oxidative decomposition of anthracene can produce carbon oxide(s) and acrid, irritating smoke.

Section 11- Toxicological Information

Toxicity Data:*

Skin Effects:
Mouse, skin: 118 µg caused mild irritation.
Mutagenicity:
Rat, liver cell: 300 µmoL caused DNA damage.
Acute Oral Effects:
Mouse, oral, LD: > 17 g/kg caused fatty liver degeneration.
Tumorigenicity:
Rat, oral: 20 g/kg intermittently for 79 weeks caused liver tumors.

* See NIOSH, *RTECS* (CA9350000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Leponis macrochirus* (bluegill sunfish), LC_{50} = 11.9 µg/L/96 hr; *Rana pipiens* (leopard frog), LC_{50} = 0.065 ppm/30 min & 0.025 ppm/5 hr. BCF (bioconcentration factor): goldfish (162), rainbow trout (4400-9200). Bioconcentration occurs most heavily in organisms which lack the enzyme microsomal oxidase. Anthracene can become concentrated on the waxy surface of some plant leaves and fruits.
Environmental Degradation: If released to soil, anthracene is expected to absorb strongly and not leach to groundwater. It will not hydrolyze, but may be subject to biodegradation, the rate of which depends on soil type. In water, anthracene is subject to direct photolysis near the surface and undergoes significant biodegradation. Biodegradation in water is faster with increased temperature, increased oxygen, and acclimated microbes. Evaporation may also be significant with an estimated half-life range of 4.3 to 5.9 days from a river 1 m deep, flowing 1 m/sec, with a wind velocity of 3 m/sec. In the air, photolysis and reaction with photochemically-produced hydroxyl radicals (half-life: 1.67 days). Vapor phase anthracene is expected to degrade faster than particle-sorbed anthracene.
Soil Absorption/Mobility: A Koc of 26,000 suggests anthracene is relatively immobile in soil and unlikely to leach to groundwater; it will absorb strongly to soil.

Section 13 - Disposal Considerations

Disposal: Anthracene is a waste chemical stream constituent which may be subjected to ultimate disposal by controlled incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name:
Environmentally hazardous substances, solid, n.o.s.*
Shipping Symbols: —
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9
Special Provisions (172.102): 8, B54, N50

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: None
b) Cargo Aircraft Only: None

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: —

* Classified as a hazardous substance when anthracene 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 Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per CWA, Sec. 311 (b)(4)
CERCLA Reportable Quantity (RQ), 5000 lb (2270 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 103, 124, 132, 136, 149, 159, 176, 184, 187, 189, 192

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... DJ Wilson, CIH
Medical Review ..... T Thoburn, MD, MPH

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Issue Date: 2000-07

Acetone
MSDS 300
ACE4750

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Acetone **CAS Number:** 67-64-1
Chemical Formula: C_3H_6O
Structural Chemical Formula: CH_3COCH_3
Synonyms: ACETON; ACETONE; CHEVRON ACETONE; DIMETHYL KETONE; DIMETHYLFORMALDEHYDE; DIMETHYLKETAL; EPA PESTICIDE CHEMICAL CODE 004101; KETONE PROPANE; KETONE,DIMETHYL; BETA-KETOPROPANE; METHYL KETONE; 2-PROPANONE; PROPANONE; PYROACETIC ACID; PYROACETIC ETHER
General Use: Solvent for fats, oils, waxes, resins, rubber, plastics, lacquers.
Used in manufacture of methyl isobutyl ketone, mesityl oxide, acetic acid, diacetone alcohol, isoprene. Used in solvent extraction processes.
Solvent in the manufacture of explosives and rayon. Component of adhesives, glues, cleaning solvents, lacquer thinners, nail polish, paint removers.
Storing acetylene gas (takes up about 24 times its volume of the gas).
Purifying paraffin and biomedical hardening and dehydrating tissues.
Minor food additive, permitted in USA.

Section 2 - Composition / Information on Ingredients

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

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

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

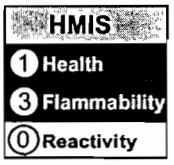
DFG (Germany) MAK
TWA: 500 ppm; 1200 mg/m^3.

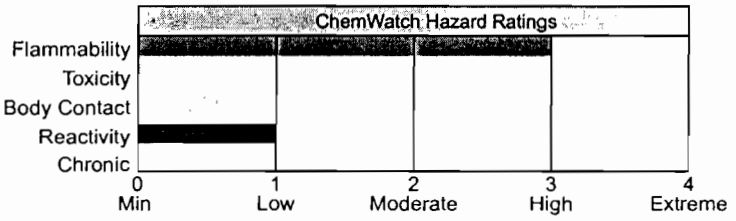
OSHA PEL Vacated 1989 Limits
TWA: 750 ppm; 1800 mg/m^3;
STEL: 1000 ppm; 2400 mg/m^3.

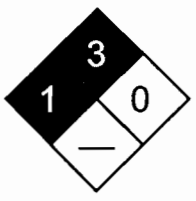
IDLH Level
2500 ppm; LEL.

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

Section 3 - Hazards Identification







Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

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

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

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Exposure to ketone vapors may produce nose, throat and mucous membrane irritation. High concentrations of vapor may produce central nervous system depression characterized by headache, vertigo, loss of coordination, narcosis and cardiorespiratory failure. Some ketones produce neurological disorders (polyneuropathy) characterized by bilateral symmetrical paresthesia and muscle weakness primarily in the legs and arms.
Symptoms of exposure may include restlessness, headache, vomiting, stupor, low blood pressure and rapid and irregular pulse, eye and throat irritation, weakness of the legs, dizziness and lightheadedness.
Inhalation of high concentrations produces dryness of the mouth and throat, dizziness, nausea, incoordinated movements, loss of coordinated speech, drowsiness, and in extreme cases, coma.
Inhalation of acetone vapors over long periods causes irritation of the respiratory tract, coughing, headache. Acetone concentrations of 52200 ppm for 1 hour produced narcosis in rats and fatalities at 126600 ppm.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration.
The vapor is discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin if exposure is prolonged and may cause drying of the skin, which may lead to dermatitis.
Toxic effects may result from skin absorption.
Open cuts, abraded or irritated skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is highly discomforting and mildly toxic if swallowed but may be harmful if swallowed in quantity.
Small amounts or low dose rates are regarded as practically non-harmful.

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

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.
Workers exposed to 700 ppm acetone for 3 hours/day for 7-15 years showed inflammation of the respiratory tract, stomach and duodenum, attacks of giddiness and loss of strength. Exposure to acetone may enhance liver toxicity of chlorinated solvents.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

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

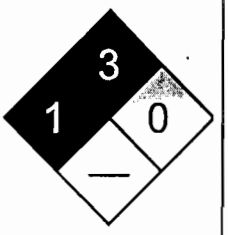
Ingestion: Rinse mouth out with plenty of water.
Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: For acute or short-term repeated exposures to acetone:
1.Symptoms of acetone exposure approximate ethanol intoxication.
2.About 20% is expired by the lungs and the rest is metabolized.
Alveolar air half-life is about 4 hours following two hour inhalation at levels near the Exposure Standard; in overdose, saturable metabolism and limited clearance, prolong the elimination half-life to 25-30 hours.
3.There are no know antidotes and treatment should involve the usual methods of decontamination followed by supportive care.

Section 5 - Fire-Fighting Measures

Flash Point: -20 °C
Autoignition Temperature: 465 °C
LEL: 2.15% v/v
UEL: 13% v/v



Fire Diamond

Extinguishing Media: Water spray or fog; alcohol stable foam.
Dry chemical powder.
Bromochlorodifluoromethane (BCF) (where regulations permit).
Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
PLEASE NOTE: 10% of acetone in water has a flash point below 20 deg. C.

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

Section 6 - Accidental Release Measures

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

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

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

Section 7 - Handling and Storage

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

DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment

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

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

Respiratory Protection:

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

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

Glove Selection Index:

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

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

Section 9 - Physical and Chemical Properties

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

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

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

Section 10 - Stability and Reactivity

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

Section 11 - Toxicological Information

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

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

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

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

Section 12 - Ecological Information

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

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

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

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

Additional Shipping Information:

Section 15 - Regulatory Information

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

Section 16 - Other Information

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

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Issue Date: 2000-07

Ethylbenzene
MSDS 385
ETH3050

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Ethylbenzene **CAS Number:** 100-41-4
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_5 \cdot C_2H_5$
Synonyms: AETHYLBENZOL; BENZENE,ETHYL-; EB; ETHYL BENZENE; ETHYLBENZEEN; ETHYLBENZENE; ETHYLBENZOL; ETILBENZENE; ETYLOBENZEN; PHENYLETHANE
General Use: Used in the manufacture of cellulose acetate, styrene and synthetic rubber; solvent or diluent; component of automotive and aviation gasoline.
Component of many petroleum hydrocarbon solvents, thinners.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethylbenzene	100-41-4	>95

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

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 125 ppm; 545 mg/m^3.

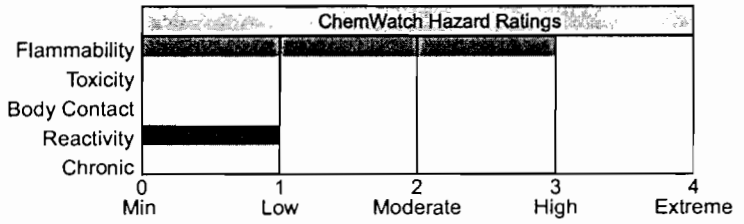
ACGIH TLV
TWA: 100 ppm; 434 mg/m^3;
STEL: 125 ppm; 543 mg/m^3.

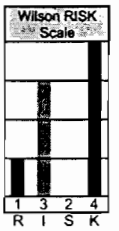
NIOSH REL
TWA: 100 ppm; 435 mg/m^3.
STEL: 125 ppm; 545 mg/m^3.

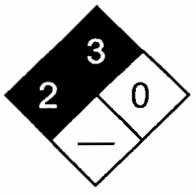
IDLH Level
800 ppm; LEL.

DFG (Germany) MAK
TWA: 100 ppm; 440 mg/m^3.

Section 3 - Hazards Identification







Fire Diamond

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact
Target Organs: eyes, respiratory system, skin, central nervous system (CNS), blood
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Inhalation of vapor may aggravate a pre-existing respiratory condition such as asthma, bronchitis, emphysema.

When humans were exposed to the 100 and 200 ppm for 8 hours about 45-65% is retained in the body. Only traces of unchanged ethyl benzene are excreted in expired air following termination of inhalation exposure.

Humans exposed to concentrations of 23-85 ppm excreted most of the retained dose in the urine (mainly as metabolites).

Guinea pigs that died from exposure had intense congestion of the lungs and generalized visceral hyperemia. Rats exposed for three days at 8700 mg/m^3 (2000 ppm) showed changes in the levels of dopamine and noradrenaline in various parts of the brain.

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

The vapor is discomforting to the eyes.

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

Two drops of the material in to the conjunctival sac produced only slight irritation of the conjunctival membrane but no corneal injury.

Skin: The liquid is discomforting to the skin if exposure is prolonged and is capable of causing skin reactions which may lead to dermatitis.

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

The mean rate of absorption of liquid ethyl benzene applied to 17.3 cm2 area of the forearm of seven volunteers for 10-15 minutes was determined to be 38 mg/cm2/hr. Immersion of the whole hand in aqueous solutions of ethyl benzene (112-156 mg/l) for 1 hour yielded mean absorption rates of 118 and 215.7 ug/cm2/hr. The rate of absorption is thus greater than that of aniline, benzene, nitrobenzene, carbon disulfide and styrene.

Repeated application of the undiluted product to the abdominal area of rabbits (10-20 applications over 2-4 weeks) resulted in erythema, edema and superficial necrosis. The material did not appear to be absorbed through the skin in sufficient quantity to produce outward signs of toxicity.

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

The liquid may produce considerable gastrointestinal discomfort and may be harmful or toxic if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

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

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

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

Industrial workers exposed to a maximum level of ethyl benzene of 0.06 mg/l (14 ppm) reported headaches and irritability and tired quickly. Functional nervous system disturbances were found in some workers employed for over 7 years whilst other workers had enlarged livers.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

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

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

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

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

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

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. DO NOT induce vomiting.

Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.

Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink.

Transport to hospital or doctor without delay.

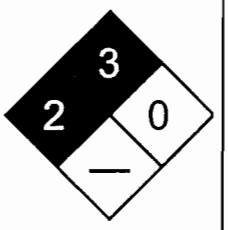
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance
4. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
   Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6. Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

Flash Point: 12.8 °C Closed Cup
Autoignition Temperature: 432 °C
LEL: 1.6% v/v
UEL: 7% v/v



Fire Diamond

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

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.

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

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

Section 6 - Accidental Release Measures

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

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

If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves or Nitrile gloves.
Protective footwear.
Respiratory Protection:
Exposure Range >100 to <800 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 800 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Eyewash unit.
Glove Selection Index:

VITON	A
TEFLON	A

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid; floats on water. Aromatic solvent odor. Soluble in alcohol, benzene, carbon tetrachloride and ether.

Physical State: Liquid
Vapor Pressure (kPa): 1.333 at 25.9 °C
Vapor Density (Air=1): 3.66
Formula Weight: 106.17
Specific Gravity (H_2O=1, at 4 °C): 0.8670 at 20 °C
Water Solubility: 0.01% by weight
Evaporation Rate: Fast
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 136.2 °C (277 °F) at 760 mm Hg
Freezing/Melting Point Range: -95 °C (-139 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

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

TOXICITY
Oral (rat) LD_{50}: 3500 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm/8h
Inhalation (rat) LC_{Lo}: 4000 ppm/4h
Intraperitoneal (mouse) LD_{50}: 2642 mg/kg~
Dermal (rabbit) LD_{50}: 17800 mg/kg~

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

Liver changes, utheral tract, effects on fertility, specific developmental abnormalities (musculoskeletal system) recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

See NIOSH, *RTECS* DA 0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it exist predominantly in the vapor phase based on its vapor pressure where it will photochemically degrade by reaction with hydroxyl radicals (half-life 0.5 to 2 days) and partially return to earth in rain. It will not be subject to direct photolysis. Releases into water will decrease in concentration by evaporation and biodegradation. The time for this decrease and the primary loss processes will depend on the season, and the turbulence and microbial populations in the particular body of water. Representative half-lives are several days to 2 weeks. Some may be adsorbed by sediment but significant bioconcentration in fish is not expected to occur based upon its octanol/water partition coefficient. It is only adsorbed moderately by soil. It will not significantly hydrolyze in water or soil.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) 275 mg/l 96 hr in a static unmeasured bioassay; LC_{50} Pimephales promelas (fathead minnow) 12.1 mg/l/96 hr (confidence limit 11.5 - 12.7 mg/l), flow-through bioassay with measured concentrations, 26.1 °C, dissolved oxygen 7.0 mg/l, hardness 45.6 mg/l calcium carbonate, alkalinity 43.0 mg/l; Toxicity threshold (cell multiplication inhibition test): Pseudomonas putida (bacteria) 12 mg/l ; LC_{50} Palaemonetes pugio (grass shrimp, adult) 14,400 ug/l/24 hr in a static unmeasured bioassay; LC_{50} Palaemonetes pugio (grass shrimp, larva) 10,200 ug/l/24 hr in a static unmeasured bioassay; Toxicity threshold (cell multiplication inhibition test): Microcystis aeruginosa (algae) 33 mg/l; Scenedesmus quadricauda (green algae) > 160 mg/l

Henry's Law Constant: 8.44×10^{-3}

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): theoretical 2.8%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 3.15

Soil Sorption Partition Coefficient: K_{oc} = 164

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHYLBENZENE
Additional Shipping Information: PHENYL ETHANE
Hazard Class: 3.1
ID No.: 1175
Packing Group: II
Label: Flammable Liquid [3]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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Material Safety Data Sheet Collection
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Issue Date: 2000-07

Toluene
MSDS 317
TOL2320

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Toluene **CAS Number:** 108-88-3
Chemical Formula: C_7H_8
Structural Chemical Formula: $C_6H_5CH_3$
Synonyms: ANTISAL 1A; BENZENE,METHYL-; CP 25; METHACIDE; METHANE,PHENYL-; METHYL BENZENE; METHYL BENZOL; METHYLBENZENE; METHYLBENZOL; PHENYL METHANE; PHENYLMETHANE; TOLUEEN; TOLUEN; TOLUENE; TOLUENO; TOLUOL; TOLUOLO; TOLU-SOL
General Use: Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners; in gasoline and aviation fuel. Used in the manufacture of chemicals, dyes, explosives, benzoic acid.
Some grades of toluene may contain traces of xylene and benzene.
Odor threshold: 2 ppm approx. Odor is not a reliable warning property due to olfactory fatigue.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
toluene	108-88-3	> 99.5

OSHA PEL
TWA: 200 ppm; STEL: 300 ppm; from Table Z-2. Other Values: 500 mg/m^3; 10 min peak 8hr ppm.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 375 mg/m^3; STEL: 150 ppm; 560 mg/m^3.

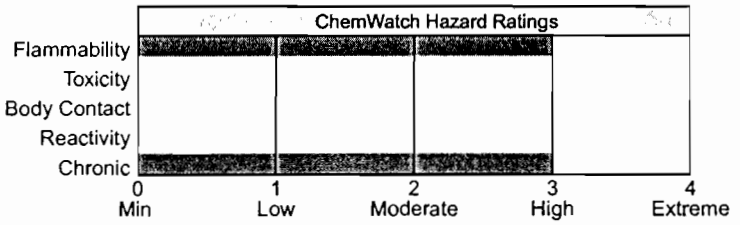
ACGIH TLV
TWA: 50 ppm; 188 mg/m^3.

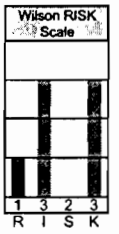
NIOSH REL
TWA: 100 ppm; 375 mg/m^3. STEL: 150 ppm; 560 mg/m^3.

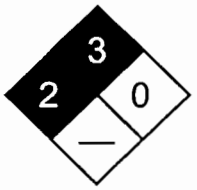
IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 50 ppm; 190 mg/m^3.

Section 3 - Hazards Identification







Fire Diamond

ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sickly, sweet odor. Irritating to the eyes/skin/respiratory tract. Also causes: weakness, headache, dizziness, confusion, and insomnia. Chronic: liver and kidney damage. May cause birth defects. Flammable.

Potential Health Effects

Primary Entry Routes: Inhalation, skin contact/absorbtion.
Target Organs: Skin, liver, kidneys, central nervous system.
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Central nervous system (CNS) depression may include nonspecific discomfort, symptoms of giddiness, headache, dizziness, nausea, anesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness.

Serious poisonings may result in respiratory depression and may be fatal.

Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes if exposure is prolonged.

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

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

Defatting and/or drying of the skin may lead to dermatitis and it is absorbed by skin.

Toxic effects may result from skin absorption.

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

The material may accentuate any pre-existing skin condition.

