REPORT

Pre-Design Investigation Work Plan Area A

Central Hudson Gas & Electric Corporation
Poughkeepsie, New York

April 2006

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1. Introduction

This Pre-Design Investigation (PDI) Work Plan has been prepared by Blasland, Bouck & Lee, Inc. (BBL) on behalf of Central Hudson Gas & Electric Corporation (CHGE) in accordance with an Order on Consent (Order) between the New York State Department of Environmental Conservation (NYSDEC) and CHGE (Index #D3-0001-95-06) dated October 1995. Under the Order, CHGE is required to investigate and, if necessary, remediate hazardous substances located at the site of CHGE's former manufactured gas plant (MGP) in Newburgh, New York or in other areas where constituents from the Newburgh former MGP may have migrated (the Site). A Site Location Map is provided as Figure 1.

A remedial investigation (RI) and feasibility study (FS) were conducted at the site from 1996 to 2003. The objectives of the RI/FS were to characterize the nature and extent of impacts associated with the former MGP and to screen, evaluate and select remedial alternatives to address the impacts. During the RI/FS process, the Site was divided into three distinct areas primarily due to the varied land uses and physical characteristics of each of the three areas. This was also done for ease of evaluation of remedial alternatives. Area A is the former MGP itself; Area B is the area between the former MGP and the Hudson River currently occupied by the City of Newburgh sewage treatment plant (STP); and Area C is the Hudson River off-shore from the former MGP. A Site Map is provided as Figure 2.

As previously discussed with NYSDEC, it is CHGE's intention to complete the remedial design and construction activities in Area A in 2006. Because the investigation and monitoring tasks that will be performed for Areas B and C are more complex and of a longer duration, this PDI Work Plan presents only the scope of work for pre-design investigation activities that will be conducted in Area A. Pre-design activities in Areas B and C will be detailed in a subsequent work plan to be prepared and submitted to NYSDEC.

1.1 Area A Description

Area A is the portion of the Site where the former MGP was located. It is bordered to the north by South William Street, to the east by South Water Street, to the south by Renwick Street, and to the west by South Colden Street. The former MGP is approximately 1.8 acres in size and is enclosed by a chain link fence. Currently, CHGE operates a natural gas regulator station and a propane peaking plant at the Site. Features associated with these operations include a control building, five regulator stations and associated natural gas lines, a vaporizer, six 60,000-gallon propane tanks, and roads/paved access areas.

1.2 Area A History and Background

This section provides a brief summary of the history and previous investigation activities conducted at the Former MGP (Area A). A thorough evaluation of the Site history and details pertaining to previous investigations and remedial actions has been presented in previous reports submitted to the NYSDEC, including the *Remedial Investigation Report* (RI Report) (BBL, 1999) and the *Feasibility Study Report* (FS Report) (BBL, 2003).

1.2.1 Area A History

The MGP was built in 1876. Between 1878 and 1911, the MGP was owned and operated by various companies, including the Consumer Gas Company of Newburgh, New York, the Newburgh Gaslight Company, and the Newburgh Light, Heat & Power Company. In 1911, the Newburgh Light, Heat & Power Company became the Central Hudson Gas & Electric Company. In 1926, Central Hudson Gas & Electric Company consolidated with other utilities to form CHGE.

The Newburgh MGP produced gas by the water gas method and by the carbureted water gas method. From 1931 to 1948, the MGP was used as a gas storage and distribution center and for reserve gas production. In 1951, CHGE demolished the MGP, which included the decommissioning of above-grade buildings, gas holders, and oil tanks. Since demolition of the former MGP, CHGE has operated a natural gas regulator station and natural gas transmission interconnect at the former MGP site. In 1985, CHGE constructed a propane peaking plant in the southern portion of the former MGP site.

1.2.2 Previous Investigations and Remedial Activities

A Phase I Investigation was conducted at the former MGP by EA Science and Technology in 1987. The Phase I Investigation included a compilation of site information from CHGE files and publicly available resources, a site reconnaissance, a soil vapor survey, and the calculation of a preliminary Hazard Ranking System (HRS) score. This investigation provided a historical overview of the former MGP site as well as some general information on the physical setting of the site. The results of the Phase I Investigation were presented in the *Phase I Investigation, Newburgh Coal Gasification Plant Site* (EA Science and Technology, 1987).

A Phase II Investigation was conducted at the former MGP site in 1988 by Blasland & Bouck Engineers, P.C. The Phase II Investigation included the installation of soil borings and monitoring wells and the subsequent sampling and analysis of subsurface soil samples, surface soil samples, and groundwater samples. The results of this investigation are presented in the *Phase II Investigation Report for the Former Coal Gasification Plant Site* (Blasland & Bouck Engineers, P.C., 1989). A subsequent round of groundwater samples was collected for laboratory analysis from the Phase II monitoring wells in 1994. Based on the results of the Phase I and Phase II investigation activities, a comprehensive RI was conducted.

Initial RI activities were completed in 1996. Supplemental RI activities were performed in 1997, 1998, and 1999. The RI activities included a project area survey, source investigation, geologic investigation, hydrogeologic investigation, drain investigation, Hudson River investigation, air quality investigation, and ecological investigation. These investigations were conducted in general accordance with the following documents:

- Remedial Investigation Newburgh Project Work Plan (RI Work Plan) (BBL, 1996);
- Sampling and Analysis Plan (BBL, 1996);
- Health and Safety Plan (BBL, 1996);
- Citizens Participation Plan (BBL, 1996);
- Supplemental Hudson River Investigation Plan (BBL, 1997);
- Supplemental Source and Hydrogeologic Investigation Plan (BBL, 1997);
- 1998 Supplemental RI Scope of Work (BBL, 1998); and
- Non-Aqueous Phase Liquid (NAPL) Evaluation Work Plan (BBL, 1998).