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

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

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Chronic toluene habituation occurs following intentional abuse (glue-sniffing) or from occupational exposure. Ataxia, incoordination and tremors of the hands and feet (as a consequence of diffuse cerebral atrophy), headache, abnormal speech, transient memory loss, convulsions, coma, drowsiness, reduced color perception, frank blindness, nystagmus (rapid, involuntary eye-movements), decreased hearing leading to deafness and mild dementia have all been associated with chronic abuse.

Peripheral nerve damage, encephalopathy, giant axonopathy, electrolyte disturbances in the cerebrospinal fluid and abnormal computer tomographic (CT) scans are common amongst toluene addicts. Although toluene abuse has been linked with kidney disease, this does not commonly appear in cases of occupational toluene exposures. Cardiac and hematological toxicity are however associated with chronic toluene exposure. Cardiac arrhythmia, multifocal and premature ventricular contractions and supraventricular tachycardia are present in 20% of patients who abused toluene-containing paints.

Previous suggestions that chronic toluene inhalation produced human peripheral neuropathy have largely been discounted. However central nervous system (CNS) depression is well documented where blood toluene levels exceed 2.2 mg%. Toluene abusers can achieve transient circulating concentrations of 6.5 mg%. Amongst workers exposed for a median time of 29 years to toluene no subacute effects on neurasthenic complaints and pyschometric test results could be established.

The prenatal toxicity of very high toluene concentrations has been documented for several animal species and man. Malformations indicative of specific teratogenicity have not generally been found. The toxicity described in the literature takes the form of embryo death or delayed fetal growth and delayed skeletal system development. Permanent damage of children has been seen only when mothers had suffered from chronic intoxication as a result of "sniffing".

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

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

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

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

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

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

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: Following acute or short-term repeated exposures to toluene:

1. Toluene is absorbed across to alveolar barrier, the blood/air mixture being 11.2/15.6 (at 37 °C) The order of toluene, in expired breath, is of the order of 18 ppm following sustained exposure to 100 ppm.
The tissue/blood proportion is 1/3 except in adipose where the proportion is 8/10.
2. Metabolism by microsomal mono-oxygenation, results in the production of hippuric acid. This may be detected in the urine in amounts between 0.5 and 2.5 g/24hr which represents, on average 0.8 gm/gm of creatinine.
The biological half life of hippuric acid is in the order of 1-2 hours.
3. Primary threat to life from ingestion and/or inhalation is respiratory failure.
4. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
8. Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

BIOLOGICAL EXPOSURE INDEX - BEI

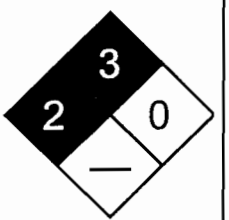
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

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

NS: Non-specific determinant; also observed after exposure to other material
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.
B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: 4 °C Closed Cup
Autoignition Temperature: 480 °C
LEL: 1.2% v/v
UEL: 7.1% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO) and carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Nitric acid with toluene, produces nitrated compounds which are explosive.



Fire Diamond

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

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; Metal drum; Metal safety cans. Packing as supplied by manufacturer.
Plastic containers may only be used if approved for flammable liquid.
Check that containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area; local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; chemical goggles. Full face shield.

DO NOT we contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:

Exposure Range >200 to <500 ppm: Air Purifying, Negative Pressure, Half Mask

Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face Cartridge Color: black

Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:

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

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 2.93 at 20 °C
Vapor Density (Air=1): 3.2
Formula Weight: 92.14
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 20 °C
Water Solubility: < 1 mg/mL at 18 °C
Evaporation Rate: 2.4 (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 111 °C (232 °F) at 760 mm Hg
Freezing/Melting Point Range: -95 °C (-139 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers.

Section 11 - Toxicological Information

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

TOXICITY
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 636 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm
Inhalation (man) TC_{Lo}: 200 ppm
Inhalation (rat) LC_{50}: > 26700 ppm/1h
Dermal (rabbit) LD_{50}: 12124 mg/kg
Reproductive effector in rats

IRRITATION
Skin (rabbit): 20 mg/24h-moderate
Skin (rabbit): 500 mg - moderate
Eye (rabbit): 0.87 mg - mild
Eye (rabbit): 2 mg/24h - SEVERE
Eye (rabbit): 100 mg/30sec - mild

See NIOSH, *RTECS* XS 5250000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be lost by evaporation from near-surface soil and by leaching to the groundwater. Biodegradation occurs both in soil and groundwater, but it is apt to be slow especially at high concentrations, which may be toxic to microorganisms. The presence of acclimated microbial populations may allow rapid biodegradation. It will not significantly hydrolyze in soil or water under normal environmental conditions. If released into water, its concentration will decrease due to evaporation and biodegradation. This removal can be rapid or take several weeks, depending on temperature, mixing conditions, and acclimation of microorganisms. It will not significantly adsorb to sediment or bioconcentrate in aquatic organisms. If released to the atmosphere, it will degrade by reaction with photochemically produced hydroxyl radicals (half-life 3 hr to slightly over 1 day) or be washed out in rain. It will not be subject to direct photolysis.

Ecotoxicity: LC_{50} Aedes aegypti-4th instar (mosquito larvae) 22 mg/l /Conditions of bioassay not specified; LC_{50} Cyprinodon variegatus (sheepshead minnow) 277-485 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Calandra granaria (grain weevil) 210 mg/l /in air; LC_{50} Cancer magister (crab larvae stage I) 28 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 4.3 ppm 96 hr /Conditions of bioassay not specified; LC_{50} Artemia salina (brine shrimp) 33 mg/l 24 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (striped bass) 7.3 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnows) 55-72 mg/l (embryos), 25-36 mg/l (1-day posthatch protolarvae), and 26-31 mg/l (30-day-old minnows)/ 96 hour /Conditions of bioassay not specified

Henry's Law Constant: 0.0067

BCF: eels 13.2

Biochemical Oxygen Demand (BOD): 0%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.69

Soil Sorption Partition Coefficient: K_{oc} = silty loam 37

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: TOLUENE
Additional Shipping Information: TOLUOL
Hazard Class: 3.1
ID No.: 1294
Packing Group: II
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U220 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per RCRA Section 3001; per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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Issue Date: 2000-07

Perchloroethylene
MSDS 313
TET2750

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Perchloroethylene **CAS Number:** 127-18-4
Chemical Formula: C_2Cl_4
Structural Chemical Formula: $Cl_2C=CCl_2$
Synonyms: ANKILOSTIN; ANTISAL 1; ANTISOL 1; CARBON BICHLORIDE; CARBON DICHLORIDE; CZTEROCHLOROETYLEN; DIDAKENE; DILATIN PT; DOW-PER; ENT 1,860; EPA PESTICIDE CHEMICAL CODE 078501; ETHENE,TETRACHLORO-; ETHYLENE TETRACHLORIDE; ETHYLENE,TETRACHLORO-; FEDAL-UN; NEMA; PCE; PER; PERAWIN; PERC; PERCHLOORETHYLEEN,PER; PERCHLOR; PERCHLORAETHYLEN,PER; PERCHLORETHYLENE; PERCHLORETHYLENE,PER; PERCHLOROETHYLENE; PERCLENE; PERCLENE D; PERCLOROETILENE; PERCOSOLV; PERCOSOLVE; PERK; PERKLONE; PERSEC; TETLEN; TETRACAP; TETRACHLOORETHEEN; TETRACHLORAETHEN; TETRACHLORETHYLENE; TETRACHLOROETHENE; 1,1,2,2-TETRACHLOROETHYLENE; TETRACHLOROETHYLENE; TETRACLOROETENE; TETRAGUER; TETRALENO; TETRALEX; TETRAVEC; TETROGUER; TETROPIL
General Use: Used as a drycleaning solvent, a vapor-degreasing solvent; a drying agent for metals and certain other solids. Used also as a heat transfer medium and in the manufacture of fluorocarbons.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
perchloroethylene	127-18-4	100

OSHA PEL
TWA: 100 ppm; STEL: 200 ppm; from Table Z-2. Other Values: 300 mg/m^3; 5 min peak 3hr ppm.

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

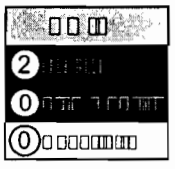
ACGIH TLV
TWA: 25 ppm; 170 mg/m^3; STEL: 100 ppm; 6850 mg/m^3.

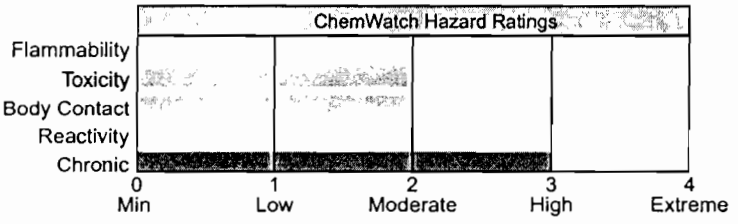
NIOSH REL
No data found.

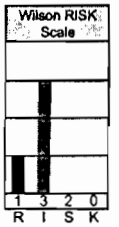
IDLH Level
150 ppm.

DFG (Germany) MAK
TWA: 50 ppm; 345 mg/m^3.

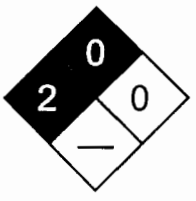
Section 3 - Hazards Identification







ANSI Signal Word



Fire Diamond

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; ether-like odor. Irritating to eyes/skin/respiratory tract. Also causes: headache, dizziness, CNS depression, incoordination, slurred speech. Chronic: liver/kidney damage; possible cancer hazard based on animal studies.

Potential Health Effects

Primary Entr Routes: inhalation, skin contact, eye contact

Target Organ Liver, kidneys, eyes, upper respiratory system, skin, central nervous system (CNS)

Acute Effects

Inhalation: A ute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible na osis are evident in the first stage and in the second stage signs of injury to organs may become evident. A single organ alone is (almost) never involved.
The vapor is highly discomforting to the upper respiratory tract and lungs.
Inhalation hazard is increased at higher temperatures.
Anesthetic and narcotic effects (with dulling of senses and odor fatigue) are a consequence of exposure to chlorinated solvents.
Individual response varies widely; odor may not be considered objectionable at levels which quickly induce central nervous system effects.
High vapor concentrations may give a feeling of euphoria. This may result in reduced responses, followed by rapid onset of unconsciousness, possible respiratory arrest and death.
Accidental high level exposure has produced lightheadedness, unconsciousness and liver and kidney damage in workers. In at least two cases such exposures were fatal. Subjects exposed to 106 ppm in laboratory studies experienced slight eye irritation; dizziness and sleepiness were reported at 216 ppm; at exposures of 280 ppm or 600 ppm for 10 minutes there was a loss of motor coordination. In another study subjects exposed for 7 hours at 101 ppm complained of eye irritation and subjective symptoms such headache, drowsiness and sleepiness.

Eye: The liquid may produce eye discomfort and is capable of causing temporary impairment of vision and/or transient eye inflammation, ulceration Eye contact may cause lachrymation (tears) and burning sensation.
The vapor is highly discomforting to the eyes.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is highly discomforting to the skin if exposure is prolonged and may cause drying of the skin, which may lead to dermatitis.
Toxic effects may result from skin absorption.
Absorption by skin may readily exceed vapor inhalation exposure.
Symptoms for skin absorption are the same as for inhalation.
Bare unprotected skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.
The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).
This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.
Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.
Industrial experience shows localized skin irritation. Prolonged dermal contact can cause chemical burns and blistering.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is highly discomforting and toxic if swallowed and may be fatal if swallowed in large quantity.
Ingestion may result in nausea, abdominal irritation, pain and vomiting.
When used in the treatment of hookworm (4.5 to 6.5 gm orally) the only adverse effect is inebriation. Transient hepatotoxicity in patients given single oral doses of up to 5 mL have been recorded.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.
Workers inhaling 232 to 385 ppm for 8 hours/day, 5 days/week for 2 to 6 years have shown abnormal hepatic function, including cirrhosis, with lightheadedness, headache, malaise and dizziness.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

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

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Avoid giving milk or oils.
Avoid giving alcohol.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.
Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.
For acute or short-term repeated exposures to perchloroethylene:
Tetrachloroethylene/perchlorethylene is well absorbed through the lungs with peak levels more important than duration in determining blood concentration.
Lungs excrete most of the absorbed tetrachloroethylene in an unchanged state; about 3% is converted by the liver to form trichloracetic acid and subsequently excreted by the kidney. Exhaled material has a biological half-life of 65 hours.
INHALATION:
The treatment of acute inhalation exposures is supportive with initial attention directed to evaluation/support of ventilation and circulation.
As with all hydrocarbons care must be taken to reduce the risk of aspiration by proper positioning and medical observation.
INGESTION:
1.The ingestion level at which emesis should be induced is difficult to predict in the absence of extensive human studies.
2.The role of charcoal and cathartics remains uncertain.

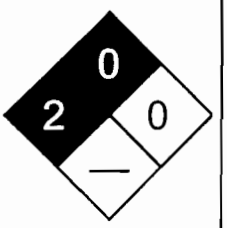
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker who has been exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Perchloroethylene in end-exhaled air	10 ppm	Prior to last shift of work-week	
Perchloroethylene in Blood	1 mg/L	Prior to last shift of work-week	
Trichloroacetic acid in urine	7 mg/L	End of work-week	NS,SQ

NS: Non-specific determinant; also seen after exposure to other materials
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: 490 °C
LEL: 1.8% v/v
UEL: 11.5% v/v at 740 mm Hg 160 °C
Extinguishing Media: Use extinguishing media suitable for surrounding area.
General Fire Hazards/Hazardous Combustion Products: Nonflammable liquid. However vapor will burn when in contact with high temperature flame. Ignition ceases on removal of flame.
May form a flammable/explosive mixture in an oxygen enriched atmosphere. Heating may cause expansion/vaporization with violent rupture of containers. Decomposes on heating and produces corrosive fumes of hydrochloric acid, carbon monoxide and small amounts of toxic phosgene.



Fire Diamond

Fire Incompatibility: Avoid mixing with strong alkalis or powdered metals, particularly zinc as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately.
Wear protective neoprene gloves and chemical goggles.
If risk of overexposure exists, wear NIOSH-approved respirator.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
DO NOT discharge into sewer or waterways.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Minor hazard. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Check that containers are clearly labeled. Glass container.
Heavy gauge metal packages/heavy gauge metal drums.
Avoid storage with zinc, galvanized or diecast metal (including bungs).
DO NOT use aluminum or galvanized containers.
Packaging as recommended by manufacturer.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
If inhalation risk exists, wear NIOSH-approved organic-vapor respirator or air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Chemical goggles. Full face shield.
Hands/Feet: Neoprene gloves; Viton gloves.
PVA gloves.
PVC gloves.
Protective footwear.
Respiratory Protection:
Exposure Range >100 to <150 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 150 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties
Other: Overalls. Eyewash unit. Ensure there is ready access to an emergency shower.

Glove Selection Index:

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

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless liquid, with a chloroform-like odor. Extremely stable, resists hydrolysis. Miscible with alcohol, ether and oils.

Physical State: Liquid
Vapor Pressure (kPa): 2.11 at 22 °C
Vapor Density (Air=1): 5.83
Formula Weight: 165.82
Specific Gravity (H_2O=1, at 4 °C): 1.63 at 15 °C
Water Solubility: 0.02% by weight
Evaporation Rate: 0.09 Ether=1

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

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable and hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents. Segregate from strong alkalis.
Haloalkenes are highly reactive. Some of the more lightly substituted lower members are highly flammable; many members of the group are peroxidizable and polymerizable.
The presenceof 0.5% trichloroethylene as an impurity caused generation of dichloroacetylene during unheated drying over solid sodium hydroxide.
Subsequent fractional distillation produced an explosion.

Section 11 - Toxicological Information

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

TOXICITY
Oral (rat) LD_{50}: 2629 mg/kg
Inhalation (man) LD_{Lo}: 2857 mg/kg
Inhalation (human) TC_{Lo}: 96 ppm/7 hrs
Inhalation (man) TC_{Lo}: 280 ppm/2 hrs
Inhalation (man) TC_{Lo}: 600 ppm/10 min
Inhalation (rat) LC_{Lo}: 34200 mg/m^3/8 hr

IRRITATION
Skin (rabbit): 810 mg/24h -SEVERE
Eye (rabbit): 162 mg -mild

See NIOSH, *RTECS* KX 3850000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If it is released to soil, it will be subject to evaporation into the atmosphere and to leaching to the groundwater. Biodegradation may be an important process in anaerobic soils based on laboratory tests with methanogenic columns. Slow biodegradation may occur in groundwater where acclimated populations of microorganisms exist. If released to water, it will be subject to rapid volatilization with estimated half-lives ranging from <1 day to several weeks. It will not be expected to significantly biodegrade, bioconcentrate in aquatic organisms or significantly adsorb to sediment. It will not be expected to significantly hydrolyze in soil or water under normal environmental conditions. If released to the atmosphere, it will exist mainly in the gas-phase and it will be subject to photooxidation with estimates of degradation time scales ranging from an approximate half-life of 2 months to complete degradation in an hour. Some in the atmosphere may be subject to washout in rain based on the solubility in water.

Ecotoxicity: LC_{50} Tanytarsus dissimilis (midge) 30, 840 ug/l/48 hr, static bioassay; LC_{50} Poecilia reticulata (guppy) 18 ppm/7 days /Conditions of bioassay not specified; LC_{50} Daphnia magna (water flea) 18 mg/l/48 hr, static bioassay, at 22 °C; LC_{50} Salmo gairdneri (rainbow trout) 5 mg/l/96 hr, static bioassay at 12 °C
Henry's Law Constant: 2.87×10^{-2}
BCF: fathead minnow 38.9
Biochemical Oxygen Demand (BOD): none
Octanol/Water Partition Coefficient: $\log K_{ow} = 3.40$
Soil Sorption Partition Coefficient: $K_{oc} = 209$

Section 13 - Disposal Considerations

Disposal: Reclaim solvent at an approved site.
Allow absorbed spillage to evaporate in an open top container, away from habitation.
Incinerate residue at an approved site.
Used containers should be left upside down with bungs out.
Return containers to drum reconditioner or recycler.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name:
TETRACHLOROETHYLENE
Additional Shipping Information: PERCHLOROETHYLENE
Hazard Class: 6.1(b)
ID No.: 1897
Packing Group: III
Label: Harmful[6]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U210 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001; per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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Issue Date: 2001-06

Benz[a]anthracene
MSDS: BEN2040

Section 1 - Chemical Product and Company Identification 55

Material Name: Benz[a]anthracene **CAS Number:** 56-55-3
Chemical Formula: $C_{18}H_{12}$
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

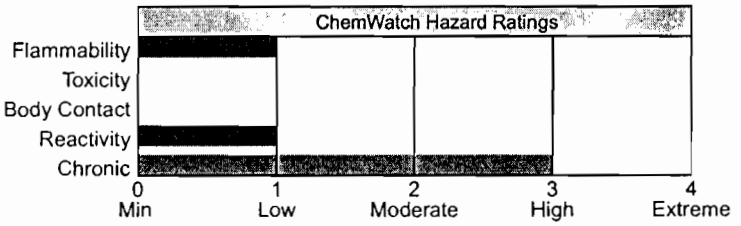
Name	CAS	%
benz[a]anthracene	56-55-3	>98

OSHA PEL
No data found.

NIOSH REL
No data found.

ACGIH TLV
No data found.

Section 3 - Hazards Identification



ANSI Signal Word

Danger!


Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Target Organs: No data found.
Primary Entry Routes: accidental skin and eye contact, inhalation of generated dusts
Acute Effects

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

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

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

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

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

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

Section 4 - First Aid Measures

Inhalation: • If dust is inhaled, remove to fresh air.
• Encourage patient to blow nose to ensure clear breathing passages.
• Rinse mouth with water. Consider drinking water to remove dust from throat.
• Seek medical attention if irritation or discomfort persist.
• If fumes or combustion products are inhaled, remove to fresh air.
• Lay patient down. Keep warm and rested.
• Other measures are usually unnecessary.
Eye Contact: • Immediately hold the eyes open and flush with fresh running water.
• Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
• Seek medical attention if pain persists or recurs.
• Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: • Immediately remove all contaminated clothing, including footwear (after rinsing with water).
• Wash affected areas thoroughly with water (and soap if available).
• Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center. If more than 15 minutes from a hospital:
• INDUCE vomiting with IPECAC SYRUP, or fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. NOTE: Wear a protective glove when inducing vomiting by mechanical means.
• SEEK MEDICAL ATTENTION WITHOUT DELAY.
• In the meantime, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
• If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided.
• If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

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

Section 6 - Accidental Release Measures

Small Spills: • Clean up all spills immediately.
• Avoid contact with skin and eyes.

- Wear protective clothing, gloves, safety glasses and dust respirator.
- Use dry clean up procedures and avoid generating dust.
- Vacuum up or sweep up.
- Place in clean drum then flush area with water.

Large Spills: • Clear area of personnel and move upwind.
- Contact fire department and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or waterways.
- No smoking, bare lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse/absorb vapor.
- Contain or absorb spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
- If contamination of drains or waterways occurs, advise emergency services.

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

Section 7 - Handling and Storage

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

Recommended Storage Methods: Glass container. Plastic container. Metal can. Metal drum. Check that all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment

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

Hands/Feet: Wear chemical protective gloves, e.g. PVC. Wear safety footwear.

Other: • Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

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

Physical State: colorless plates

Vapor Pressure (kPa): 5×10^{-9} torr at 20 °C

Formula Weight: 228.29

Water Solubility: 0.014 mg/L in Water at 25 °C

Evaporation Rate: Half life 89 hours

Boiling Point Range: Sublimes at 435 °C (815 °F)

Freezing/Melting Point Range: 162 °C (323.6 °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
Intravenous (rat) LD_{50}: > 200 mg/kg

Irritation
Nil reported

See NIOSH, *RTECS* CV9275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When released into water it will rapidly become adsorbed to sediment or particulate matter in the water column, and bioconcentrate into aquatic organisms. In the unadsorbed state, it will degrade by photolysis in a matter of hours to days. Its slow desorption from sediment and particulate matter will maintain a low concentration in the water. Because it is strongly adsorbed to soil it will remain in the upper few centimeters of soil and not leach into groundwater. It will very slowly biodegrade when colonies of microorganisms are acclimated but this is too slow a process (half-life ca 1 year to be significant). In the atmosphere it will be transported long distances and will probably be subject to photolysis and photooxidation although there is little documentation about the rate of these processes in the literature.
Ecotoxicity: Algae: Anabaena flos-aquae 2w EC_{50} growth +0.014 mg/l NOEC growth +0.003 mg/l
BCF: daphnia 4.0
Octanol/Water Partition Coefficient: log K_{ow} = 5.61
Soil Sorption Partition Coefficient: K_{oc} = sediments 55 to 1.87 x10^6

Section 13 - Disposal Considerations

Disposal: • Recycle wherever possible or consult manufacturer for recycling options.
• Follow applicable local, state, and federal regulations.
• Bury residue in an authorized landfill.
• Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U018 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, and 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:.....2000-11 **Review Date:** 2001-05

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Material Safety Data Sheet Collection

Benzo[*b*]fluoranthene MSDS No. 1091

Date of Preparation: 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Benzo[*b*]fluoranthene
Chemical Formula: $C_{20}H_{12}$
CAS Number: 205-99-2
Synonyms: B[*b*]B; B[*b*]F; BBF; BEF; B[*e*]F; 3,4-benz[*e*]acephenanthrylene; benz[*e*]acephenanthrylene; 2,3-benzfluoranthene; 3,4-benzfluoranthene; 3,4-benzofluoranthene; benzo[*e*]fluoranthene; 2,3-benzofluoranthrene
Derivation: No manufacturing information available; found in coal tar, coke oven emissions, cigarette smoke and automobile exhaust.
General Use: Used as a research chemical.
Vendors: There is no commercial production of this compound in the U.S.

Section 2 - Composition / Information on Ingredients

Benzo[*b*]fluoranthene, 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
As oil mist, mineral
8-hr TWA: 5 mg/m^3

ACGIH TLV
As oil mist, mineral*
TWA: 5 mg/m^3
STEL†: 10 mg/m^3

NIOSH REL
As oil mist, mineral
10-hr TWA: 5 mg/m^3
STEL: 10 mg/m^3

*Sampled by method that does not collect vapor.
†Notice of Impending Change: delete STEL

DFG (Germany) MAK
None established

Section 3 - Hazards Identification

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).

Wilson Risk Scale
R 1
I 2
S 1*
K 1
*Skin absorption

HMIS
H 2*
F 1
R 0
PPE†
*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption
Target Organs: Eyes, skin, respiratory system, gastrointestinal (GI) system, blood, liver, kidneys
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: IARC lists benzo[*b*]fluoranthene as Group 2B (Possibly Carcinogenic to Humans); EPA, B2 (Probable Human Carcinogen, with sufficient evidence from animal studies); MAK, A2 (Unmistakably carcinogenic in animal experimentation only); NTP, 2B (Reasonably anticipated to be a carcinogen, with sufficient evidence of carcinogenicity from studies in experimental animals); and ACGIH, TLV A2 (Suspected human carcinogen). OSHA does not list benzo[*b*]fluoranthene as a carcinogen.
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.
Other: Animal testing suggests a synergism (combined effect greater than sum of parts) of mutagenicity between benzo[*b*]fluoranthene and other PAHs.

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).

Section 5 - Fire-Fighting Measures

Flash Point: Not applicable; probable combustible solid **Autoignition Temperature:** None reported.
LEL: None reported. **UEL:** None reported.
Flammability Classification: Probable combustible solid
Extinguishing Media: Use water spray; carbon dioxide, dry chemical powder or appropriate foam.
Unusual Fire or Explosion Hazards: None reported.
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.
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.

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
Containment: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.
Cleanup: 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.
Storage Requirements: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Periodically inspect stored materials.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Work with benzo[*b*]fluoranthene only under an exhaust hood.
Ventilation: 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.
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.

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.

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

Appearance and Odor: Colorless needles

Vapor Pressure: 5 x10^{-7} mm Hg at 68 °F (20 °C)

Formula Weight: 252.32

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).

Water Solubility: 0.0012 mg/L

Melting Point: 334.4 °F (168 °C)

Henry's Law Constant (H): 1.38 x10^{-4} atm-m^3/mole, estimated

Octanol/Water Partition Coefficient: log K_{ow} = 6.124

Soil Sorption Coefficient (log K_{oc}): 5.88, estimated

Section 10 - Stability and Reactivity

Stability: Benzo[*b*]fluoranthene is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include strong oxidizing agents.

Conditions to Avoid: Heat, sunlight.

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

Section 11- Toxicological Information

Toxicity Data:*

Tumorigenicity:

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.

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.

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.

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

Genetic Effects:

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

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

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

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

*See NIOSH, *RTECS* (CU1400000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Evidence suggests that PAHs in lake bottom sediments may cause tumors in fish.

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.

Environmental Degradation: 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).

Soil Adsorption/Mobility: A high Koc indicates significant sorption and low mobility in the soil column.

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.*
Shipping Symbols: –
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9
Special Provisions (172.102): 8, B54

Packaging Authorizations
a) **Exceptions:** 173.155
b) **Non-bulk Packaging:** 173.213
c) **Bulk Packaging:** 173.240

Quantity Limitations
a) **Passenger, Aircraft, or Railcar:** No limit
b) **Cargo Aircraft Only:** No limit

Vessel Stowage Requirements
a) **Vessel Stowage:** A
b) **Other:** –

*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:
Listed as a RCRA Hazardous Waste (40 CFR 261.33)
RCRA Hazardous Waste Number: F039
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per (2) CWA Section 307(a)
CERCLA Final Reportable Quantity (RQ): 1 lb (0.454 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1 as oil mist, mineral)

Section 16 - Other Information

References: 1, 73, 103, 136, 209, 216, 217, 223, 230, 232

Prepared By..... HM Spliethoff, MS
Industrial Hygiene Review..... S Gilson, CIH
Medical Review..... G Kelafant, MD

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Issue Date: 2001-06

Benzo[k]fluoranthene
MSDS: BEN4680

Section 1 - Chemical Product and Company Identification 55

Material Name: Benzo[k]fluoranthene **CAS Number:** 207-08-9
Chemical Formula: $C_{20}H_{12}$
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

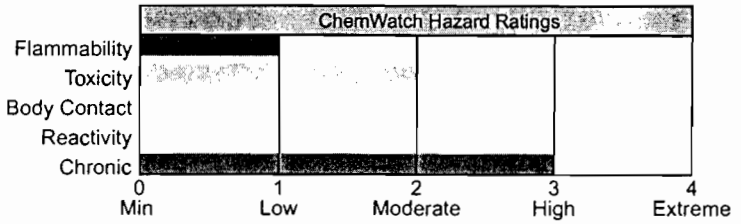
Name	CAS	%
benzo[k]fluoranthene	207-08-9	>98

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

Water Solubility: Insoluble in Water

Boiling Point Range: 480 °C (896 °F) at 760 mm Hg

Freezing/Melting Point Range: 217 °C (422.6 °F)

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^{8}
BCF: fish 4.97
Octanol/Water Partition Coefficient: log $K_{ow} = 6.84$
Soil Sorption Partition Coefficient: K_{oc} = nearly 1×10^{6}

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: TOXIC SOLID, ORGANIC, N.O.S. **Additional Shipping Information:**
Hazard Class: 6.1
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) 5,000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Not listed

Section 16 - Other Information

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

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Material Safety Data Sheet Collection

Chrysene

MSDS No. 1092

Date of Preparation: 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Chrysene
Chemical Formula: $C_{18}H_{12}$
CAS Number: 218-01-9
Synonyms: 1,2-benzophenanthrene; benzo(*a*)phenanthrene; benz(*a*)phenanthrene; 1,2-benzphenanthrene; 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.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

OSHA PEL*
8-hr TWA: 0.2 mg/m^3

ACGIH TLV
Coal tar pitch volatiles, as benzene solubles: 8-hr TWA: 0.2 mg/m^3

NIOSH REL*
Cyclohexane-extractable fraction
10-hr TWA: 0.1 mg/m^3
Carcinogen: lowest feasible concentration

IDLH Level
As coal tar pitch volatiles: 80 mg/m^3

DFG (Germany) MAK
None established

*These specific exposure limits may also be applied to the total concentration of benzene soluble coal tar pitch volatiles.

Section 3 - Hazards Identification

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.

Wilson Risk Scale	
R	1
I	3
S	2
K	1

HMIS	
H	2*
F	1
R	0
PPE†	

*Chronic Effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Skin absorption
Target Organs: Eyes, skin, respiratory system
Note: *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.*

Acute Effects
Inhalation: May cause irritation.
Eye:. May cause irritation.
Skin: May cause irritation or be absorbed.
Ingestion: None reported.

Carcinogenicity: IARC lists chrysene as Group 3 (Not classifiable as to carcinogenicity to humans); OSHA, X (Carcinogen defined with no further categorization); EPA, B2 (Probable human carcinogen; sufficient evidence from animal studies; inadequate evidence or no data from epidemiologic studies); TLV, A3 (Animal carcinogen); MAK, A2 (Unmistakably carcinogenic in animal experimentation only); NTP, 1 (Known to be a carcinogen); and NIOSH, X (Carcinogen defined with no further categorization).
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

Genium


Flash Point: Not applicable; 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.
Unusual Fire or Explosion Hazards: None reported.
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.
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.

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
Containment: 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.
Storage Requirements: Store in tightly closed containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles.

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.
Ventilation: 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.

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.

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.

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 clothing separately 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

Appearance and Odor: Colorless to white rhombic plates with reddish-blue fluorescence.

Vapor Pressure: 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

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.

Boiling Point: 838 °F (448 °C); sublimes easily in a vacuum

Melting Point Range: 489 °F (254 °C) to 496 °F (258 °C)

Henry's Law Constant (H): 9.4 $x10^{-8}$

Octanol/Water Partition Coefficient: log K_{ow} = 5.61 to 5.91

Ionization Potential (eV): 7.59 ± 0.2

Section 10 - Stability and Reactivity

Stability: Chrysene is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Include strong oxidizers.

Conditions to Avoid: Avoid contact with chemical incompatibles, heat and ignition sources.

Hazardous Decomposition Products: Thermal oxidative decomposition of chrysene can produce acrid smoke and fumes, including carbon monoxide and carbon dioxide.

Section 11- Toxicological Information

Toxicity Data:*

Acute Effects:

Mouse, intraperitoneal, LD_{50}: >320 mg/kg

Mouse, skin, TD_{Lo}: 3600 µg/kg

Mutagenicity:

Human, lymphocyte: 6 µmol/L produced mutation.

Bacteria, *S typhimurium*: 5 mg/plate (-S9) produced mutation.

Tumorigenic Effects:

Mouse, skin, 3600 mg/kg for 30 weeks, intermittent; toxic effects: tumorigenic - equivocal tumorigenic agent by RTECS criteria; skin and appendages - tumors.

Mouse, skin: 23 mg/kg; toxic effects: tumorigenic - neoplastic by RTECS criteria; skin and appendages - tumors.

Genetic Effects:

Hamster, intraperitoneal: 900 mg/24 hr induced sister chromatid exchange.

Mouse, skin: 192 µmol/kg produced DNA adducts.

* See NIOSH, *RTECS* (GC0700000), for additional toxicity data.

Section 12 - Ecological Information

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.

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.

Environmental Degradation: 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.

Soil Adsorption/Mobility: 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.

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.

Container Cleaning and Disposal: Handle empty containers carefully as hazardous residues may still remain. Triple rinse containers and dispose of wash wastewater appropriately.

Section 14 - Transport Information

Shipping Name: Environmentally hazardous substances, solid, n.o.s.*
Shipping Symbols: –
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: CLASS 9
Special Provisions (172.102): 8, B54

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: No limit
b) Cargo Aircraft Only: No limit

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: –

*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:
Listed as a RCRA Hazardous Waste (40 CFR 261.33)
RCRA Hazardous Waste Number: U050
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per (2) CWA, Sec. 307(a); (4) RCRA, Sec. 3001
CERCLA Final Reportable Quantity (RQ), 100 lb (45.4 kg)
SARA Toxic Chemical (40 CFR 372.65): Not Listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

Section 16 - Other Information

References: 1, 73, 103, 124, 136, 176, 190, 208, 209, 216, 217, 222, 223, 230, 232

Prepared By..... S Fleming, BS/ HM Spliethoff, MS
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Material Safety Data Sheet Collection

Fluoranthene

MSDS No. 1151

Issue Date: 1999-10

Section 1 - Chemical Product and Company Identification 53

Product/Chemical Name: Fluoranthene
Chemical Formula: $C_{16}H_{10}$
CAS Number: 206-44-0 **EINECS Number:** 205-912-4
Synonyms: 1,2-benzacenaphthene; 1,2-(1,8-naphthalene) benzene; benzene, 1,2-(1,8-naphthalenediyl)-; benzene, 1,2-(1,8-naphthylene)-; benzo (jk) fluorene; Idryl; 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.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Fluoranthene, ca 98% wt

OSHA PEL	NIOSH REL	DFG (Germany) MAK	AIHA WEEL
None established	None established	None established	None established

ACGIH TLV
None established

Section 3 - Hazards Identification

ANSI Signal Word: Caution! May be harmful if swallowed.

☆☆☆☆☆ 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.

Wilson Risk Scale	
R	1
I	1
S	1
K	1

HMIS	
H	1*
F	1
R	1
PPE†	

*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, skin/eye contact, ingestion
Target Organs: Eyes, skin, and respiratory system
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.
Acute Effects
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 and OSHA do not list fluoranthene as a carcinogen. IARC lists it as Group 3 (Not Classifiable as to Carcinogenicity in Humans) and EPA as Class D (Not Classifiable as to Human Carcinogenicity).
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.

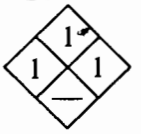
Autoignition Temperature: Data not found.

LEL: Data not found.

UEL: Data not found.

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

Genium



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.

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.

Storage Requirements: 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.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor dispersion into the work area.

Ventilation: 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).

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.

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.

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 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.

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; needles or plates from alcohol
Color: Colorless to pale yellow
Vapor Pressure: 0.01 mm Hg at 68 °F (20 °C)
Formula Weight: 202.2
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

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)
Melting Point: 230 °F (110 °C)
Ionization Potential: 7.95 ± 0.3 eV
Octanol/Water Partition Coefficient (log K_{ow}): 4.90
Soil Sorption Coefficient (K_{oc}): 6.6×10^4
Bioconcentration Factor (BCF): 2.58 (rainbow trout)

Section 10 - Stability and Reactivity

Stability: Fluoranthene is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization cannot occur.
Chemical Incompatibilities: Include strong oxidizing agents.
Conditions to Avoid: Avoid contact with chemical incompatibles, heat, and sources of ignition.
Hazardous Decomposition Products: Thermal oxidative decomposition of fluoranthene can produce toxic fumes of carbon monoxide and carbon dioxide.

Section 11- Toxicological Information

Toxicity Data:*

Acute Dermal Effects:
Rabbit, skin, LD_{50}: 3180 mg/kg
Acute Oral Effects:
Rat, oral, LD_{50}: 2 g/kg
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.

Multiple Dose Toxicity Data:
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.
Tumorigenic Effects:
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 toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Lepomis macrochirus*/ LC_{50}: 4.0 mg/L/96 hr

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.

Soil Adsorption/Mobility: 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.

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.

Container Cleaning and Disposal: 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): Not specifically listed.