The RI Report contains an extensive summary of the RI activities conducted at the Site and the results.

Following the RI, a FS was prepared for the Site to identify and evaluate remedial alternatives that are appropriate for the Site area-specific conditions, protective of human health and the environment, and consistent with applicable laws, regulations, and guidance documents. The focus of the FS was to recommend appropriate remedial alternatives that cost-effectively satisfy the remedial action objectives (RAOs). The FS evaluated several remedial alternatives for each area of the Site. The proposed alternative for Area A included a combination of institutional controls, soil excavation/disposal at the southeast corner of the former MGP, former relief holder contents excavation/disposal, and overburden/bedrock NAPL removal. A more thorough description of the remedial alternatives evaluated, as well as the details related to the selected alternative, are presented in the FS Report.

The *Record of Decision (ROD) Central Hudson Newburgh Site* was issued by the NYSDEC in December 2005. The ROD presents the remedy selected for the site by the NYSDEC in accordance with the New York State Environmental Conservation Law. As detailed in the ROD, the components of the remedy selected by the NYSDEC for Area A include:

- Performance of a remedial design program to provide the details necessary to implement the selected remedial alternative;
- Excavation of the NAPL-impacted soils in the southeast corner of the MGP property;
- Relocation/management of the existing gas regulator station and excavation of NAPL-impacted soils in the former relief holder and surrounding area;
- Installation of overburden/bedrock NAPL collection wells along Water Street;
- Development of a Site Management Plan (SMP). The SMP will identify the institutional controls and engineering controls to: (a) address residual NAPL-impacted soils; (b) evaluate the potential for vapor intrusion for buildings developed on the site; (c) provide for the operation and maintenance of the components of the remedy; (d) monitor the groundwater quality; and (e) identify appropriate use restrictions;
- Establishment of an institutional control in the form of an environmental easement that will limit the use of the property to commercial or industrial uses and restrict use of groundwater; and
- Performance of an Institutional Control/Engineering Control (IC/EC) certification on a periodic basis.

1.3 Pre-Design Investigation Objectives

The data collected in Area A to date were collected in order to provide sufficient information to characterize the conditions and to evaluate various remedial alternatives. Prior to implementation of the remedial alternative selected by the NYSDEC as outlined in the ROD, a remedial design must be prepared. This Pre-Design Investigation Work Plan presents a scope of work for the collection of the additional data necessary to allow for the preparation of the detailed design.

1.4 Work Plan Organization

This PDI Work Plan is organized into the following sections:

Section	Purpose
Section 1 – Introduction	Provides an overview of the Site history and background, objectives of the PDI, and organization of the PDI Work Plan.
Section 2 – Area A Pre-Design Investigation Activities	Provides the scope of work for the PDI activities in Area A, the former MGP.
Section 3 – Quality Assurance/Quality Control	Provides an overview of the Quality Assurance/Quality Control protocols for the Area A PDI activities.
Section 4 – Data Reporting and Schedule	Provides a description of the data reporting activities to be completed following field activities, and a schedule for completion of the PDI.
Section 5 – References	Presents a list of references cited in this PDI Work Plan.
Figures	Presents the Figures that are referenced throughout this PDI Work Plan.
Appendices	Appendix A presents the Standard Operating Procedures (SOPs) that will be followed in completing the work outlined herein. Appendix B presents the Site Health and Safety Plan (HASP).

2. Area A Pre-Design Investigation Activities

This section presents the scope of work for pre-design investigation activities in Area A. The pre-design investigation activities in Area A are required to provide the following information required for the completion of a remedial design:

- Horizontal and vertical delineation of the former tar tank remediation area;
- Horizontal and vertical delineation of the former relief holder remediation area;
- Geotechnical evaluation of the former tar tank and former relief holder remediation areas;
- Groundwater hydraulic characterization;
- Waste disposal characterization; and
- An evaluation of conditions in the proposed utility relocation corridor.

To achieve these objectives, the following investigation activities will be conducted:

- Test pit excavation;
- Test boring advancement;
- Soil sampling and laboratory analysis for waste disposal characterization;
- Monitoring well installation; and
- Hydraulic conductivity testing.

The following sections provide an overview of the activities that will be conducted for each task outlined above. Specific methods for the completion of the investigation activities outlined herein are presented in the SOPs included in Appendix A. All work will be performed in accordance with the Site-Specific HASP that has been prepared by BBL for the project (Appendix B).

The field work will be conducted in such a way as to allow for flexibility to modify this scope of work based upon field conditions. CHGE will be removing select above ground natural gas piping to allow for access to perform certain portions of the field activities discussed herein. BBL will be meeting with appropriate CHGE staff prior to mobilization to locate underground utilities at the site. These pipe removal and utility mark-out activities may require that the proposed locations of test pits and soil borings be modified in the field. Additional borings and/or test pits may also be added if field conditions (e.g., observations on the presence or absence of NAPL) indicate that such additional characterization is warranted.

The proposed sampling and investigation areas identified herein are illustrated on Figure 3.

2.1 Horizontal and Vertical Delineation of the Former Tar Tank Remediation Area

The objective of this task is to collect the additional data necessary to define the excavation limits in the former tar tank remediation area (located in the southeast corner of Area A) by visually delineating the horizontal and vertical extent of NAPL-impacted soil. Figure 3 illustrates the preliminary limits of excavation in the former tar tank area that were presented in the ROD.