Section 15 - Regulatory Information

EPA Regulations:

Listed as a RCRA Hazardous Waste (40 CFR 261.33); RCRA Hazardous Waste Number: U120
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) specific per CWA, Sec. 307(a); RCRA, Sec. 3001
CERCLA Final Reportable Quantity (RQ): 100 lb (45.4 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
Toxic Substances Control Act (TSCA): Listed

OSHA Regulations:

Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

Section 16 - Other Information

References: 1, 99, 136, 184, 209, 216, 217, 218, 222, 227, 229, 230, 234

Prepared By..... R Reals, MS/M Adams, Ph.D
Research Date: 1999-03
Review Date: 2000-01
Industrial Hygiene Review..... RE Langford, CIH
Medical Review ..... G Kelafant, MD

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Phenanthrene **MSDS No. 905**

Date of Preparation: 6/94

Section 1 - Chemical Product and Company Identification 44

Product/Chemical Name: Phenanthrene
Chemical Formula: $(C_6H_4CH)_2$
CAS No.: 85-01-8
Synonyms: 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.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Phenanthrene, ca 100 % wt

OSHA PEL*
8-hr TWA: 0.2 mg/m^3

ACGIH TLV*
TWA: 0.2 mg/m^3

NIOSH REL*
10-hr TWA: 0.1 mg/m^3, *cyclohexane extractable fraction*

DFG (Germany) MAK
None established

*Coal tar pitch volatiles (benzene soluble)

Section 3 - Hazards Identification

☆☆☆☆☆ **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.

Wilson Risk Scale
R 1
I 3
S 3
K 1

HMIS
H 1
F 1
R 0

PPE*
*Sec. 8

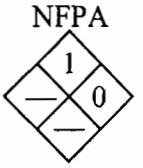
Potential Health Effects

Primary Entry Routes: Skin contact.
Target Organs: Skin.
Acute Effects
Inhalation: Effects not reported.
Eye: Effects not reported.
Skin: Can cause photosensitization of the skin.
Ingestion: Effects not reported.
Carcinogenicity: Although it has produced skin cancer in experimental animals, the results were not statistically significant and IARC has assigned phenanthrene a Class 3 (unclassifiable as to carcinogenicity) designation. The NTP and OSHA do not list phenanthrene as a carcinogen.
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)
Flash Point Method: OC
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.
Unusual Fire or Explosion Hazards: None reported
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.
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.

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
Containment: Flush large spill to containment area for later disposal. Do not release into sewers or waterways.
Cleanup: 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.
Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from heat, ignition sources, and strong oxidizers.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around phenanthrene.
Ventilation: 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.(103)
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin.
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.
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. 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
Appearance and Odor: Colorless, shiny crystals with a faint, aromatic odor.
Vapor Pressure: 1 mm Hg at 244.76 °F (118.2 °C); 400 mm Hg at 586.4 (308 °C)
Formula Weight: 178.22
Density (H_2O=1, at 4 °C): 1.179 g/L at 77 °F (25 °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.
Boiling Point: 644 °F (340 °C)
Melting Point: 213 °F (101 °C)
Refraction Index: 1.59427
Octanol/Water Partition Coefficient: log Kow = 4.57

Section 10 - Stability and Reactivity

Stability: Phenanthrene is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization does not occur.
Chemical Incompatibilities: Strong oxidizers.
Conditions to Avoid: Phenanthrene dust generation and exposure to heat ignition sources, or oxidizers.
Hazardous Decomposition Products: Thermal oxidative decomposition of phenanthrene can produce carbon oxide(s).

Section 11- Toxicological Information

Toxicity Data:*

Acute Oral Effects:
Mouse, oral, LD_{50}: 700 mg/kg

Carcinogenicity:
Mouse, skin: 71 mg/kg produced tumors at site of application.

Mutagenicity:
Rat, liver cell: 3 mmol/L caused DNA damage
Human, lymphocyte: 100 µmol/L caused mutation

* See NIOSH, *RTECS* (SF7175000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Neanhes arenaceodentata*, TLm = 0.6 ppm/96 hr, sea water at 71.6 °F (22 °C)
Environmental Degradation: 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).
Soil Absorption/Mobility: Phenanthrene absorbs strongly to soil and sediment in water.

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.*
Shipping Symbols: —
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9
Special Provisions (172.102): 8, B54, N50

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: None
b) Cargo Aircraft Only: None

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: —

* Classified as a hazardous substance when 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 Hazardous Waste Number: Not listed
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per CWA, Sec. 307(a)
CERCLA Reportable Quantity (RQ), 5000 lb (2270 kg)
SARA 311/312 Codes: 1
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed (coal tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 23, 73, 103, 124, 132, 133, 136, 139, 159, 164, 187, 190
Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... PA Roy, MPH, CIH
Medical Review ..... W Silverman, MD

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Issue Date: 2000-07

Pyrene
MSDS 711
PYR1640

Section 1 - Chemical Product and Company Identification 54.1

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

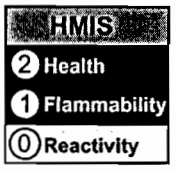
Name	CAS	%
pyrene	129-00-0	>98

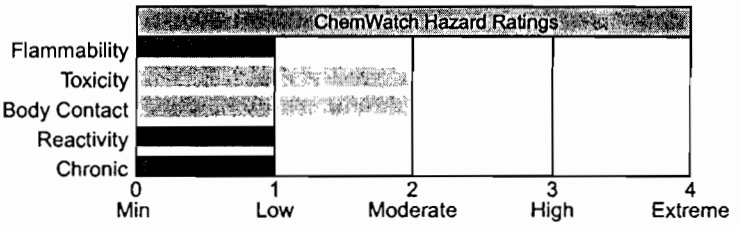
OSHA PEL
TWA: 0.2 mg/m^3.

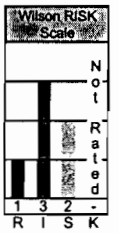
NIOSH REL
No data found.

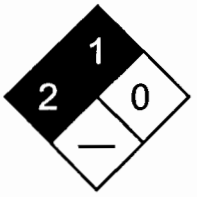
ACGIH TLV
No data found.

Section 3 - Hazards Identification









Fire Diamond

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

Primary Entry Routes: inhalation, ingestion, skin contact
Target Organs: skin, eyes, respiratory system
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

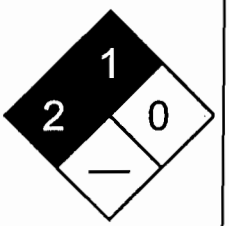
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.

Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Solid which exhibits difficult combustion or is difficult to ignite.

Avoid generating dust, particularly clouds of dust in a confined or unventilated space. Dust may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion.

Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport. Build-up of electrostatic charge may be prevented by bonding and grounding.



Fire Diamond

Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

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

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

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: 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.
Additional Shipping Information:
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) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Not listed 1000/10000 lb
SARA EHS 40 CFR 355: Listed 5,000 lb
TSCA: Listed

Section 16 - Other Information

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

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Material Safety Data Sheets Collection

Benzo(a)pyrene **MSDS No. 164**

Date of Preparation: 2/94

Section 1 - Chemical Product and Company Identification 43

Product/Chemical Name: Benzo(a)pyrene
Chemical Formula: $C_{20}H_{12}$; a polynuclear aromatic hydrocarbon
CAS No.: 50-32-8
Synonyms: BaP; 3,4-benz(a)pyrene; BP; 3,4-benzopyrene; 3,4-benzpyrene. Formerly called 1,2-benzpyrene.
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. **Vendors:** Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Benzo(a)pyrene, 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 PELs
Coal tar pitch volatiles
8-hr TWA: 0.2 mg/m^3

ACGIH TLVs
A2: Suspected Human Carcinogen

NIOSH REL
10-hr TWA: 0.1 mg/m^3
Carcinogen; coal tar pitch volatile, cyclohexane extractable fraction.

DFG (Germany) MAK
None established

IDLH Level
700 mg/m^3
Coal tar pitch volatiles (benzene soluble fraction)

Section 3 - Hazards Identification

☆☆☆☆☆ 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!

Wilson Risk Scale	
R	1
I	4
S	4
K	1

HMIS	
H	2*
F	1
R	0

* Chronic Effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion. **Target Organs:** Respiratory system, bladder, kidneys, skin.
Acute Effects: **Inhalation:** Respiratory tract irritation. **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: IARC, NTP, NIOSH, ACGIH, EPA, and MAK list benzo(a)pyrene as: an IARC 2A (probably carcinogenic to humans: limited human evidence, sufficient evidence in experimental animals), an NTP-2 (reasonably anticipated to be a carcinogen: limited evidence from studies in humans or sufficient evidence from studies in experimental animals), a NIOSH-X (carcinogen defined with no further categorization); an ACGIH TLV-A2 (suspected human carcinogen: carcinogenic in experimental animals, but available epidemiological studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans); an EPA-B2 (sufficient evidence from animal studies, inadequate evidence or no data from epidemiological studies); and an MAK-A1 (capable of inducing malignant tumors as shown by experience with humans) carcinogen, respectively.
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.
Comments: 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).

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.

Unusual Fire or Explosion Hazards: None reported.

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.

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 and full protective clothing.

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

Containment: For large spills, dike far ahead of liquid spill or contain dry spill for later disposal. Do not release into sewers or waterways.

Cleanup: *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.

Storage Requirements: Store in tightly closed and properly labeled containers in a cool, well-ventilated area.

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.

Ventilation: 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.[103]

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 + FEV_1, and CBC to detect any leukemia or aplastic anemia. It is recommended that this exam be repeated on an annual basis and semi-

annual 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.

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.

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.

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: 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.

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: Pale yellow monoclinic needles with a faint, aromatic odor.

Vapor Pressure: >1 mm Hg at 68 °F (20 °C)

Formula Weight: 252.30

Specific Gravity (H_2O=1, at 4 °C): 1.351

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.

Boiling Point: >680 °F (>360 °C); 540 °F (310 °C) at 10 mm Hg

Melting Point: 354 °F (179 °C)

Octanol/Water Partition Coefficient: log Kow= 6.04

Section 10 - Stability and Reactivity

Stability: 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.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Strong oxidizers (chlorine, bromine, fluorine) and oxidizing chemicals (chlorates, perchlorates, permanganates, and nitrates).

Conditions to Avoid: Avoid heat and ignition sources and incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of benzo(a)pyrene can produce carbon monoxide and carbon dioxide.

Section 11- Toxicological Information

Toxicity Data:*

Tumorigenic Effects:

Rat, oral: 15 mg/kg produced gastrointestinal and musculoskeletal tumors.

Mouse, inhalation: 200 ng/m^3/6 hr administered intermittently over 13 weeks produced tumors of the lungs.

Rabbit, skin: 17 mg/kg administered intermittently over 57 weeks produced tumors of the skin and appendages.

Teratogenicity:

Rat, oral: 2 g/kg administered 28 days prior to mating and 1-22 days of pregnancy produced a stillbirth.

Rat, oral: 40 mg/kg on the 14th day of pregnancy caused changes in the extra embryonic structures.

Mouse, oral: 75 mg/kg administered to the female during the 12-14 day of pregnancy produced biochemical and metabolic effects on the newborn.

Skin Effects:
Mouse: 14 µg caused mild irritation.

Mutagenicity:
Human, liver cell: 100 nmol/L caused DNA damage.
Human, lung cell: 1 µmol/L caused DNA damage.
Human, HeLa cell: 1500 nmol/L caused DNA inhibition.

* See NIOSH, *RTECS* (DJ3675000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Oysters, BCF (bioconcentration factor): 3000; rainbow trout, BCF: 920; *Daphnia pulex*, BCF: 13,000.
Environmental Transport: 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.
Environmental Degradation: 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).
Soil Absorption/Mobility: 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.

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.*
Shipping Symbols: —
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9
Special Provisions (172.102): 8, B54

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: None
b) Cargo Aircraft Only: None

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: —

* 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:
Listed as a RCRA Hazardous Waste (40 CFR 261.33)
RCRA Hazardous Waste Number: U022
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA and CWA, Sec. 307(a)
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
SARA 311/312 Codes: 1,2
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)
Listed as an OSHA Specifically Regulated Substance, Coal Tar Pitch Volatiles, (29CFR 1910.1002)

Section 16 - Other Information

References: 73, 103, 124, 127, 132, 133, 136, 139, 148, 164, 169, 174, 175, 184, 187, 189, 190
Prepared By .. MJ Wurth, BS **Industrial Hygiene Review** .... PA Roy, MPH **Medical Review** .... T Thoburn, MD, MPH
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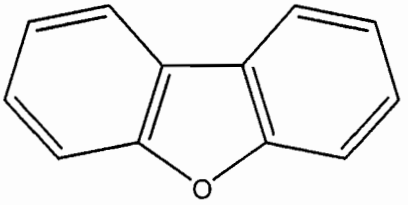
DIBENZOFURAN

RTECS: HP4430000
EINECS Number: 205-071-3
Molecular Formula: $C_{12}H_8O$
Formula Weight: 168.19



Chemical Structure

Synonyms: (1,1'-BIPHENYL)-2,2'-DIYL OXIDE; 2,2'-BIPHENYLENE OXIDE; 2,2'-BIPHENYLYLENE OXIDE; DIBENZO(B,D)FURAN; DIBENZOL(B,D)FURAN; DIPHENYLENE OXIDE
Description: white, crystalline solid
Use: insecticide

Physical Properties

Boiling Point: 287 °C (549 °F) at 760 mm Hg
Freezing Point: 86 °C (186.8 °F) to 87 °C (188.6 °F)
Specific Gravity: 1.0886 at 99 °C/4 °C
Vapor Density: 5.8 Air=1
Water Solubility: < 1 mg/mL at 20 C
Other Solubilities: 95% Ethanol: 10-50 mg/ml at 20 °C; Acetone: >=100 mg/ml at 20 °C; Acetic Acid: Soluble; Benzene: Slightly Soluble; DMSO: >=100 mg/ml at 20 °C; Ether: Soluble.
Odor Threshold: 0.7752 to 1.6150 mg/m^3
Refraction Index: 1.6079 at 99 °C/D
Ionization Potential (eV): 7.9 +/-1.0
Flash Point: Not available; probably combustible

RTECS Toxicity Data

Mutagenic: Hamster Sister Chromatid Exchenge; Cell Type: ovary; Dose: 10 mg/L.

Hazard Overviews

Health: May cause irritation. Other Acute Effects: may be harmful by inhalation, ingestion, or skin absorption.
Fire: Will burn. Extinguishing agents: water spray; carbon dioxide, dry chemical powder or appropriate foam. Precautions: combustible liquid.
Reactivity: Incompatible with: strong oxidizing agents. Hazardous decomposition products: toxic fumes of: carbon monoxide, carbon dioxide.
Carcinogenicity: IARC - Not listed; NIOSH - Not listed; NTP - Not listed; ACGIH - Not listed; OSHA - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed

Environmental

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.

Environmental Physical Data

Henry's Law Constant: estimated at 9.73×10^{-5}
Octanol/Water Partition Coefficient: log $K_{ow} = 4.12$
Sorption Partition Coefficient: 4600 to 6350
BCF: fish 947

Regulations

RCRA 40CFR: Not listed
CERCLA: 40CFR 302.4: Listed per CAA Section 112 RQ: 100 lb (45.35 kg)
SARA 40CFR 372.65: Listed
SARA EHS 40CFR 355: Not listed
TSCA: Listed

Analytical Methods

Soil: CLP MC_SVOA, OHC; EPA 1625; SW846 1311, 3640A, 8250A, 8270B, 8270C, 8275A, 8410; DOE OS050
Water / Groundwater: EPA 1625
Plasma: EPA 29

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Material Safety Data Sheet Collection

Hexachlorobenzene **MSDS No. 964**

Date of Preparation: 10/95

Section 1 - Chemical Product and Company Identification 47

Product/Chemical Name: Hexachlorobenzene
Chemical Formula: C_6Cl_6
CAS Number: 118-74-1
Synonyms: Amatin, Anticarie, Bunt-Cure, Granox NM, HCB, Julin's Carbon Chloride, pentachlorophenyl chloride, perchlorobenzene, phenyl perchloryl, Sanocide, Snieciotox, Voronit C
Derivation: Prepared by the chlorination of benzene; isolation from by-product residues of tetrachloroethylene production; reaction of hexachlorocyclohexane with chlorine or sulfuryl chloride.
General Use: Used in organic synthesis, manufacture of electrodes, dye manufacture, wood preservatives, production of aromatic fluorocarbons; to impregnate paper; as a plasticizer for polyvinyl chloride, rubber peptizing agent. Formerly used as a selective fungicide/pesticide (until 1985).
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Hexachlorobenzene, ca 100 %wt
Trace Impurities: Polychlorinated dibenzo-*p*-dioxins and dibenzofurans; octa-chlorinated and hepta-chlorinated congeners dominate at 0.35 to 58.3 ppm.

OSHA PEL
None established

NIOSH REL
None established

DFG (Germany) MAK
None established

ACGIH TLV
TWA: 0.025 mg/m^3 (*Skin*)

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Hexachlorobenzene exists as a white, crystalline solid with a faint odor. Can cause skin, eye, and respiratory tract irritation. Because it is slowly absorbed into the body, chronic toxicity prevails over acute effects. Skin lesions, liver enlargement, and neurologic disturbances are common. Hexachlorobenzene is combustible.

Wilson Risk Scale
R 1
I 3
S 3*
K 1
*Skin absorption

HMIS
H 1*
F 1
R 0
*Chronic Effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, eye and skin contact/absorption.
Target Organs: Eyes, skin, respiratory tract, liver, kidneys.
Acute Effects
Inhalation: Respiratory irritation and difficulty breathing can occur.
Eye: Irritation.
Skin: Irritation; absorption through the skin can contribute to chronic effects.
Carcinogenicity: The following agencies list hexachlorobenzene as a carcinogen: EPA (Group B2, probable human carcinogen: sufficient animal evidence with insufficient human evidence); IARC (Group 2B, possible human carcinogen: limited human evidence in absence of sufficient animal evidence); NTP (Group 2, reasonably anticipated to be carcinogenic: limited human evidence or sufficient animal evidence); and ACGIH (TLV A3, confirmed animal carcinogen; not expected to be carcinogenic in humans except under uncommon or unlikely routes of exposure). OSHA does not list hexachlorobenzene as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Chronic Effects: An incident in Turkey in the 1950's where persons ingested flour made from seed grains treated with hexachlorobenzene. Over a period of 4 to 5 years, has provided the most details on hexachlorobenzene poisoning. Victims developed porphyria cutanea tarda (severe skin reaction to sun exposure, including blistering which is initiated by prior exposure to polychlorinated hydrocarbons), enlarged liver, lymph nodes, and thyroid, painless arthritis, skin lesions, hyperpigmentation, hirsutism (abnormal hair growth), weakness, paresthesias, myotonia (muscle spasms characterized by prolonged contraction). Toxic effects were still apparent 20 years after exposure. Kidney and lung damage are also possible.
Other: Urinary metabolites found in animals include pentachlorothiophenol, pentachlorophenol, and tetrachlorohydroquinone.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water 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 followed quickly by a thorough soap and water wash. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures

Genium

Flash Point: 468 °F (242 °C)
Flash Point Method: CC
Autoignition Temperature: None reported.
LEL: None reported.
UEL: None reported.
Flammability Classification: Class IIIB Combustible Liquid
Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam.
Unusual Fire or Explosion Hazards: None reported.
Hazardous Combustion Products: Carbon oxide(s), hydrogen chloride, phosgene, and chlorine gas.
Fire-Fighting Instructions: If possible without risk, move containers from fire area. If impossible, apply cooling water to container sides until well after fire is out. Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against inhalation and skin/eye contact.
Small Spills: *Do not* sweep! Carefully scoop up or vacuum (with HEPA filter) and place in suitable containers.
Large Spills
Containment: Flush spill with water to containment area for later reclamation or disposal. *Do not* release into sewers or waterways.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use with adequate ventilation to control airborne hazards and wear appropriate PPE.
Storage Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10).

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around hexachlorobenzene. Where possible, enclose processes to prevent dust dispersion into work area.
Ventilation: 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.(103)
Administrative Controls: Consider preplacement and periodic medical exams of 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. 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. Launder before reuse. Remove hexachlorobenzene from your shoes and clean personal protective equipment. Discard heavily contaminated shoes.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using hexachlorobenzene, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: White, needle-like crystals with a faint odor.
Vapor Pressure: 1 mm Hg at 237 °F (114 °C); 1.09 x 10-5 mm Hg at 68 °F (20 °C)
Formula Weight: 284.8
Density (H_2O=1, at 4 °C): 1.5691 at 74.5 °F (23.6 °C)
Water Solubility: 0.035 ppm
Henry's Law Constant: 0.03 to 0.07
Other Solubilities: Soluble in benzene, chloroform, carbon disulfide, and ether. Slightly soluble in alcohol and carbon tetrachloride.
Boiling Point Range: 613 to 619 °F (323 to 326 °C), *sublimes*
Freezing Point: 448 °F (231 °C)
Critical Temperature: 1025 °F (552 °C)
Critical Pressure: 28.1 atm
Octanol/Water Partition Coefficient : log Kow = 5.31

Section 10 - Stability and Reactivity

Stability: Hexachlorobenzene stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization does not occur.
Chemical Incompatibilities: Contact with dimethylformamide causes a violent reaction above 149 °F (65 °C).
Conditions to Avoid: Exposure to heat, ignition sources and dimethyl formamide.
Hazardous Decomposition Products: Thermal oxidative decomposition of hexachlorobenzene can produce carbon oxide(s), hydrogen chloride, and chlorine gas.

Section 11 - Toxicological Information

Toxicity Data:*

Acute Inhalation Effects:
Rat, inhalation, LC_{50}: 3600 mg/m^3
Rabbit, inhalation, LC_{50}: 1800 mg/m^3

Acute Oral Effects:
Rat, oral, LD_{50}: 10 g/kg

Reproductive Effects:
Rat, oral: 40 mg/kg administered from the 10th to 13th day of pregnancy caused specific developmental abnormalities of the musculoskeletal system.
Rat, oral: 6450 mg/kg administered from the 1st to 22nd day of pregnancy and on the 21st day post-pregnancy resulted in specific developmental abnormalities of the blood and lymphatic systems including the spleen and bone marrow.

Multiple Dose Toxicity Data:
Rat, oral: 1596 mg/kg administered for 28 continuous days produced changes in liver and kidney weight.
Rat, oral: 250 mg/kg administered intermittently for 5 weeks caused changes in liver weight, urine composition, and serum composition.

Tumorigenicity:
Rat, oral: 2738 mg/kg administered for 2 continuous years produced kidney tumors and leukemia.
Rat, oral: 1050 mg/kg administered for 30 continuous weeks caused liver tumors, and affected body biochemistry including porphyrin and bile pigments.

* See NIOSH, *RTECS* (DA2975000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Pimephales promelas* (fathead minnow), LC_{50} = 22 mg/L/96 hr; *Micropterus salmoides* (large mouth bass), LC_{50} = 12 mg/L/96 hr.
Environmental Fate: Hexachlorobenzene is very persistent in the environment. If released to land, hexachlorobenzene will absorb strongly to soil and is not expected to leach to groundwater. Half-life = 1530 days. In water, it will partition from the water column to sediment or suspended particles. Volatilization is rapid (half-life = 8 hr) but if suspended matter is plentiful, persistence in water can occur. In air, hexachlorobenzene is expected to exist primarily in the vapor phase. Degradation is slow via reaction with hydroxyl radicals (half-life is 2 years). Long-range global transport is possible. It can also be removed from air via wet and dry deposition.

Section 13 - Disposal Considerations

Disposal: Hexaxchlorobenzene is a potential candidate for rotary kiln incineration in an incinerator equipped with an appropriate scrubber. Irradiation via UV light has degraded hexachlorobenzene into carbon dioxide, hydrogen chloride, and chlorine gas. Studies show that hexachlorobenzene can be dechlorinated at a rate of 13.6 µmol/L/day in fresh anaerobic digester sludge following a lag of ~ 7 days. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name:
Hexachlorobenzene
Shipping Symbols: –
Hazard Class: 6.1
ID No.: UN2729
Packing Group: III
Label: Keep Away From Food
Special Provisions (172.102): –

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 60 L
b) Cargo Aircraft Only: 220 L

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): U127
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001 and CWA, Sec. 307(a)
CERCLA 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
OSHA Regulations:
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

Section 16 - Other Information

References: 73, 103, 124, 136, 167, 189, 190, 197, 201, 203

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... PA Roy, MPH, CIH
Medical Review ..... W Boucher, MD

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B-ENDOSULFAN

RTECS: RB9875200
Molecular Formula: $C_9H_6Cl_6O_3S$
Formula Weight: 406.91
Synonyms: BETA-BENZOEPIN; B-ENDOSULFAN-BETA; BETA-ENDOSULFAN; ENDOSULFAN 2; ENDOSULFAN B; GENERAL WEED KILLER; BETA-THIODAN; ALPHA-THIONEX
Description: brown crystals
Use: insecticide

Physical Properties

Freezing Point: 208 °C (406.4 °F) to 210 °C (410 °F)
Water Solubility: Insoluble
Other Solubilities: 95% Ethanol: Soluble; Acetone: Soluble; Benzene: Soluble; Ether: Soluble.

RTECS Toxicity Data

Acute Oral: Rat LD_{50} Dose: 240 mg/kg.

Hazard Overviews

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

Environmental

Cleanup/Disposal: Guide No. 151: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Regulations

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

Analytical Methods

Soil: CLP LC_PEST, MC_PEST, OHC; SW846 3630B, 3640A, 8080A, 8081, 8081A, 8250A, 8270B, 8270C; EPA 16, 3, P-002-1, P-011-1; USGS O5104, O7104
Water / Groundwater: EPA P-003-1, P-004-1, 608, 617, 625, 625-S, 680; APHA 6410-B, 6630-B, 6630-C, 6630-D
Drinking Water: EPA 508, 508.1, 525.2; AOAC 990.06
Food: FDA 212.1, 212.2, 232.1, 232.4, 242.1; EPA 4
Plasma: EPA 001, 003, 028, 29; FDA 211.1, 231.1, 252, 253
Other: EPA P-009-1, 1656

END8980 **CAS #: 7421-93-4**

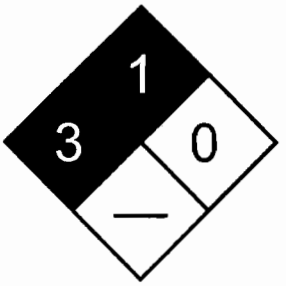
ENDRIN ALDEHYDE

DOT: UN2761; UN2995; UN2996; IMO6.1
Molecular Formula: $C_{12}H_8Cl_6O$
Formula Weight: 380.89
Synonyms: 1,2,4-METHENECYCLOPENTA(C,D)PENTALENE-R-CARBOXALDEHYDE,2,2A,3,3,4,7-HEXACHLORODECAHYDRO; 1,2,4-METHENOCYCLOPENTA(CD)PENTALENE-5-CARBOXALDEHYDE,2,2A,3,3,4,7-HEXACHLORODECAHYDRO-,(1ALPHA,2BETA,2ABETA,4BETA,4ABETA,5BETA,6ABETA,6BBETA,7R*)-; SD 7442
Use: not commercially used but occurs as an impurity of endrin

Physical Properties

Freezing Point: 235 °C (455 °F)
Saturated Vapor Density: 1.200000004 kg/m^3
Vapor Pressure: 2 $x10^{-7}$ torr at 25 °C
Water Solubility: 0.25 ppm at 25 °C
Flash Point: Will not burn

Hazard Overviews



Fire Diamond

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

Environmental

Environmental Fate: If released to soil, it is not expected to leach in most soil types based on estimated K_{oc} values of 8500 to 45000. Additional data were not available to predict the environmental fate in soil. If released to water, adsorption to sediments and bioconcentration appears to be important fate processes. Aquatic hydrolysis, oxidation (via peroxy radicals or singlet oxygen), or volatilization are not expected to be significant. No data are available to predict biodegradability. If released to the atmosphere, it may exist predominantly in the adsorbed-phase. Particulates will be subject to wet and dry deposition.

Cleanup/Disposal: Guide No. 131: Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Use clean non-sparking tools to collect absorbed material. Large Spills: Dike far ahead of liquid spill for later disposal. Water spray may reduce vapor; but may not prevent ignition in closed spaces. Guide No. 151: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Do not get water inside containers.

Environmental Physical Data

Henry's Law Constant: 2.9×10^{-9}
Octanol/Water Partition Coefficient: log $K_{ow} = 5.34$
Sorption Partition Coefficient: estimated at 8500 to 4.5×10^{4}
BCF: calculated at 2200

Regulations

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

Analytical Methods

Air: EPA TO-10
Soil: CLP LC_PEST, MC_PEST; SW846 3630B, 3640A, 8080A, 8081, 8081A, 8250A, 8270B, 8270C; EPA 16, 3
Water / Groundwater: EPA 608, 617, 625, 680, 6; APHA 6410-B, 6630-C, 6630-D
Drinking Water: EPA 508, 508.1, 525.2; AOAC 990.06
Food: FDA 212.1, 232.1; EPA 4
Plasma: EPA 001, 027, 028, 29; FDA 211.1, 231.1, 252
Other: EPA P-009-1, 1656

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Material Safety Data Sheet Collection

Fensulfothion **MSDS No. 1004**

Date of Preparation: 4/96

Section 1 - Chemical Product and Company Identification 48

Product/Chemical Name: Fensulfothion
Chemical Formula: $C_{11}H_{17}O_4PS_2$
CAS Number: 115-90-2
Synonyms: Agricur; Daconit; O,O-diethyl O-*p*-(methylsulfinyl)phenyl) phosphorothioate; phosphorothioic acid, O,O-diethyl O-(4-(methylsulfinyl)phenyl) ester; Terracur P; Vuagt
Derivation: Produced by reaction of *p*-(methylsulfinyl)phenol with O,O-diethylphosphorochloridothioate. Available commercially in many products in the form of a wettable powder, emulsifiable concentrate, dust, or granules.
General Use: Used as an insecticide, especially for nematocide control.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Fensulfothion, ca 100% vol

ACGIH TLV	OSHA PEL	NIOSH REL	DFG (Germany) MAK
TWA: 0.1 mg/m^3	*Vacated 1989 Final Rule Limits* 8-hr TVA: 0.1 mg/m^3, skin	10-hr TWA: 0.1 mg/m^3	None established

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Fensulfothion exists as a yellowish-brown, oily liquid. It is irritating to the skin. Toxicity is due to inhibition of the enzyme, cholinesterase, which causes severe central nervous system effects.

Wilson Risk Scale	
R	2
I	4
S	2
K	0

HMIS	
H	3
F	0
R	0

PPE† †Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, skin contact, ingestion.
Target Organs: Skin, respiratory system, central nervous system, cardiovascular system, blood cholinesterase.
Acute Effects
Inhalation: Salivation, watering eyes, nausea, vomiting, diarrhea, pinpoint pupils, blurred vision, hypertension, cardiac arrythmias, muscle cramps, weakness, agitation, headache, giddiness, dizziness, incoordination, confusion, delirium, seizures, difficulty breathing, and respiratory paralysis.
Eye: No effects reported, but may cause mechanical irritation.
Skin: Irritation. Although fensulfothion has been shown to readily absorb through the skin in animals, studies in humans have not shown that it is absorbed in toxic amounts. A 5% granular preparation applied for 2 hr/day for 5 days resulted in irritation but no decrease in whole blood cholinesterase.
Ingestion: Symptoms as via inhalation.
Carcinogenicity: IARC, NTP, and OSHA do not list fensulfothion as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Chronic Effects: Repeated small exposures may result in symptoms similar to those seen in acute exposures.
Other: The acceptable daily intake is set at 0.0003 mg/kg. Children tend to be more sensitive to organophosphates than adults.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain or irritation persist.
Skin Contact: *Quickly* remove contaminated clothing. Wash with soap and water, followed by a 95% ethanol wash and a second soap and water wash. Tincture of green soap contains 30% ethanol and should be used if available.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting due to the possibility of respiratory depression or seizures.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Support respiratory and cardiovascular function. Administer atropine, 2 to 5 mg every 10 to 15 min until atropinization is complete. Alternatively, 2-PAM may be given by IV: 1 to 2 g at 0.5 g/min. Repeat in 1 hr and every 6 to 12 hr if needed.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible.
Autoignition Temperature: None reported.
LEL: None reported.
UEL: None reported.
Flammability Classification: Noncombustible liquid.
Extinguishing Media: Use agents suitable for surrounding fire.
Unusual Fire or Explosion Hazards: None reported.
Hazardous Combustion Products: Carbon oxide(s), phosphorus oxide(s), and sulfur oxide(s).
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

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 contact.
Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material.
Large Spills
Containment: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.
Cleanup: Damp mop any residue with a dilute alkaline solution.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use with sufficient ventilation to prevent hazardous air levels and wear appropriate PPE.
Storage Requirements: Store in tightly closed containers in a cool (< 30 °C), dry, dark, well-ventilated area away from alkalis.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose all processes where possible to prevent dispersion of vapors into work area.
Ventilation: 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.(103)
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers. Obtain baseline blood cholinesterase levels and test regularly. Anyone with a 30 to 40% decrease in blood cholinesterase should be removed from exposure.
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.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Neoprene is a suitable material for PPE. *Do not* wear leather, as it tends to absorb organophosphorus compounds and is difficult to decontaminate. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove fensulfothion from your shoes and clean personal protective equipment. Discard any contaminated leather.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using fensulfothion, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance and Odor: Yellowish-brown, oily.
Vapor Pressure: 6.82 x 10^{-7} mm Hg at 77 °F (25 °C), est.
Formula Weight: 308.37
Density (H_2O=1, at 4 °C): 1.202 g/m^3 at 68 °F (20 °C)
Water Solubility: 1.54 g/L at 77 °F (25 °C)
Other Solubilities: Soluble in most organic solvents.
Boiling Point: 280.4 °F (138 °C) at 0.01 mm Hg
Refractive Index: 1.540 at 77 °F (25 °C)
Octanol/Water Partition Coefficient: log Kow = 2.229
Henry's Law Constant: 1.8 x 10^{-10} atm/m^3/mole

Section 10 - Stability and Reactivity

Stability: Fensulfothion readily oxidizes in air to form sulfone and isomerizes to the S-ethyl isomer.
Polymerization: Hazardous polymerization does not occur.
Chemical Incompatibilities: Fensulfothion is subject to hydrolysis upon contact with alkalis.
Conditions to Avoid: Exposure to alkalis.
Hazardous Decomposition Products: Thermal oxidative decomposition of fensulfothion can produce carbon oxide(s), phosphorus oxide(s), and sulfur oxide(s).

Section 11 - Toxicological Information

Toxicity Data:*

Acute Dermal Effects:
Rat, skin, LD_{50}: 3 mg/kg
Acute Inhalation Effects:
Human, inhalation, LC_{50}: 113 mg/m^3/ 1 hr
Acute Oral Effects:
Rat, oral, LD_{50}: 2.2 mg/kg

* See NIOSH, *RTECS* (TF3850000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Rainbow trout, LC_{50} = 8.8 mg/L/96 hr; Carp, LC_{50} = 5.7 mg/L/48 hr & 12.8 mg/L/24 hr.
Environmental Fate: If released to soil, fensulfothion is subject to extensive leaching as shown by its estimated absorption coefficient (Koc = 77 to 105). Absorption to soil appears to increase with increased organic content. In water, it is subject to hydrolysis (half-life = 58 to 87 days at 25 °C and pH 4.5 to 8.0). Under anaerobic conditions, it will biodegrade in 8 to 12 weeks with conversion to fensulfothion sulfide. Volatilization and bioconcentration will not be significant (log BCF = 0.99 to 1.46). In air, it will exist mainly in the vapor phase and react with photochemically-produced hydroxyl radicals with an estimated half-life of 7.03 hr. at 77 °F (25 °C). It will not react with ozone.

Section 13 - Disposal Considerations

Disposal: Complete deactivation can occur via hydrolysis with an alkali such as sodium bicarbonate or calcium hydroxide. Alternatively, fensulfothion can be incinerated in a facility equipped with an afterburner and scrubber. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Container Cleaning and Disposal: Triple rinse containers with a dilute alkaline solution and dispose of as above.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Organophosphorus pesticides, liquid, toxic
Shipping Symbols: –
Hazard Class: 6.1
ID No.: UN3018
Packing Group: I
Label: Poison
Special Provisions (172.102): N76, T42

Packaging Authorizations
a) Exceptions: None
b) Non-bulk Packaging: 173.201
c) Bulk Packaging: 173.243

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 1L
b) Cargo Aircraft Only: 30L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: 40

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355), Threshold Planning Quantity (TPQ): 500 lb
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 16 - Other Information

References: 73, 103, 114, 136, 176, 197, 202, 209, 217

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... DJ Wilson, CIH
Medical Review ..... R Teichman, MD

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Material Safety Data Sheet Collection

Methoxychlor

MSDS No. 951

Date of Preparation: 4/95

Section 1 - Chemical Product and Company Identification 46

Product/Chemical Name: Methoxychlor
Chemical Formula: $Cl_3CCH(C_6H_4OCH_3)_2$
CAS Number: 72-43-5
Synonyms: benzene, 1,1'-(2,2,2-trichloroethylidene) bis (4-methoxy-); 2,2-bis (*p*-anisyl)-1,1,1-trichloroethane; 1,1-bis (*p*-methoxyphenyl)-2,2,2-trichloroethane; Chemform; dianisyltrichloroethane; dimethoxy-DDT; DMDT; ethane, 2,2-bis (*p*-anisyl)-1,1,1-trichloro-; Higalmetox; Maralate; Methoxide; methoxy-DDT; Metox; Moxie; Prentox; 1,1,1-trichloro-2,2-bis (*p*-anisyl) ethane; 2,2,2-trichloro-1,1-bis (4-methoxyphenyl) ethane.
Derivation: Produced by reaction of methyl phenyl ether and chloral hydrate or by condensation of anisole with chloral in the presence of sulfuric acid.
General Use: Used as an insecticide for fruits, vegetables, forage crops, and livestock. It has replaced DDT in many applications because it is less persistent in the environment.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Methoxychlor, ca 88 %wt *p, p'* isomer and < 12% *o, p'* isomer.
Trace Impurities: Contains up to 50 impurities including 3,6,11,14-tetramethoxydibenzo (G, P) chrysene; 1,1,1,2-tetrachloro-2-(*p*-methoxyphenyl) ethane; *o, p'*-DMDE; methoxychlor olefin; chlorotrianisene; 3,6-dimethyl-9,10-bis (*p*-methoxyphenyl) phenanthrene; and 1-trichloro-2-(*p*-hydroxyphenyl)-2-(*p*-methoxyphenyl) ethane.