Additional NAPL delineation will be conducted on the northern, western, and southern sides of the proposed excavation. Since the proposed excavation will not extend into South Water Street, additional delineation will not be required on the eastern side of the proposed excavation area.

It is anticipated that eight soil borings (PDI-SB-8 through PDI-SB-10 and PDI-SB-12 through PDI-SB-16) will be advanced around the proposed excavation area. Borings will be advanced using a direct-push technology (DPT) rig until bedrock is encountered. Soil samples will be collected continuously in four-foot increments using a Macro-Core device with disposable acetate liners. Field staff will record soil classification, depth to groundwater, and the presence and/or absence of NAPL, sheens, staining and odors.

Two geotechnical soil borings (PDI-SB-11 and PDI-SB-17) will be advanced on the northwestern and southern sides of the proposed excavation area, respectively. These borings will be advanced as part of the geotechnical evaluation described in Section 2.3 of this Work Plan. Soil samples collected during the geotechnical investigation will be classified as indicated above and for engineering purposes.

2.2 Horizontal and Vertical Delineation of the Former Relief Holder Remediation Area

Currently, CHGE maintains a series of natural gas lines that run across the top of the relief holder. Due to the presence of these gas lines, investigation in the immediate vicinity of the former relief holder has not been possible to date. CHGE will relocate these lines in the summer/early fall of 2006 to accommodate the remediation activities in this area of the Site. However, certain sections of above-grade piping will be removed in order to allow access (for heavy equipment and drill rigs) for the completion of the PDI activities outlined herein. A flexible approach to NAPL delineation in this area will be employed in the field. In consultation with CHGE, field staff may modify the proposed locations of the soil borings and test pits based on observations made in the field and the presence of gas lines and other structures.

The specific objectives of this task are to collect the additional data necessary to:

- define the excavation limits in the Former Relief Holder Remediation Area by visually delineating the horizontal and vertical extent of NAPL-impacted soils;
- determine the relationship between the relief holder bottom and the top of bedrock; and
- assess the structural integrity of the relief holder.

This information will be used during design to determine the extent of remediation that will be required as well as to determine whether or not the holder itself will require removal.

Two test pits will be excavated on the outside edges of the relief holder (PDI-TP-3 and PDI-TP-4), one on the east side and one on the northwest side. These two test pits will be oriented such that they are approximately tangent to the outside edge of the relief holder as illustrated on Figure 3. The purpose of these test pits is to obtain information on the presence or absence of NAPL-impacted soils outside of the relief holder and to assess the structural integrity of the relief holder. One test pit will also be excavated inside the relief holder (PDI-TP-5). The purpose of the test pit inside the relief holder is to further assess the structural integrity of the relief holder and to evaluate whether there are any depth changes in the holder (some older holders have an elevated hump in the center of the holder).

An attempt will be made to advance each test pit to bedrock. However, the size and depth of each test pit will ultimately be determined in the field by an excavation-competent person (ECP) based upon site conditions, including the observed stability of the test pit sidewalls, the depth to groundwater, and other factors. Excavated soil will be staged on plastic sheeting in the order in which it is removed. Field staff will photograph and document observations from each test pit. Observations will include soil classification, depth to groundwater, and the presence and/or absence of NAPL-impacted soils, sheens, staining, and odors. Additionally, field staff will record qualitative observations on the structural integrity of the relief holder wall. Excavation of the test pits will cease in the event the structural integrity of the relief holder is observed to be compromised. Once the test pits have been sufficiently documented, they will be backfilled with the stockpiled material in the reverse order in which it was excavated (e.g., last out, first in). If the test pits in the relief holder area do not encounter bedrock, a DPT rig will be used to advance a boring at the approximate location of the test pit(s) after they have been backfilled to characterize the remaining soil profile.

Five borings (PDI-SB-1 through BDI-SB-3, PDI-SB-6, and PDI-SB-7) will be advanced in and around the former relief holder with a DPT rig to vertically and horizontally delineate the extent of NAPL-impacted soil. Borings will be advanced until bedrock is encountered. Soil samples will be collected continuously in four-foot increments using a Macro-core device with disposable acetate liners. Field staff will record soil classification, depth to groundwater, and the presence and/or absence of NAPL, sheens, staining and odors.

Two geotechnical soil borings (PDI-SB-4 and PDI-SB-5) will be advanced on the northern and eastern sides of the proposed excavation area. These borings will be advanced as part of the geotechnical evaluation detailed in Section 2.3 of this Work Plan. Soil samples collected during the geotechnical investigation will be classified as indicated above and for engineering purposes.

2.3 Geotechnical Investigation

Due to space constraints and the presence of physical structures at the Site that must be protected, and the anticipated depth of soil excavation required, excavation support (e.g., sheet piling) will be required during remedial activities in the former tar tank and former relief holder areas. Therefore, the objective of this task will be to obtain geotechnical data required to design the excavation support systems in those areas.

The required data will be obtained from two geotechnical soil borings advanced in the former tar tank area (PDI-SB-11 and PDI-SB-17) and two soil borings advanced in the relief holder area (PDI-SB-4 and PDI-SB-5). The soil borings will be advanced using a conventional drill rig. The approximate location of these soil borings are illustrated on Figure 3. Each of these soil borings will be advanced approximately 15 feet into bedrock. Continuous standard penetration testing (SPT) of the overburden will be performed using 2-inch outside diameter (OD) split-spoon samplers in accordance with ASTM D1586. The bedrock will be cored with NX-size core samplers in accordance with ASTM D2113. The bedrock core samples from each boring will be collected and submitted for laboratory testing of unconfined compressive strength in accordance with ASTM D2938. Soil and rock samples will be visually classified in the field for engineering purposes. Borings will be abandoned with a bentonite/cement grout using a tremmie pipe. Drill cuttings will be containerized in 55-gallon drums pending off site disposal by CHGE.

2.4 Hydraulic Characterization

The objective of this task is to collect the additional data necessary to determine the anticipated dewatering rates for the excavations in the former tar tank and former relief holder remediation areas. One new monitoring well (PDI-MW-1) will be installed in the former relief holder area in the approximate location shown on Figure 3. The new monitoring well will be installed with 0.010-inch slotted, 2-inch diameter, schedule 40 polyvinyl chloride (PVC) well screen and 2-inch diameter, schedule 40 PVC casing. The screen will be installed from 5-

feet above the observed water table to the top of bedrock. The newly installed monitoring well will be developed in accordance with the SOP included in Appendix A. The integrity of existing monitoring well NW-3, located in the former tar tank remediation area, will be verified in the field. If it is found to be in suitable condition, it will be redeveloped using the procedures for well development detailed in the SOP included in Appendix A and the top of casing elevation will be resurveyed. If the integrity of NW-3 is found to be compromised, it will be abandoned and a new monitoring well will be installed adjacent to it using the same procedures outlined above. The location of the new monitoring well(s) will be surveyed following installation, including ground surface elevation and top-of-casing elevation.

Specific capacity tests will be performed on monitoring well NW-3 (or a new monitoring well, if required) and monitoring well PDI-MW-1 (the newly installed monitoring well) in accordance with the SOP included in Appendix A. Specific capacity testing involves pumping groundwater at a constant rate while monitoring the groundwater levels observed during the pumping. Groundwater removed during the testing activities will be containerized in 55-gallon drums pending off-site disposal by CHGE.

2.5 Waste Disposal Characterization Sampling

The primary purpose of waste disposal characterization sampling is to provide information required to support the selection of a treatment and/or disposal facility for soil removed during the Area A remediation activities. One composite soil sample will be collected from each proposed excavation area (i.e., the former tar tank and former relief holder remediation areas). Each composite sample will be comprised of three aliquots collected from the soil cuttings during the advancement of one of the borings in each area. The composite soil samples will be collected from a boring where NAPL is observed in order to document the worst case scenario for disposal.

In addition to the two soil samples for waste characterization purposes, BBL will also analyze two groundwater samples for waste disposal characterization purposes. The groundwater samples are necessary to support the determination of treatment/disposal requirements for groundwater removed from excavation areas during the Area A remediation activities. One sample will be collected from the former Tar Tank Remediation Area and one sample will be collected from the Relief Holder Area. If sufficient groundwater infiltrates into the test pits excavated in each of these areas, the required groundwater treatment/disposal characterization samples will be collected during the test pit excavation activities described in Sections 2.1 and 2.2. Otherwise, these groundwater samples will be collected during the specific capacity testing described in Section 2.4.

The analytical parameters for the soil and groundwater waste characterization samples will be determined based upon the requirements of the treatment and/or disposal facilities being considered for each media by CHGE at the time of field activities.

2.6 Evaluation of Utility Relocation Corridor

Two test pits (PDI-TP-1 and PDI-TP-2) will be excavated along the proposed utility relocation corridor on the eastern side of Area A. These test pits will be excavated to evaluate the potential presence of NAPL in this area prior to the relocation of the natural gas lines at the site (for worker safety). Test pits will be oriented in an east-west direction as illustrated on Figure 3. Each test pit will be excavated to a depth of approximately 5 feet. Test pit activities will be supervised by and ECP. Excavated soil will be staged on plastic sheeting in the order in which it is removed. Field staff will photograph and document observations from each test pit. Observations will include soil classification, depth to groundwater, and the presence and/or absence of NAPL-impacted soils, sheens, staining and odors. Once the test pits have been sufficiently documented, they will be backfilled with the stockpiled material in the reverse order in which it was excavated (e.g., last out, first in).

3. Quality Assurance/Quality Control

This section provides a summary of appropriate and applicable quality assurance/quality control (QA/QC) elements and procedures for the Area A PDI activities.

3.1 Project Organization

On behalf of CHGE, BBL will be responsible for implementing the PDI field activities and protocols described herein, including the specified investigation activities and preparation of the specified report deliverables. Laboratory chemical analyses will be performed by a NYSDOH ELAP certified laboratory. Geotechnical analyses will be performed by a qualified geotechnical laboratory. Overall project direction will be provided by CHGE, with review by NYSDEC.

Key personnel involved with the implementation of this PDI work plan will include:

CHGE

- Tera Stoner, Project Manager

BBL

- Nancy Gensky – CHGE Principal-in-Charge
- Mark Gravelding, P.E. – Vice President, Engineer-in-Charge
- Doug Weeks – Project Manager
- Andrew Graham – PDI Task Manager
- Philip Burgmeier, P.E. – Project Geotechnical Engineer
- David Cornell – Field Supervisor
- Dennis Capria – Data Management Supervisor

BBL and CHGE are currently in the process of procuring subcontractors for field services (soil borings and test pits) and laboratory analytical services. The names of the selected subcontractors will be provided to NYSDEC under separate cover after the entities have been selected

3.2 Analytical Procedures and Laboratories

Chemical laboratory analyses will be performed in accordance with methods and QA/QC requirements specified by the treatment and/or disposal facilities being considered by CHGE. Category B deliverables will be provided for all chemical analyses. The exact analytical methods for the disposal characterization sampling will be determined prior to mobilization and will be based upon the analytical requirements of the potential disposal and/or treatment facilities being considered by CHGE at that time. Due to the limited scope of the chemical sampling, QA/QC sampling will not be performed. However, the QA/QC field protocols outlined in Section 3.3 will be adhered to.