OSHA PEL
8-hr TWA: 15 mg/m^3, total dust
Vacated 1989 Rule Limit
10 mg/m^3, total dust

ACGIH TLV
TWA: 10 mg/m^3

NIOSH REL
Ca; lowest feasible concentration
Limit of Quantitation: 0.07 mg/m^3

DFG (Germany) MAK
TWA: 15 mg/m^3, total dust
Category III: Substances with systemic effects
Onset of Effect: > 2 hr
Half-life: > shift length (strongly cumulative)

Peak Exposure Limit:
150 mg/m^3, 30 min. average value, 1/shift

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Methoxychlor exists as a white, crystalline solid (pure) or gray, flaky powder (technical grade) with a slightly fruity odor. It is slightly irritating to the skin. Absorption through the skin can lead to somnolence (general depressed activity). Neurological effects have been seen in animals but have not been documented in humans. There is controversy over whether methoxychlor is carcinogenic (see below). In general, methoxychlor does not appear to present a major health hazard and the National Academy of Sciences considers it to be one of the safest of all insecticides.

Wilson Risk Scale
R 1
I 1
S 1
K 0

HMIS
H 1*
F 0
R 0

* Chronic effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, skin contact/absorption.
Target Organs: Kidneys, liver, reproductive organs, central nervous system, skin.
Acute Effects
Inhalation: There is one reported case of toxicity upon inhalation of a pesticide containing methoxychlor and captan. Fatigue and bruising were noticeable early on and progressed to aplastic anemia which resulted in death 6 months post exposure. It is not possible to determine if the methoxychlor or the captan was responsible for the toxicity. In another case, neurological effects were experienced after a 15 to 20 minute exposure to a pesticide containing 15% methoxychlor and 7.5% malathion. Symptoms included blurred vision, dehydration, nausea, vomiting, abdominal cramps, dizziness, complete hearing loss, difficulty moving feet and hands, and leg pain. Six years after exposure, no improvement was seen in the person's condition. Since neither methoxychlor or malathion typically produce such drastic effects, it was concluded that the individual either lacked the capability of metabolizing malathion or that the two materials led to a synergistic effect.
Eye: Irritation may occur.
Skin: Slight irritation may occur. Absorption through the skin can cause somnolence (general depressed activity).
Ingestion: The estimated human lethal dose is 7.5 g/kg.
Carcinogenicity: Listed by the following agencies: IARC (Group 3, not classifiable as to carcinogenicity in humans), NIOSH (Class X, carcinogen defined with no further categorization), and EPA (Group D, not classifiable as to human carcinogenicity; inadequate human and animal evidence or no data available). The NTP and OSHA do not list methoxychlor as a carcinogen.

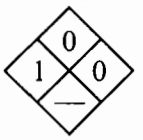
Medical Conditions Aggravated by Long-Term Exposure: Liver and kidney disease, convulsive disorders.
Chronic Effects: Kidney damage, reproductive damage and tumors of the liver, lungs, prostate, and ovaries have been reported in animal studies after chronic ingestion. There are no reports of chronic toxicity in humans.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain or irritation persist.
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water repeatedly. 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

Genium



Flash Point: Noncombustible
Autoignition Temperature: Noncombustible
LEL: None reported.
UEL: None reported.
Extinguishing Media: Use agents suitable for surrounding fire.
Unusual Fire or Explosion Hazards: None reported.
Hazardous Combustion Products: Carbon oxide(s) and hydrogen chloride gas.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel need to protect against inhalation and skin/eye contact.
Small Spills: Carefully scoop up material and place in a suitable container for disposal. *Do not* sweep! If methoxychlor is dissolved in a solvent, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container for disposal.
Large Spills
Containment: Flush spill with water to containment area 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: *Do not* use near oxidizers or alkaline materials. Wear appropriate PPE.
Storage Requirements: Store in a cool, dry, well-ventilated area away from incompatibles (Sec. 10). Keep in a dark area because it turns pink or tan on exposure to light.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose all processes where possible to prevent dust dispersion into work area.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the central nervous system, blood, kidneys, and liver.
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 dust 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.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polycarbonate and butyl rubber have been recommended as PPE materials. Do not wear leather clothing because it concentrates pesticides, making the leather nearly impossible to clean. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove methoxychlor from your shoes and clean personal protective equipment. Dispose of contaminated leather clothing or shoes.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using methoxychlor, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: White, crystalline solid (*pure*) or pale buff to gray flaky powder (*technical grade*) with a slightly fruity odor.
Odor Threshold: 4.7 mg/kg (in water)
Vapor Pressure: 1.4×10^{-6} mm Hg (est.) at 77 °F (25 °C)
Formula Weight: 345.65
Density (H_2O=1, at 4 °C): 1.41 g/cm^3 at 77 °F (25 °C)
Water Solubility: 0.10 mg/L at 77 °F (25 °C)
Henry's Law Constant: 1.6×10^{-5} atm/m^3/mole at 77 °F (25 °C)
Other Solubilities: g/kg solvent at 72 °F (22 °C): chloroform (440), methanol (50), xylene (440); g/100 g solvent at 22 °C: methylene dichloride (60), dichlorobenzene (40), cyclohexanone (50), methylated naphthalenes (30), carbon tetrachloride (16), odorless kerosene (2); very soluble in ether and benzene; moderately soluble in petroleum oils.
Boiling Point: Decomposes
Melting Point: 192 °F/89 °C (*pure*), 170 °F/77 °C (*technical*)
Octanol/Water Partition Coefficient: log Kow = 4.83, 4.91, 5.08

Section 10 - Stability and Reactivity

Stability: Methoxychlor is stable at room temperature in closed containers under normal storage and handling conditions. It turns pink or tan on exposure to light.
Polymerization: Hazardous polymerization does not occur.
Chemical Incompatibilities: Decomposes on exposure to alkaline materials. May cause fire on contact with strong oxidizers. Slightly corrosive to aluminum and iron. Will attack some plastics, rubber, and coatings.
Conditions to Avoid: Exposure to light and incompatibles. Avoid dispersing methoxychlor dusts into air.
Hazardous Decomposition Products: Thermal oxidative decomposition of methoxychlor can produce carbon oxide(s) and hydrogen chloride gas.

Section 11 - Toxicological Information

Toxicity Data:*

Acute Dermal Effects:
Human, skin, TD_{Lo}: 2414 mg/kg caused somnolence (general depressed activity).
Acute Oral Effects:
Human, oral, LD_{Lo}: 6430 mg/kg
Rat, oral, LD_{50}: 1855 mg/kg caused convulsions or effect on seizure threshold, excitement, and ataxia.
Multiple Dose Toxicity Data:
Rat, oral: 226 mg/kg administered intermittently for 19 weeks caused blood and liver changes.
Mutagenicity:
Mouse, lymphocyte: 10 mg/L caused mutation.
Tumorigenicity:
Rat, oral: 18.2 g/kg administered continuously for 2 years caused prostate tumors.
Rat, oral: 41 g/kg administered continuously for 2 years caused lung, thorax, and respiratory tumors.
Rat, oral: 80 g/kg administered continuously for 2 years caused liver and ovarian tumors.
Teratogenicity:
Rat, 2 g/kg administered from 6 to 15 days of pregnancy caused specific developmental abnormalities of the musculoskeletal system, post-implantation mortality, and fetotoxicity.

* See NIOSH, *RTECS* (KJ3675000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Rainbow trout (*Salmo gairdneri*), LC_{50} = 62 mcg/L/96 hr.; fathead minnow (*Pimephales promelas*), LC_{50} = 39 mcg/L/96 hr; bluegill (*Lepomis macrochirus*), LC_{50} = 32 mcg/L/96 hr; crayfish (*Orconectes nais*), LC_{50} = 0.50 mcg/L/96 hr.
Environmental Degradation: In soil, methoxychlor is expected to remain relatively immobile (Koc = 9700 to 41,000 in sand). It will biodegrade rapidly under anaerobic conditions (half-life = 1 wk to 2 months) and slowly if conditions are aerobic (half-life > 3 months). In water, it may adsorb to suspended solids. Bioaccumulation may occur in some organisms, but most species are able to metabolize methoxychlor quickly enough to prevent it. It may undergo direct photolysis (half-life = 4.5 months) or indirect "sensitized" photolysis (half-life = 5 hr) depending on the presence of photosensitizers. Volatilization from a model river 1 m deep, flowing 1m/sec with a wind speed of 3 m/sec has an estimated half-life of 4.5 hr. In air, methoxychlor reacts with photochemically-produced hydroxyl radicals with an estimated vapor half-life of 3.7 hr. It may also be physically removed by settling out or washing out in precipitation.

Section 13 - Disposal Considerations

Disposal: Burn large amounts in an incinerator equipped with a scrubber. Small amounts should be landfilled. 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: Organochlorine Pesticides, solid, toxic, n.o.s.
Shipping Symbols: –
Hazard Class: 6.1
ID No.: UN2761
Packing Group: I
Label: Poison
Special Provisions (172.102): –

Packaging Authorizations
a) Exceptions: None
b) Non-bulk Packaging: 173.211
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5 kg
b) Cargo Aircraft Only: 50 kg

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33): U247
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4)
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 103, 124, 136, 176, 189, 192, 197, 201, 204

Prepared By ..... M Gannon, BA
Industrial Hygiene Review ..... DJ Wilson, CIH
Medical Review ..... R Teichman, MD, MPH

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Beryllium
MSDS 59
BER3010

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Beryllium **CAS Number:** 7440-41-7
Chemical Formula: Be
Structural Chemical Formula: Be
Synonyms: BERYLLIUM; BERYLLIUM-9; BERYLLIUM DUST; BERYLLIUM METALLIC; BERYLLIUM,METAL POWDER; GLUCINIUM; GLUCINUM
General Use: Major use of metal is in alloys; i.e. beryllium-copper for its high strength, good thermal and electrical conductivity.
The high strength and light weight of some alloys is used in structural material in space technology; gyroscopes, inertial guidance systems.
Moderator and reflector of neutrons in nuclear reactors; source of neutrons when bombarded with alpha particles; special windows for x-ray tubes.
Additive in solid propellant rocket fuels. Computer parts.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
beryllium	7440-41-7	>99

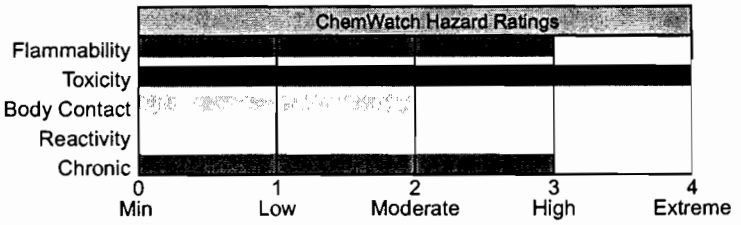
OSHA PEL
TWA: 0.002 mg/m^3; as Be. Other Values: 0.025 mg/m^3; as Be 30 min/8 Hr.

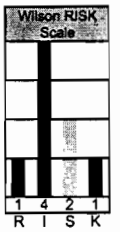
ACGIH TLV
TWA: 0.002 mg/m^3; as Be.

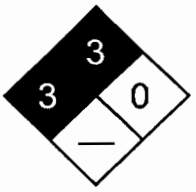
NIOSH REL
STEL: 0.0005 mg/m^3; Ceiling as Be.

IDLH Level
4 mg/m^3; as Be.

Section 3 - Hazards Identification







Fire Diamond

ANSI Signal Word
Danger!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Gray-white powder; odorless. Poison! Causes respiratory inflammation, congestion, coughing, pulmonary edema. Heavy exposures: brain, spleen hemorrhaging, liver inflammation. Chronic: lung, heart, liver, spleen, kidney damage. May cause cancer. Flammable.

Potential Health Effects

Primary Entry Routes: inhalation
Target Organs: lungs, mucous membranes, eyes, skin
Acute Effects
Inhalation: The dust may be highly discomforting to the upper respiratory tract and may be fatal if inhaled. Beryllium absorption from the lungs into the blood takes place more readily than by ingestion but is by no means rapid. A significant part of the dose is transported to the skeletal system. Of the remainder, ionic forms (for the greater part) go to the kidney (and are excreted in the urine) whereas colloidal forms collect in the liver.

Acute pneumonitis can occur from a single high level exposure to soluble beryllium compounds and beryllium exposures in excess of 1 mg/m^3 consistently produce cases among all workers. Symptoms from an exposure may appear in a few hours and recovery may take up to 12 weeks.
Typical symptoms appear as anorexia, weight loss, weakness and varying degrees of cyanosis. Physical signs include lowered vital capacity, fine to course sibilant rales and rapid pulse.
Early pulmonary changes in guinea pigs receiving intratracheal beryllium oxide are similar to a characteristic delayed hypersensitivity.

Eye: The dust may be discomforting to the eyes.
May can cause itching, conjunctivitis and corneal burns. Sometimes an allergic eye problem develops, breaking out again with future exposure.

Skin: The material is moderately discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.
Open cuts, abraded or irritated skin should not be exposed to this material.
Beryllium is a cutaneous sensitizer and primary skin irritant that produces contact dermatitis, skin granulomas and ulcers. An affinity for proteins found in the skin may explain the allergic sensitization produced in guinea pig epidermis. The onset and pattern of the sensitization suggests that tissue reactions induced by beryllium compounds should be considered immunologic reactions of the delayed or tuberculin type.
Beryllium dermatitis in humans consists of erythematous, papular or papulo- vesicular lesions usually confined to the exposed parts of the body.
Conjunctivitis and upper respiratory tract involvement usually appear at the same time. The dermatitis appears 1 to 2-weeks after exposure to soluble salts. From patch tests a latent period of 12 to 13 days occurs before a dermal response, this being the time necessary for the development of a hypersensitive state.
Beryllium ulcer is a localized phenomenon resulting from the embedding of a particle of beryllium salt into an abrasion or crack in the skin. The ulcerated lesions may last for months unless excised.

Ingestion: The solid/dust is discomforting to the gastrointestinal tract.
Beryllium even in its most highly soluble forms is poorly absorbed from the gastrointestinal tract.
Extremely low concentrations of beryllium are effective in inhibiting a number of metabolically critical enzymes.
Further toxic action has been attributed to an affinity by beryllium for binding to the cell mitochondria and disrupting lysosomes the so-called "suicide bags of the cell".

Carcinogenicity: NTP - Class 2A, Reasonably anticipated to be a carcinogen, limited evidence of carcinogenicity from studies in humans; IARC - Group 1, Carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Chronic Effects: Chronic exposure to beryllium dusts and fumes may cause berylliosis (progressive lung damage) and systemic beryllium disease, including pneumonitis, joint pain, skin lesions, chills and fever and damage to liver, kidney, spleen, lymph nodes and heart. The onset may be marked by weakness, easy fatigue and weight loss without cough or dyspnea.
Kidney stones can occur following high or repeated exposures.
Chronic beryllium disease may appear months or years after all exposure to beryllium has ceased. Granulation tissue in the lung may appear in 3-months to 15 years, often after short exposure to low concentrations.
Unless treated the condition is often fatal. Granulumatous lesions may also develop in the abdominal lymph nodes, spleen, liver and bone marrow.
The biological half-life of beryllium is long with the material being detected more than 20-years after the last exposure.
A significant risk of chronic beryllium disease exists among workers who smelt, burn, refine, or weld the metal or its alloys, even if exposures are below the adopted respiratory standards. Disease may result from occupational exposures to alloys containing less than 2% beryllium. The disease proves to be of long duration with exacerbation and/or remission in most cases. When chills and fever develop as complications the prognosis is bad.
Some 60 individuals are known to have become ill by incidental exposure to beryllium. This exposure may have arisen as a result of living near a beryllium-producing facility (within 1 km) and/or by contact with contaminated clothing brought home by workers.
There is some evidence that beryllium causes lung and bone cancer in humans a result confirmed in animal experiments.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

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

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.

Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: Acute berylliosis produces interstitial fibrotic disease rather than the simple focal nodular lesions seen in simple pneumoconiosis. Fibrotic lesions appear out of proportion to dust-laden macrophages. In common with asbestosis and aluminosis the condition is characterized by reduced lung volumes, elasticity and diffusion. Chronic exposure causes chronic granulomatous disease similar to sarcoidosis and miliary tuberculosis.

Multi-system involvement includes lymph nodes, spleen, liver, myocardium, kidney and bones. Occasionally hypercalcemia develops. Initially non- specific symptoms appear and are followed by dyspnea and cough.

Symptoms are progressive and steroids may help to blunt the course of the disease. ACTH and cortisone therapy have been encouraging.

Aurin tricarboxylic acid effectively protects monkeys exposed to lethal quantities of beryllium - no data is available for humans to substantiate its safety or effectiveness.

Section 5 - Fire-Fighting Measures

Flash Point: Combustible solid

Autoignition Temperature: 649 °C

Extinguishing Media: Dry chemical powder, dry sand or sodium chloride.

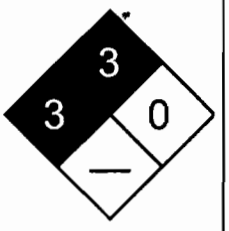
DO NOT use water.

DO NOT use carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Flammable solid.

Fine powder may ignite spontaneously in air.

Moderate fire and explosion hazard, in the form of dust, when exposed to heat or flame.



Fire Diamond

Metal powders, while generally regarded as noncombustible, may burn when metal is finely divided and energy input is high. Metal dust fires are slow moving but intense and difficult to extinguish. DO NOT disturb burning dust.

Explosion may result if dust is stirred into a cloud, by providing oxygen to a large surface of hot metal. DO NOT use water or foam as generation of explosive hydrogen may result.

Emits highly toxic fumes on combustion.

Fire Incompatibility: Avoid reaction with oxidizers, carbon tetrachloride, trichloroethylene, lithium and phosphorus.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.

Use water delivered as a fine spray to control fire and cool adjacent area.

Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.

Avoid contact with skin and eyes.

Wear protective clothing, gloves, safety glasses and dust respirator.

Use dry clean-up procedures and avoid generating dust.

Place spilled material in clean, dry, sealable, labeled container.

Large Spills: Clear area of personnel and move upwind.

Contact fire department and tell them location and nature of hazard.

Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.

No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so.

Water spray or fog may be used to disperse/absorb vapor.

Contain or absorb spill with sand, earth or vermiculite.

Collect recoverable product into labeled containers for recycling.

Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains.

After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

If contamination of drains or waterways occurs, advise emergency services.