Geotechnical laboratory analyses will be performed in accordance with the respective ASTM methods listed in Section 2.3.

3.3 Standard Operating Procedures

The Area A PDI activities will be performed in accordance with the SOPs presented in Appendix A. SOPs for the following activities are provided in Appendix A:

- Soil Boring Installation and Sampling;
- Collecting and Describing Bedrock Core Samples;
- Monitoring Well Development;
- Fluid Level Measurement and Sampling for Monitoring Wells;
- Specific Capacity Testing;
- Field Documentation;
- Test Pit Excavation;
- Chain-of-custody, handling, packing, and shipping;
- Equipment Cleaning; and
- Handling and storage of Investigation-Derived Waste.

These SOPs will be followed, to the extent possible, during the implementation of this Work Plan. Any deviations from these procedures will be documented.

3.4 Training Requirements/Certifications

In compliance with the Occupational Safety and Health Administration's (OSHA) final rule, "Hazardous Waste Operations and Emergency Response," 29CFR'1910.120(e), personnel performing PDI field activities will have completed the training requirements for OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER). Persons in field supervisory positions will also have completed the requisite OSHA Supervisory Training.

3.5 Field Instrument Calibration and Maintenance

Field instrumentation will be required during air monitoring activities as outlined in the HASP. Field personnel will be responsible for ensuring that the field instruments used on the Site are properly calibrated and maintained in accordance with the manufacturer's specifications and the SOP provided in Appendix A. The field personnel will also be responsible for ensuring that a master calibration/maintenance log is maintained following the procedures specified for each measuring device. Instruments and equipment used to gather, generate, or measure environmental data will be calibrated at the intervals specified by the manufacturer or more frequently, and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service. Equipment found to be out of tolerance during the period of use shall be removed from the field.

All equipment which requires charging or batteries will be fully charged and have fresh batteries. Appropriate spare parts will be made available for field meters, as practicable.

3.6 Field Documentation

Field personnel will provide appropriate documentation of the PDI activities. This documentation consists of a record that allows reconstruction of field events to aid in the data review and interpretation process. Documents, records, and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the PDI activities include:

- Daily Documentation - A field logbook consisting of a waterproof, bound notebook will be maintained each day by field personnel. The field logbook will contain a record of the weather conditions and the PDI activities performed at the Site.

- Photo/Video Documentation – Field personnel will document the PDI field activities and conditions using photos taken with a digital camera. A videotape recorder may also be used as appropriate.

- Sampling Information - Detailed notes will be made as to the test pit and soil boring locations, sampling locations, and physical observations.

- Sample Custody – Chain-of-custody (COC) forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratories. COC forms will be filled out at the end of each day of sampling by field personnel responsible for sample custody. In the event that the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample custody transfer. The original COC form will accompany the samples to the laboratory, and copies will be placed in the project files. A sample COC form is included in Appendix A in the SOP titled *Field Sample Designation, Containerization, Preservation, Handling, Packaging, and Shipping.* Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

4. Data Reporting and Schedule

This section presents a preliminary project schedule and a brief description of the PDI data reporting activities.

4.1 Preliminary Schedule

As previously discussed with NYSDEC, it is CHGE's intention to complete the design and construction activities in Area A in 2006. In order to achieve this objective, the Area A PDI activities will be initiated approximately 14 days following submittal of this Work Plan. As noted in Section 2, implementation of portions of the PDI activities will require removal of the select natural gas lines present in the former relief holder area. CHGE is currently coordinating this work.

4.2 Data Reporting

The data collected as a result of the PDI activities outlined herein will be provided to the NYSDEC in a brief data summary report. It is anticipated that the data summary report will include a description of the field activities conducted, summary tables and figures presenting the data, boring/test pit locations and logs, well construction logs, and relevant Site photographs. The data summary report will present the conceptual limits of excavation in the former tar tank area and the former relief holder area. The limits of excavation will form the basis of the remedial design for Area A.

The data summary report will be submitted to NYSDEC within 45 days following completion of field activities.

5. References

BBL, 1996. *Remedial Investigation Newburgh Project Work Plan*.

BBL, 1996. *Sampling and Analysis Plan.*

BBL, 1996. *Health and Safety Plan*.

BBL, 1996. *Citizens Participation Plan*.

BBL, 1997. *Supplemental Hudson River Investigation Plan.*

BBL, 1997. *Supplemental Source and Hydrogeologic Investigation Plan*.

BBL, 1997 (Revised 1999). *Newburgh Project Remedial Investigation Report*.

BBL, 1998. *1998 Supplemental RI Scope of Work.*

BBL, 1998. *Non-Aqueous Phase Liquid (NAPL) Evaluation Work Plan*.