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

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Keep dry.
Avoid generating and breathing dust. Avoid contact with skin and eyes.
Avoid smoking, bare lights, heat or ignition sources Use spark-free tools when handling.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use.
Avoid physical damage to containers.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
For large scale or continuous use: spark-free, grounded ventilation system venting directly to outside and separate from usual ventilation systems.
Provide dust collectors with explosion vents.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Special ventilation requirements apply for processes which result in the generation of beryllium or cadmium fume.
The use of mechanical ventilation by local exhaust systems is required as a minimum in all circumstances (including outdoor work).
Personal respirators and special glove boxes afford additional protection (In confined spaces always check that oxygen has not been depleted by excessive rusting of steel or snowflake corrosion of aluminum). Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0.5 meter/sec.
Personal Protective Clothing/Equipment
Eyes: Safety glasses; safety glasses with side shields; chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.
Respiratory Protection:
Exposure Range >0.002 to 0.02 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >0.02 to 0.2 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >0.2 to 2 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >2 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)
Other: Overalls. PVC apron. PVC protective suit may be required if exposure severe.
Eyewash unit. Ensure there is ready access to a safety shower.
For large scale or continuous use: tight-weave non-static clothing (no metallic fasteners, cuffs or pockets); & non sparking safety footwear.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Odorless greyish white metallic powder. Soluble in acids (except nitric) and alkalis.

Physical State: Divided solid
Vapor Pressure (kPa): Not applicable
Vapor Density (Air=1): Not applicable
Formula Weight: 9.01
Specific Gravity (H_2O=1, at 4 °C): 1.848
Water Solubility: Insoluble in cold water
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 2970 °C (5378 °F)
Freezing/Melting Point Range: 1287 °C (2348.6 °F)
Volatile Component (% Vol): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers, acids, alkalis, carbon tetrachloride, trichloroethylene, lithium and phosphorus.

Section 11 - Toxicological Information

Mutation DNA damage Human Tumorigenic - neoplastic by RTECS criteria.

See NIOSH, *RTECS* DS 1750000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: Tlm Pimephales promelas (fathead minnow) 150 ug/l/96 hr (soft water) /Conditions of bioassay not specified

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury or incinerate residue at an approved site.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: BERYLLIUM POWDER **Additional Shipping Information:**
Hazard Class: 6.1(a)
ID No.: 1567
Packing Group: II
Label: Poison[6],Flammable Solid

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed P015 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001; per CWA Section 307(a); per CAA Section 112 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

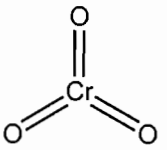
Section 16 - Other Information

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.

CHROMIC (VI) OXIDE (1:3)

RTECS: GB6650000
DOT: UN1463; NA1463; IMO5.1
EINECS Number: 215-607-8
Molecular Formula: CrO_3
Structured MF: CrO_3
Formula Weight: 99.99



Chemical Structure

Synonyms: ANHYDRIDE CHROMIQUE; ANIDRIDE CROMICA; CHROME (TRIOXYDE DE); CHROMIA; CHROMIC ACID; CHROMIC ACID,SOLID; CHROMIC ACID,SOLUTION; CHROMIC ANHYDRIDE; CHROMIC OXIDE; CHROMIC TRIOXIDE; CHROMIC (VI) ACID; CHROMIC VI ACID; CHROMIC(VI) ACID; CHROMIUM OXIDE; CHROMIUM OXIDE [CRO3]; CHROMIUM (6+) TRIOXIDE; CHROMIUM TRIOXIDE; CHROMIUM(6+) TRIOXIDE; 5CHROMIUM TRIOXIDE,ANHYDROUS; CHROMIUM VI OXIDE; CHROMIUM(VI) OXIDE; CHROMSAEUREANHYDRID; CHROMTRIOXID; CHROOMTRIOXYDE; CHROOMZUURANHYDRIDE; CROMO(TRIOSSIDO DI); MONOCHROMIUM OXIDE; MONOCHROMIUM TRIOXIDE; PURATRONIC; PURATRONIC CHROMIUM TRIOXIDE

Description: dark purplish-red crystals, powder; no detectable odor

Use: in chromium plating: copper stripping; aluminum anodizing; corrosion inhibitor; photography; purifying oil and acetylene; hardening microscopical preparations; oxidant in organic chemistry

Physical Properties

Boiling Point: Decomposes at 250 °C (482 °F)
Freezing Point: 197 °C (386.6 °F)
Specific Gravity: 2.7
Density: 2.7 g/mL
Vapor Pressure: Reid; Very low
Water Solubility: Very Soluble
Other Solubilities: 95% Ethanol: Soluble; Nitric acid: Soluble.
pH: Acid
Ionization Potential (eV): 11.6 +/-0.5
Flash Point: Nonflammable

RTECS Toxicity Data

Acute Oral: Rat LD_{50} Dose: 80 mg/kg; Toxic Effects: Lungs, Thorax, or Respiration - Cyanosis; Gastrointestinal - Hypermotility, diarrhea; Skin and appendages - Hair. Mouse LD_{50} Dose: 127 mg/kg.

Acute Inhalation: Human TC_{Lo} Dose: 110 ug/m^3.

Acute Dermal: Mouse LD_{Lo} Route: Subcutaneous Dose: 20 mg/kg.

Chronic (Multiple Dose) Inhalation: Rat Dose: 29 ug/m^3/20H/90D-I; Toxic Effects: Behavioral - Muscle contraction or spasticity; Lungs, Thorax, or Respiration - Other changes; Biochemical - Carbonic anhydrase.

Reproductive/Teratogenic: Mouse Route: Subcutaneous; Dose: 20 mg/kg; Duration: female 8D of pregnancy; Effects on Embryo or Fetus - Extra embryonic structures; Fetotoxicity. Hamster Route: Intravenous; Dose: 5 mg/kg; Duration: female 8D of pregnancy; Specific Developmental Abnormalities - Homeostasis; Craniofacial (including nose and tongue); Central nervous system. Hamster Route: Intravenous; Dose: 7500 ug/kg; Duration: female 8D of pregnancy; Effects on Fertility - Post-implantation mortality; Effects on Embryo or Fetus - Fetotoxicity; Specific

OCEAN COUNTY

Barnegat Light Borough
Barnegat Township (Union)
Bay Head Borough
Beach Haven Borough
Beachwood Borough
Berkeley Township
Brick Township
Dover Township
Eagleswood Township
Harvey Cedars
Island Heights Borough
Jackson Township
Lacey Township
Lakehurst Borough
Lakewood Township
Lavallette Township
Little Egg Harbor Township
Long Beach Township
Manchester Township
Mantoloking Borough
Ocean Gate Township
Pine Beach Borough
Point Pleasant Beach Boro
Point Pleasant Borough
Seaside Heights Borough
Seaside Park Borough
Ship Bottom Borough
South Toms River Borough
Stafford Township
Surf City Borough
Tuckerton Borough

SALEM COUNTY

Alloway Township (not in CAFRA area)
Elsinboro Township
Lower Alloways Creek Township
Mannington Township
Pennsville Township
Quinton Township
Salem City
Upper Penns Neck

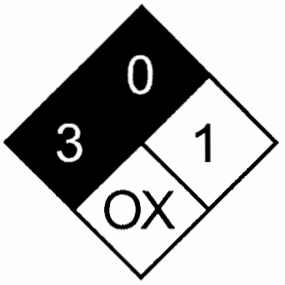
Developmental Abnormalities - Musculoskeletal system. Hamster Route: Intravenous; Dose: 8 mg/kg Duration: female 8D of pregnancy; Specific Developmental Abnormalities - Body wall.

Mutagenic: Human Cytogenetic Analysis; Cell Type: leukocyte; Dose: 2 mg/L. Human Morphological Transformation; Cell Type: fibroblast; Dose: 100 nmol/L.

Tumorigenic: Human Route: Inhalation; Dose: 110 ug/m^3/3Y-C; Toxic Effects: Tumorigenic - Carcinogenic by RTECS criteria; Sense organs and special senses - Tumors; Lungs, Thorax, or Respiration - Tumors. Rat Route: Implant; Dose: 125 mg/kg; Toxic Effects: Tumorigenic - Carcinogenic by RTECS criteria; Tumorigenic - Tumors at site of application.

Hazard Overviews

Corrosive



Fire Diamond

Health: Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic Chronic Effects: dermatitis, tooth erosion, and nasal septum perforation.

Fire: Noncombustible. Use extinguishing media suitable for surrounding area.

Reactivity: Stable. Hazardous polymerization cannot occur. Avoid: heat; organic materials; combustibles. Incompatible with: acetic acid; acetic anhydride; acetone; alcohols; alkali metals; ammonia; arsenic; anthracene; benzene; bromine pentafluorine; butyric acid; camphor; chromous sulfide; diethyl ether; glycerol; hydrogen sulfide; methyl alcohol; naphthalene; peroxyformic acid; phosphorus; potassium hexacyanoferrate; pyridine; selenium; sodium; turpentine; ignites ethyl alcohol; hydrocarbons. Hazardous decomposition products: carbon dioxide; smoke; toxic fumes.

Carcinogenicity: IARC - Group 1, Carcinogenic to humans; NIOSH - Listed as carcinogen; NTP - Class 1, Known to be a carcinogen; ACGIH - Class A1, Confirmed human carcinogen; OSHA - Not listed; EPA - Class A, Human carcinogen; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only

Primary Target Organs:

Eyes | Skin | Respiratory System | Liver | Kidneys | Teeth

Exposure Limits

OSHA PEL: STEL: 0.1 mg/m^3; as CrO_3; Other Values: 0.1 mg/m^3; Clg Cr-VI as CrO_3.

NIOSH REL: TWA: 0.5 mg/m^3; as Cr;Cr-II;Cr-III;Cr(VI)=.001.

Respirator Recommendation

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 <15 mg/m^3 Supplied Air, Constant Flow/Pressure Demand, Full Face

Exposure Range: 15 to unlimited mg/m^3 Self-contained Breathing Apparatus, Pressure Demand, Full Face

Cartridge Color: magenta (P100)

Note: as chromium VI compounds

Environmental

Ecotoxicity: LC_{50} Ophryotrocha diadema (polychaete worm); 7,500 ug/l as chromium and Ctendrilus seratus (polychaete worm) 4,300 ug/l as chromium; static unmeasured method LC_{50} Capitella captata (polychaete worm) 8,000 ug/l as chromium (larval) and 5,000 ug/l as chromium (adult); static unmeasured method EC_{50} Salmo gairdneri (rainbow trout, embryo larva) 190 ug/l as chromium/28 days, with a water hardness of 101 mg/l as calcium carbonate; Toxic Effect: death and deformity. /Conditions of bioassay not specified Toxic threshold, Daphnia magna 0.016-0.7 ppm

Cleanup/Disposal: Guide No. 141: Keep combustibles (wood, paper, oil, etc.) away from spilled material. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area. Large Spills: Dike far ahead of spill for later disposal.

Environmental Physical Data

BCF: none

BOD: none

Regulations

RCRA 40CFR: Not listed

CERCLA: 40CFR 302.4: Listed as Compound per CWA Section 307(a) per CAA Section 112

SARA 40CFR 372.65: Listed as Compound

SARA EHS 40CFR 355: Not listed

TSCA: Listed

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Schenectady, NY 12304-4690
(518) 377-8854

Material Safety Data Sheet Collection

Molybdenum **MSDS No. 84**

Date of Preparation: 3/81 Revision: B, 3/98

Section 1 - Chemical Product and Company Identification 51

Product/Chemical Name: Molybdenum
Chemical Formula: Mo
CAS Number: 7439-98-7 .
Synonyms: MCHVL; molybdate, molybdenum metal, TSM1
Derivation: The pure metal is prepared by the reduction of purified molybdic trioxide or ammonium molybdate with hydrogen; by aluminothermic, hydrogen or electric furnace reduction of molybdenum trioxide or ammonium molybdate; extracted from molybdenite, wulfenite, and powellite and is recovered as a by-product of copper and tungsten mining operations.
General Use: In manufacture of special-purpose steel and as an alloying agent in steels and cast iron; in high temperature alloys, tools, steels; pigments for printing inks, ceramics, and paints. Used as a catalyst; solid lubricants; aircraft and missile parts; reactor vessels; cements; die-casting copperbase alloys; in special batteries; and as an additive to fertilizer.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Molybdenum: 99.9% wt
Trace Impurities: carbon, oxygen, nitrogen, iron, nickel, silicon, potassium, sodium.

OSHA PEL
8-hr TWA: 15 mg/m^3, total dust (as Mo)†

ACGIH TLV
8-hr TWA: 10 mg/m^3, (as Mo)†

NIOSH REL
None established

IDLH Level
5000 mg/m^3, (as Mo)†

DFG (Germany) MAK
8-hr TWA: 15 mg/m^3, (as Mo)*†
Category III: Substances with systemic effects; onset of effect >2 hr. Half-life > shift length (strongly cumulative)

Peak Exposure Limit
150 mg/m^3, 30 min, average value, 1/shift

*Measured as inhalable fraction of aerosol.
†Exposure limit defined for insoluble compounds.

Section 3 - Hazards Identification

ANSI Signal Word: Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Molybdenum is a silvery-white metal or grayish black powder. Most toxicity data is based on animal studies. There is little evidence of molybdenum producing toxicity in man, although biochemical changes have been noted in workers following inhalation exposure. Dust and fumes are irritating to eyes and respiratory system. Molybdenum is both flammable and explosive in powder or dust form when exposed to heat or ignition sources.

Wilson Risk Scale	
R	3
I	2
S	1
K	2

HMIS	
H	1*
F	2
R	3
PPE†	

*Chronic effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact
Target Organs: Eyes, skin, respiratory and nervous systems, liver, kidneys and blood
Acute Effects
Inhalation: Dust and fumes may cause irritation. Workers exposed to approximately 9.5 mg Mo/m^3 as soluble dust at a molybdenum-roasting planthad increased levels of molybdenum in both plasma and urine. The only adverse biochemical findings for inhalation were large elevations in serum ceruloplasmin levels (specific blood plasma compound) and some increase in serum uric acid levels.
Eye: Contact causes irritation in animal studies.
Skin: None reported.
Ingestion: Diarrhea has been reported. Limited information exists on human ingestion. High dietary intake may alter copper balance, increase serum ceruloplasmin.
Carcinogenicity: IARC, NTP, and OSHA do not list molybdenum as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Susceptibility to gout. Excessive molybdenum can interfere with copper absorption in humans which can, in theory, predispose some individuals to anemia.
Chronic Effects: Exposure may result in anemia, hyperthyroidism, and abnormal liver function tests. Headache, muscle and/or joint pain, weakness, fatigue, anorexia, impaired pulmonary function, renal disfunction, skin/hair changes, dry cough and chest pains have been reported following long-term inhalation exposure. Deformities of joint extremities in cattle, chicks, and rabbits with high dietary levels of molybdenum were reported. Persons living in regions with high molybdenum and low copper concentrations have developed gout-like conditions and deformities in the joints.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air and support breathing as needed. If cough or difficulty in breathing develops administer 100 percent humidified supplemental oxygen with assisted ventilation as required.
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 persists.
Skin Contact: Remove contaminated clothing. Rinse with flooding amounts of water followed by washing the exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the conscious and alert person drink 4 to 8 ounces of milk or water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Monitor uric acid, CBC with differential, liver function and renal function.
Special Precautions/Procedures: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures

Flash Point: Not applicable, combustible solid.
LEL: None reported.
UEL: None reported.
Flammability Classification: Combustible solid in the form of dust or powder.
Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or alcohol foam.
Unusual Fire or Explosion Hazards: Flammable if in powder or dust form. Dust-air explosions may occur. Containers may explode when heated.
Hazardous Combustion Products: When involved in heat of fire, poisonous gases of molybdenum oxide and toxic fumes of molybdenum trioxide (MoO_3) are emitted.
Fire-Fighting Instructions: *Do not* release runoff from fire control methods to sewers or waterways. Dike fire control waters for later disposal; *do not* scatter the material. For fires involving tank/car or trailer loads, fight fire from maximum distance or use unmanned hose holders, or monitor nozzles.
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 and protective clothing to prevent contact with skin.

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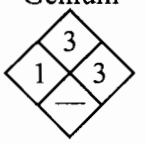

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel and evacuate all unnecessary personnel up to 160 feet. Cleanup personnel should protect against dust inhalation and skin or eye contact. Avoid dust generation, blowing, dry brushing, and dry mopping. Use nonsparking tools. Ventilate area and wash spill site after material pickup is complete.
Small Spills: *Do not* dry sweep! Use a vacuum (with appropriate HEPA filter) or wet method.
Large Spills
Containment: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways.
Cleanup: Use clean, nonsparking tools to collect material.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Practice good personal hygiene and housekeeping procedures. Use ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec 2). Where dusty conditions exist, use dust-proof goggles and appropriate respirators (see Sec. 8).
Storage Requirements: Store molybdenum in a cool, dry well-ventilated area in tightly closed wooden barrels or cartons away from all heat or ignition sources and incompatibles (see Sec. 10).

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid dust dispersion into the work area. Avoid dust generation during work operations.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Administrative Controls: Screen employees for history of certain medical conditions such as kidney disease, chronic respiratory and liver disease which could place employees at an increased risk from exposure to molybdenum. Educate workers about the health and safety hazards associated with molybdenum powder, and work practices which minimize exposure.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, where the potential exists for exposures over 10 mg/m^3, use a MSHA/NIOSH-approved respirator equipped with particulate (dust/fume/mist) filters. Select respirator based on its suitability to provide adequate worker protection

for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations ≤ 75 mg/m^3, use a dust or mist respirator (no fumes), ≤150 mg/m^3, any dust or mist respirator except single-use and quarter-mask respirators (no fumes), or supplied air respirator; ≤375 mg/m^3, supplied air respirator in continuous flow mode, or powered air-purifying respirator with dust and mist filter (no fumes); ≤750 mg/m^3, air-purifying full facepiece respirator with high efficiency particulate filter (HEPA), supplied air respirator with tight-fitting facepiece in continuous flow mode; powered air-purifying respirator with tight-fitting facepiece and HEPA filter, supplied air respirator with full facepiece, or SCBA with full facepiece; ≤5000 mg/m^3, supplied air respirator with full facepiece operated in pressure demand or other positive pressure mode; >IDLH/ unknown/emergency, SCBA with full facepiece operated in pressure demand or other positive pressure mode, or supplied air respirator with full facepiece operated in pressure demand or other positive pressure mode in combination with auxiliary SCBA operated in pressure demand or other positive pressure mode. For escape, use an air-purifying, full facepiece respirator with HEPA filter, or escape-type SCBA. 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 dust-proof safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

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

Appearance and Odor: Dark-gray or black powder with a metallic luster.

Vapor Pressure: 0 mm Hg, approximately

Vapor Density (Air=1): 0.6964

Formula Weight: 95.94

Density (H2O=1, at 4 °C): 10.28

Specific Gravity (H2O=1, at 4 °C): 10.28

Water Solubility: Insoluble

Other Solubilities: Practically insoluble in alkali hydroxides or fused alkalies. Insoluble in hydrochloric acid, hydrogen fluoride, ammonia, sodium hydroxide or dilute sulfuric acids; soluble in hot concentrated sulfuric or nitric acids.

Boiling Point: 8717 °F (4825 °C)

Melting Point: 4752 °F (2622 °C)

Ionization Potential (eV): 7.09243 +/-0,00004

Section 10 - Stability and Reactivity

Stability: Molybdenum is stable at room temperature in closed containers under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Reacts vigorously with strong oxidizers. Powdered molybdenum reacts with bromine trifluoride, chlorine trifluoride, and fluorine to produce incandescence. When mixed with lead dioxide it becomes incandescent when heated. Reaction between molybdenum and bromine trifluoride is vigorous.