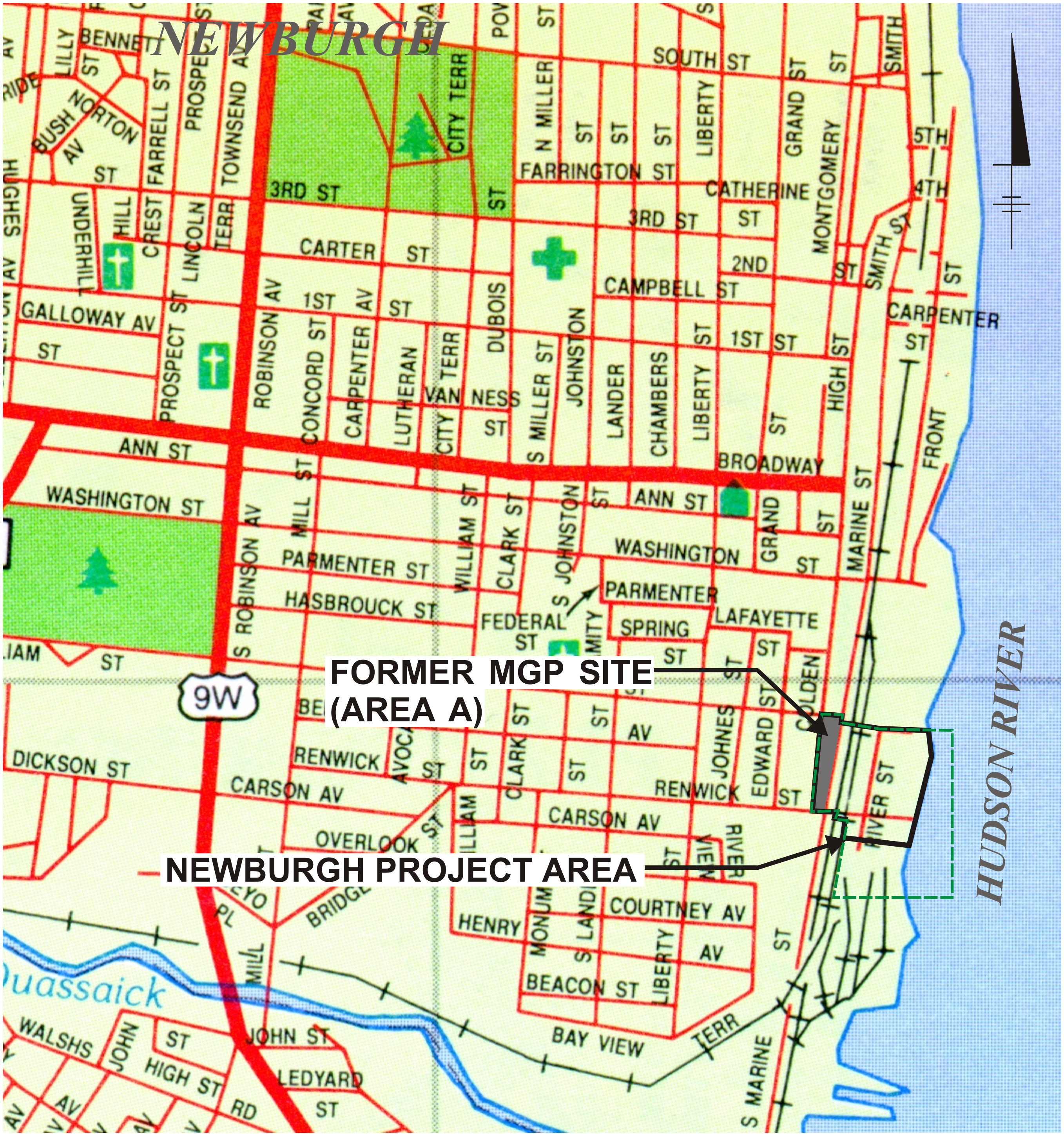
BBL, 2003. *Revised Feasibility Study Report*.

EA Science and Technology, 1987. *Phase I Investigation, Newburgh Coal Gasification Plant Site.*

NYSDEC, 1995. *Consent Order between NYSDEC and CHGE, Index #D3-001-95-06*

NYSDEC, 2006. *Record of Decision*.

Figures



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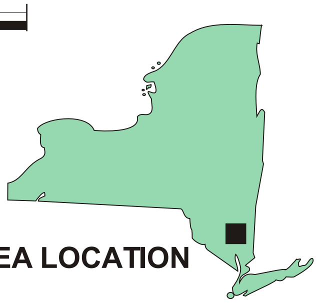


CENTRAL HUDSON GAS & ELECTRIC CORPORATION
NEWBURGH, NEW YORK

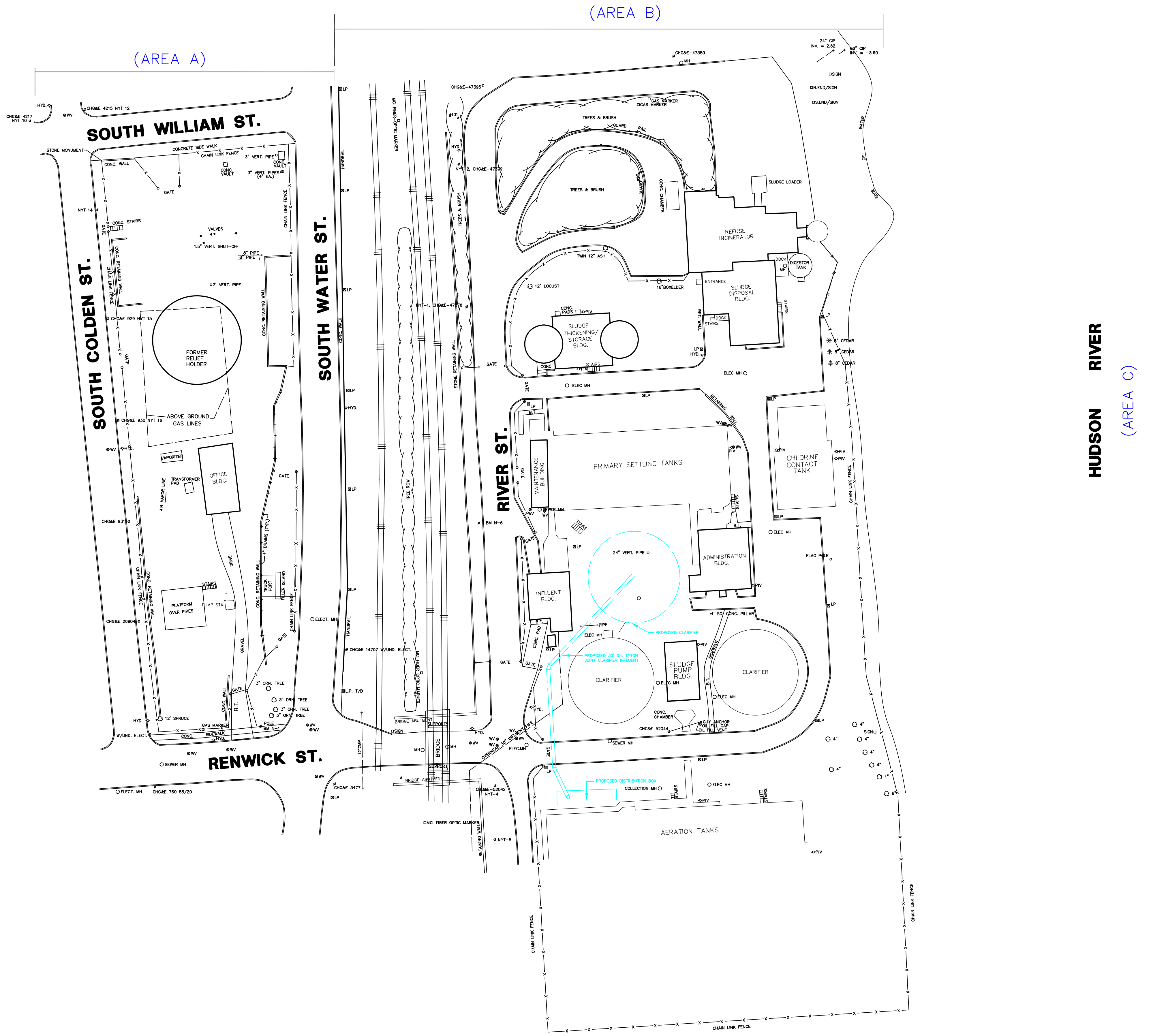
AREA A PRE-DESIGN INVESTIGATION WORK PLAN

SITE LOCATION MAP

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

FIGURE
1

02/05/06 SYR-D85-DJH MRC
20537001/20537n01.cdr



LEGEND:

⊠LP	LIGHT STAND
CB ☐	CATCH BASIN
⊗WV	WATER VALVE
○ 4"	DECIDOUS TREE
8" CEDAR ✳	CONIFEROUS TREE
MH○	MANHOLE
⌀	UTILITY POLE
⊸PIV	POSITION INDICATOR VALVE

NOTES:

1. TOPOGRAPHIC SURVEY WAS PERFORMED IN THE FIELD BETWEEN DECEMBER, 14 1995 AND JANUARY 5, 1996 WITH DEEP SNOW CONDITION. DUE TO THE SNOW CONDITIONS SOME TOPOGRAPHIC AND PANIMETRIC FEATURES MAY NOT HAVE BEEN LOCATED AND/OR MAY BE APPROXIMATE.
2. ELEVATIONS ARE BASED ON NATIONAL DEODETIC VERTICAL DATUM OF 1929.

0 100' 200'

APPROXIMATE SCALE

CENTRAL HUDSON GAS & ELECTRIC CORPORATION
NEWBURGH, NEW YORK
AREA A
PRE–DESIGN INVESTIGATION WORK PLAN

SITE PLAN

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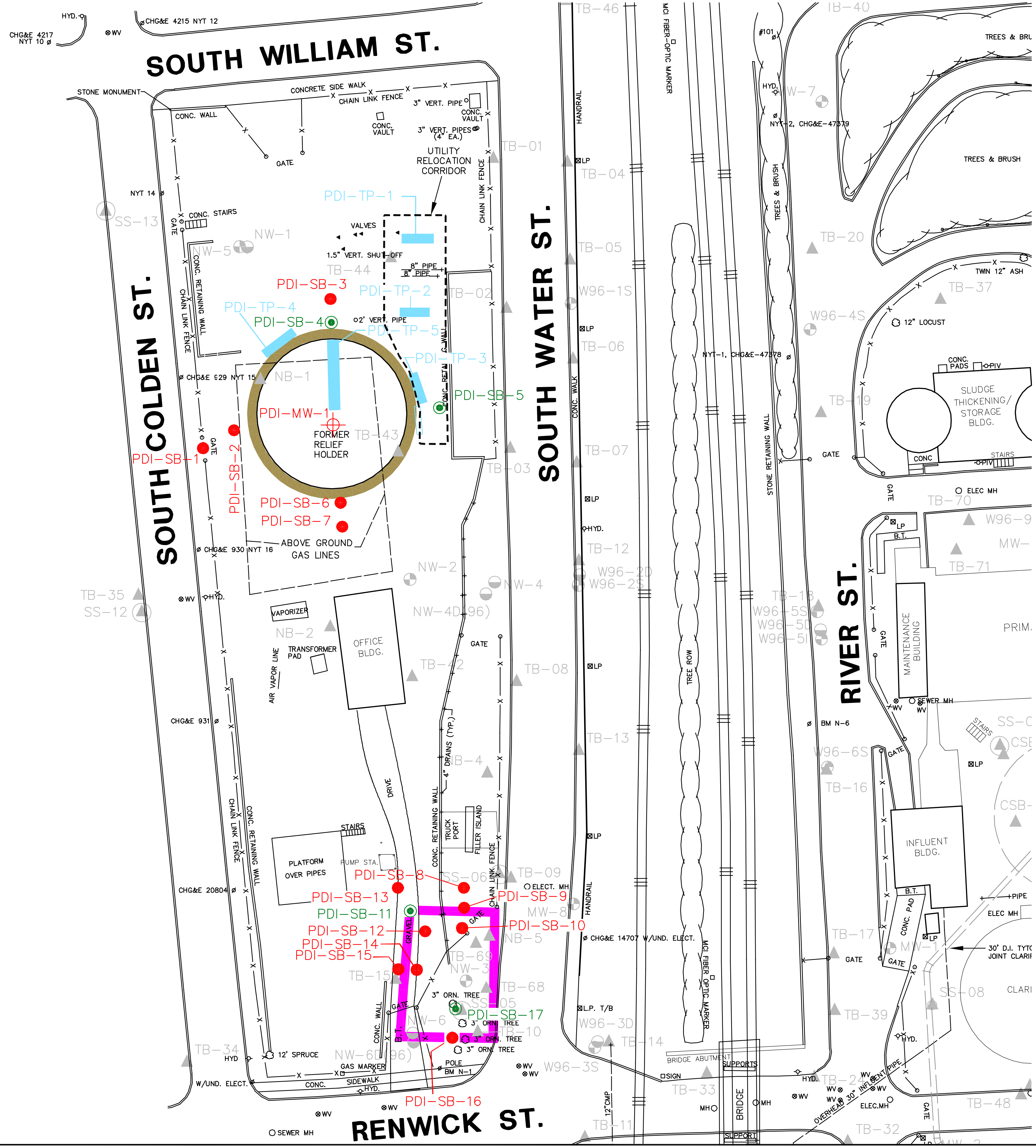
engineers, scientists, economists