Conditions to Avoid: Exposure to sources of ignition. Formation of dust clouds.

Hazardous Decomposition Products: Thermal oxidative decomposition of molybdenum can produce molybdenum trioxide (MoO_3) and molybdenum oxide.

Section 11 - Toxicological Information

Toxicity Data:*

Acute Effects:

Rabbit, intratracheal, LD_{Lo}: 70 mg/kg produced focal fibrosis (pneumoconiosis).

Animal (species not reported), oral or parenteral, LD: > 100 mg/kg (molybdenum and its salts)

Reproductive Effects:

Rat, oral: 6050 µg/kg given to female 35 weeks prior to mating produced pre-implantation mortality; post-implantation mortality; specific developmental abnormalities - musculoskeletal system.

Rat, oral: 5800 µg/kg given to female 30 weeks prior to mating and during days 1-20 of pregnancy caused specific developmental abnormalities - musculoskeletal system.

Reproductive Effects, *continued*:

Mouse, intravenous: 100 millimoles resulted in decreased fetal weight in offspring on day 8.

Mouse, oral: diet containing 0.45 ppm resulted in some runting in third generation offspring.

Cytogenetic Analysis:

Rat, inhalation: 19500 $\mu g/m^3$

Subchronic Effects:

Rat, inhalation: 12-16 g/m^3/1 hr/30 days, resulted in slight growth depression, and thickening of the intraaveolar septa, which contained connective tissue fibers.

* See NIOSH, *RTECS* (QA4680000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: *Pimephales promelas* (fathead minnow), LC_{50}: 370 mg/L/96 hours, conditions of bioassay not specified. Terrestrial plants can contain enough molybdenum to be toxic to animals but still grow normally.
Environmental Fate: In water, molybdenum will precipitate out with natural calcium.
Soil Adsorption/Mobility: Soil levels should not exceed 50 ppm to avoid problems with livestock. Sorption is most significant in soils of low pH and high organic content.

Section 13 - Disposal Considerations

Disposal: Route to metal salvage facility or contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101): Not specifically listed

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste Number: Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

Section 16 - Other Information

References: 1, 73, 99, 103, 124, 136, 149, 176, 190, 209, 216, 222, 223, 224, 227, 230

Prepared By ..... N Golub/HM Spliethoff, MS
Industrial Hygiene Review ..... PA Roy, MPH, CIH
Medical Review ..... T Thoburn, MD, MPH

ATTACHMENT 3
SAFETY AND HEALTH FORMS

Conti Environmental, Inc
Safety and Health Revision Request Form

Project Number.	Project Name:	Project Supervisor:

Revision Subject:

Revision Information

Recommended Revision:

Justification of Revision:

Submitted By

Name:	Title:
Signature:	Date:

Approval

☐ Approved ☐ Disapproved	Comment:

Name:	Title:
Signature:	Date:

Conti Environmental, Inc

Certificate of Worker/Visitor Acknowledgement

Project Name:	Worker/Visitor:

The contract for the above project requires the following: that you be provided with and complete formal and site-specific training; that you be supplied with proper personal protective equipment including respirators; that you be trained in its use; and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that your employer has met these obligations to you.

Site Required Training/Medical

Training	Date
40-Hour HAZWOPER: I have completed the formal OSHA training course	
3-Day Actual Field Experience: I have completed three days actual field experience under the direct supervision of a HAZWOPER trained, experienced supervisor.	
8-Hour HAZWOPER Supervisory: I have completed the formal OSHA training courses	
8-Hour HAZWOPER Annual Refresher: I have completed the formal OSHA training course.	
Site-Specific Training: I have been provided and have completed the site-specific training required by this SSHP. The Site safety and Health Officer conducted the training.	
Confined Space Entry Training: I have completed the OSHA formal course	
Respiratory Protection: I have been trained In accordance with the criteria in Conti's Respiratory Protection Program. I have been trained in the proper work procedures and limitations of the respirator (s) I will wear. I have been trained in and use and will abide by the facial hair policy.	
Respirator Fit-Test Training: I have been trained in the proper selection fit, use, care, cleaning, and maintenance, and storage of the respirator (s) that I will wear. I have been fit-tested in accordance with the criteria in Conti's Respiratory Program and have received a satisfactory fit. I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time.	
Medical Examination: I have had a medical examination within the last twelve months which was paid for by my employer. The examination included: health history, pulmonary Function tests and may have included an evaluation of a chest array. A physician made determination regarding my physical capacity to perform work tasks on the project while wearing protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. I have been provided with a medical certification by the occupational physician and the occupational physician has determined that there: ____ Were no limitations to performing the required work tasks; ____ Were identified physical limitations to performing the required work tasks	

I HAVE READ, UNDERSTAND AND AGREE TO FOLLOW THE SITE SAFETY AND HEALTH PLAN FOR THIS SITE.

Worker/Visitor Signature:		Social Security Number:	Date:
Site Safety and Health Officer:	Signature:	Social Security Number:	Date:

Conti Environmental, Inc
Daily Safety and Inspection Log

Project Number:	Project Name:	Project Supervisor:
Date:	**Weather Condition:**	
Summary of Day's Work Activity:		
Violations of the Site Safety and Health Plan:		
Protective Clothing and Equipment Being Used by Task:		
Physical Condition of Workers (any heat or cold stress or other medical problems):		
Accidents or Breach of Procedures:		
Description of Monitoring and Air sampling Taken:		
Miscellaneous:		
Name:	**Title:**	
Signature:	Date:	

ENVIRONMENTAL

CONFINED SPACE ENTRY PERMIT

Project Number:	Project Name:	Project Supervisor:
Date:	Time: Begin	Time: End
Operating Area/ Work To Be Done:		

NATURE OF HAZARDS

	Y	N
Oxygen Deficiency		
Flammable gas or Vapor		
Toxic gas or Vapors		
Mechanical Hazards		
Electrical Hazard		
Material Harmful To Skin		
Engulfment Hazards		
Welding Cutting Operations		
Other_____		

PREPARATION

	Y	N
Notify Affected Personnel		
Lockout all energy Sources		
Drained, Washed and Purged		
Ventilation to Provide Fresh Air		
Entry Procedures reviewed		
Atmosphere Test in Compliance		
Hot Work Permit		
Emergency Telephone Posted		
Other_____		

EQUIPMENT REQUIRED

	Y	N
Level of PPE		
Lifeline and Safety Harness		
Tripod and Retracting Winch		
Electrical Equipment		
Rescue Equipment		
Fire Protection Equipment		
Other_____		

Entrant:
Entrant:
Entrant:
Attendant:
Supervisor:

Police Department:	Fire Department:	Ambulance Services:	Other:_____

AIR MONITORING

	Limits	Results	Results	Results	Results	Results	Results
Time							
O2	19.5-23.5 %						
LEL	10 %						
H2S	10 PPM						
CO	25 PPM						
Other							

Confined Space Entry Authorization:	Date:	Time:

Conti Environmental, Inc.
Daily Air Monitoring Report

Project Number:	Project Name:	Project Supervisor:
Date:	**Duration of Monitoring**	

Work Location and Task:

Instrument:		**Instrument:**		**Instrument:**	
Reading	**Time**	**Reading**	**Time**	**Reading**	**Time**
Calibration:		**Calibration:**		**Calibration:**	

Perimeter Samples Collected:

Personnel Samples Collected:

Perimeter and Personnel Sample Results From Previous Day (Provide Data when Received):

Comments:

Name:	**Title:**
Signature:	Date:

Daily Air Monitoring Report (Cont.)

Project Number:	Project Name:	Project Supervisor:

Instrument:		**Instrument:**		**Instrument:**	
Reading	**Time**	**Reading**	**Time**	**Reading**	**Time**
Calibration:		**Calibration:**		**Calibration:**	

Signature:	Date:

Conti Environmental, Inc.
Air Sampling Report

PROJECT NUMBER:	PROJECT NAME:	Date:

WORK LOCATION AND TASK:

AIR SAMPLING INFORMATION

Sample I.D.	Name / SSAN Area	Air Sampling Compound	Analysis Method	Start Time	Stop Time	Total Time	Start Flow	Stop Flow	Average Flow Rate	Total Volume

Comments:

Signature:	Date:

Tool-Box Safety Briefing Sheet

Date:	Project:

Topics of Toolbox Safety Meeting

- ☐ Hardhats and Safety Shoes
- ☐ Eye & Ear Protection
- ☐ Work Zones and Site Control
- ☐ Heat and Cold Stress
- ☐ Designated Smoking Zone
- ☐ Review Previous Accidents
- ☐ Accident Reporting/Investigation
- ☐ Activity Hazard Analysis _____
- ☐ Activity Hazard Analysis _____
- ☐ Ladder for Excavation
- ☐ Entering Excavation
- ☐ Confined Space Entry
- ☐ Ground Fault Interrupters
- ☐ First Aid and Fire Protection
- ☐ Hazardous Communication
- ☐ Fall Protection (6 Foot Rule)
- ☐ Activity Hazard Analysis _____
- ☐ Other_____

Site Specific Hazards

Attendees

Conti Employees	Subcontractors & Visitors

Daily Operations

Site Safety and Health Officer:

Conti Environmental, Inc
Qualitative Fit Test Report

Employee Information	
Employee Name:	Date:
Employee Position/Department:	SSAN:
Test Performed By:	Title:

Respirator/Fit Test Information	
☐ Self Contained Breathing Apparatus	☐ Supplied Air Respirator
☐ Powered Air Purifying Respirator	☐ Air Purifying Respirator

☐ Clean Shaven	☐ Beard	☐ Glasses	☐ Other

	Respirator 1	Respirator 2	Respirator 3
Brand:			
Model:			
Size:			
Positive Pressure Test: (Pass/Fail)			
Negative Pressure Test: (Pass/Fail)			
Irritant Smoke Test: (Pass/Fail)			
Banana Oil Test: (Pass/Fail)			
Fit Test Result: (Pass/Fail)			

Employee Statement: I understand that my use of this respirator must be in accordance with the Tyree Health and Safety Program, Manufactures Instruction and applicable OSHA Regulations and Standards

Employee's Signature:

Tester's Signature:

Conti Environmental, Inc.
Hot Work Permit

Date:	Time: Begin	Time: End
Project Number:	Project Name:	Project Supervisor:

Operating Area:

Work To Be Done:

AREA PREPARATION	Y	N
Is the equipment or area satisfactorily cleaned for **Flammable/Combustibles?**		
Is the adjoining operations or equipment considered **OK** from the standpoint of possible effect on the job?		
Have Flammable/Combustibles been located at least **35 feet** from the operation?		
Have non-movable Flammable/Combustibles been protected fireproof curtains or covers?		
Have requirements of other procedures been met? **(Lock Out, Confined Space Entry, etc.)**		
Are proper fire extinguishers on the job? **(20 lb. ABC)**		
Is sprinkler system operable? (If applicable)		
Is water house laid out and water running? (If applicable)		
Are tarps needed to protect adjoining areas or personnel from sparks or arc flashes?		
Is supply of fresh air needed for confined areas?		
Are lower floors, pipe chases, floor drains protected?		
Other precautions? **(Protective clothing and/or equipment, signs posted)**		
Has a fire watch been appointed to watch for dangerous sparks in the work area?		

Who is the **Fire Watch**:

AIR TESTING RESULTS

Is air testing required? ☐ Yes ☐ No

Testing Requirement	Reading	Reading	Reading	Reading	Reading	Reading
1. Time						
2. Oxygen content.						
3. Flammable concentration						

Air Monitoring Performed By:	Date:	Time:
Hot Work Permit Approve By:	Date:	Time:

EQUIPMENT INSPECTION CHECKLIST

REFERENCE INFORMATION
Date:
Project No.
Project Name:
Preparer:

This form is to be used for the initial equipment inspection upon arrival at the project and Daily inspection during use. Corrective actions are required for all deficiencies noted during the inspections.

Type of Equipment (Make & Model):	Conti Equipment ID #:	Equipment Hours:

INSPECTION ITEM	YES	NO	CORRECTIVE ACTION
Fluid Level?			
Horn Operable?			
Emergency/Parking Brake System?			
Hydraulic System Operable w/No leaks?			
Engine and Transmission			
Parking Brake System?			
Headlights Operable?			
Taillights Operable?			
Brake Lights Operable?			
Audible (Reverse) Alarm System?			
Unobstructed rear View?			
ndshields?			
Windshield Wipers and Washer Fluid?			
Defroster/Defogger?			
Cab Shield or Canopy?			
Seatbelts Available and Used?			
Fire Extingushers?			
Rear View Mirror?			
Fender/Mud Flaps?			

Comments:

SIGNATURES		
Inspected By:	Signature:	Date:
Reviewer's Name:	Signature:	Date:

Conti Environmental, Inc
Equipment Decontamination Log

Project Number:	Project Name:	Project Supervisor:

Equipment Description	Equipment Number	Date Decontaminate	Date Demob

Comments:

Site Safety and Health Officer	Signature

Bureau of Labor Statistics
Log and Summary of Occupational
Injuries and Illness

U.S. Department of Labor

For Calender Year 2000

NOTE: This form is required by Public Law 91 596 and must be kept in the establishment for 5 years. Failure to maintain and post can result in the issuance of citations and assessment of penalties. (See posting requirements on the other side of form.)

RECORDABLE CASES: You are required to record information about every occupational death, every nonfatal occupational illness; and those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid). (See definitions on the other side of form.)

Company Name: Conti Environmnetal, Inc

Establishment Name:

Establishment Address: 3001 South Clinton Ave, South Plainfield, NJ 07080

Case or File Number	Date of Injury or onset of Illness	Employee's Name	Occupation	Department	Description of Injury or Illness	Injury: Fatalities – Injury Related	Injury: Nonfatal Injuries – With Lost Workdays				Injury: Nonfatal Injuries – Without Lost Workdays	Type of Illness							Illness: Fatalities – Illness Related	Illness: Nonfatal Illness – With Lost Workdays				Illness: Nonfatal Illness – Without Lost Workdays
Enter a nonduplicating number which will facilitate comparisons with supplementary records	Enter Mo./day	Enter first name or initial, middle initial, last name	Enter regular job title, not activity employee was performing when injured or at onset of illness. In the absence of a formal title, enter brief description of the employee's duties.	Enter department in which the employee is regularly employed or a description of normal workplace to which employee is assigned, even though temporarily working in another department at the time of injury or illness.	Enter a brief description of the injury or illness and indicate the part of the body affected. Typical entries for this column might be: Amputation of 1st joint right forefinger; Strain of lower back; Contact dermatitis on both hands; Electrocution-body	Enter DATE of Death Mo./day/yr	Enter a CHECK if injury involves days away from work, or days of restricted work activity, or both	Enter a CHECK if injury involves days away from work	Enter number of DAYS away from work	Enter number of DAYS of restricted work activity	Enter a CHECK if no entry was made in columns 1 or 2 but the injury is recordable as defined above	CHECK Only One Column for Each Illness (See other side of form for terminations or permanent transfer.)							Enter DATE of Death Mo./day/yr	Enter a CHECK if illness involves days away from work, or days of restricted work activity, or both	Enter a CHECK if illness involves days away from work	Enter number of DAYS away from work	Enter number of DAYS of restricted work activity	Enter a CHECK if no entry was made in columns 8 or 9
(A)	(B)	(C)	(D)	(E)	(F)	(1)	(2)	(3)	(4)	(5)	(6)	(7) (a)	(b)	(c)	(d)	(e)	(f)	(g)	(8)	(9)	(10)	(4)	(5)	(6)
					PREVIOUS PAGE TOTAL																			
					TOTAL (Instruction on other side of form.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Certification of Annual Summary Totals By: Aldo M. Gonzalez, CSP | Title: Safety and Health Manager | Date: 1/28/01

Tyree-OSHA200

POST ONLY THIS PORTION OF THE LAST PAGE NO LATER THAN FEBRUARY 1.

Conti Environmental, Inc
Site Entry and Exit Log

Project Number:	Project Name:	Project Supervisor:

Employee Name	Company	Task	Time In	Time Out

(See instructions on Reverse) | 2-Aug-99

1. Clearance is requested to proceed with work at _____ Various locations throughout base See attached Maps.

on Work Order No._____, Contract No._____

attached sketch. This area [ ] has [X] has not been staked or clearly marked.

2. TYPE OF FACILITY/WORK INVOLVED

[ ]	A. DRAINAGE SYSTEMS	[ ]	B. UTILITY	[ ]	OVERHEAD	[ ]	UNDERGROUND	[ ] C. AIRCRAFT OR VEHICULAR TRAFFIC FLOW
[ ]	D. RAILROAD TRACKS	[ ]	E. COMM	[ ]	OVERHEAD	[ ]	UNDERGROUND	[ ] F. PIPELINE REMOVAL/CLOSURE
[ ]	G. STORAGE TANKS	[ ]	REMOVAL	[ ]	INSTALLATION			[X] H. OTHER Locate buried Monitoring Wells

3. DATE CLEARANCE REQUIRED	4. DATE OF CLEARANCE	
16-Aug-99		
5. SIGNATURE OF REQUESTING OFFICIAL	6. TELEPHONE NO.	7. ORGANIZATION
Mike Wojnas	# 2275	AFBCA/DA-Griffiss

8. CONTRACTOR	ORGANIZATION	REMARKS (Use Reverse for additional comments)	REVIEWERS NAME AND INITIALS
	A. ELECTRICAL DISTRIBUTION		
	B. STEAM DISTRIBUTION		
	C. WATER AND SEWER DISTRIBUTION		
	D. NATURAL GAS DISTRIBUTION		
	E. CABLE TV		
	F. COMMUNICATIONS		
	G. OTHER *(Specify)*		
9. ENVIRONMENTAL		CLEAR	Mike Wojnas
10. BASE OPERATIONS (Air National Guard)			
	A. POL DISTRIBUTION		
	B. AIRFIELD LIGHTING		

11. OTHER *(Specify)*_____

12. REQUESTED CLEARANCE [ ] APPROVED [ ] DISAPPROVED

13. TYPED NAME AND SIGNATURE OF APPROVING OFFICER *(Representative of HARZA-Northeast)*	14. DATE SIGNED

INSTRUCTIONS

The AFBCA work clearance request is used for any work (contract or in-house) that may disrupt aircraft or vehicular flow, base utility services, protection provided by fire and intrusion alarm systems, or routine activities of the installation. This form is used to coordinate the required work with key base activities and keep customer inconvenience to a minimum. It is also used to identify potentially hazardous work conditions in an attempt to prevent accidents. The work clearance request is processed just prior to the start of work. If delays are encountered and the conditions at the job site change (or may have changed) this work clearance request must be reprocessed.

17. REMARKS. *(This section must describe specific precautionary measures to be taken before and during work accomplishment. Specific comments concerning the approved method of excavation, hand or powered equipment, should be included.)*

This work will involve the digging within the area marked on the map to locate existing buried monitoring wells. See attached maps for area where clearance is required.