FIGURE
2

X: 20528X06.DWG
L: ON=*, OFF=*REF*
P: PAGESET: DL
04/05/06 SYR–54–RCB LAS AMS
20537001/20537C09.DWG



LEGEND:

⊠LP	LIGHT STAND
▲	SOIL BORING
⊕	SURFACE SOIL SAMPLE
◒	MONITORING WELL (BEDROCK)
◍	MONITORING WELL (OVERBURDEN)
⌖	PROPOSED MONITORING WELL LOCATION
◉	PROPOSED SOIL BORING AND GEOTECHNICAL BORING LOCATION
●	PROPOSED SOIL BORING LOCATION
CB ☐	CATCH BASIN
⊗WV	WATER VALVE
○ 4"	DECIDOUS TREE
8" CEDAR ✳	CONIFEROUS TREE
MH○	MANHOLE
ø	UTILITY POLE
-○PIV	POSITION INDICATOR VALVE
🟦	PROPOSED TEST PIT LOCATION
🟪	FORMER TAR TANK REMEDIATION AREA
🟫	FORMER RELIEF HOLDER REMEDIATION AREA

NOTES:

1. TOPOGRAPHIC SURVEY WAS PERFORMED IN THE FIELD BETWEEN DECEMBER 14, 1995 AND JANUARY 5, 1996 WITH DEEP SNOW CONDITIONS. DUE TO THE SNOW CONDITIONS SOME TOPOGRAPHIC AND PLANIMETRIC FEATURES MAY NOT HAVE BEEN LOCATED AND/OR MAY BE APPROXIMATE.
2. ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
3. ALL PROPOSED TEST PIT AND SOIL BORING LOCATIONS ARE APPROXIMATE AND ARE SUBJECT TO CHANGE BASED UPON FIELD OBSERVATIONS.

0 60' 120'

APPROXIMATE SCALE

CENTRAL HUDSON GAS & ELECTRIC CORPORATION
NEWBURGH, NEW YORK
AREA A PRE-DESIGN INVESTIGATION WORK PLAN

PROPOSED INVESTIGATION ACTIVITIES
AREA A

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

FIGURE
3

X: 20528X06.DWG
L: ON=*, OFF=*REF*
P: PAGESET: DL2B1
4/25/06 SYR-85-RCB AMS PGL
20537001/20537C10.DWG

Appendices

Appendix A

Standard Operating Procedures

Standard Operating Procedure: Collecting and Describing Bedrock Core Samples

I. Scope and Application

This document describes the procedures to be used to collect and describe bedrock core samples. Bedrock cores shall be collected in accordance with ASTM Method D 2113-99, *Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation*. The bedrock cores shall be collected, labeled, and classified as outlined below.

II. Personnel Qualifications

Bedrock coring shall be observed, and recovered cores logged, by field staff working under the direction of an experienced geologist. When bedrock core samples will be used for engineering purposes (e.g. foundation design, rock mechanics, design of excavation support, etc.), field oversight staff shall work under the direction of a geotechnical engineer.

III. Equipment List

Bedrock Core Sampling

- Core boxes
- Permanent marking pen for labeling boxes and cores
- Wood blocks to separate core runs in core boxes
- Field logbook
- Rock coring logs
- Hand lens
- Pen knife
- Water-level probe
- Munsell rock color chart
- Tape measure
- Rock hammer
- Rubber hammer (for tapping rock core out of core barrel)

IV. Cautions

Prior to beginning field work, the drilling contractor shall contact and coordinate with an independent underground utility locator service to identify and locate buried utilities in the vicinity of the boring.

V. Health and Safety Considerations

Field activities associated with bedrock coring will be performed in accordance with a site-specific Health and Safety Plan (HASP), a copy of which will be present on site during such activities.

VI. Procedure

Prior to placing the core barrel into the hole, the driller shall use air/water circulation to remove cuttings in the boring that may clog the barrel. Drilling rods shall be carefully centered in initial borehole, if any, to reduce the potential for core breakage. The driller shall maintain drilling bit pressure and water pressure at a consistent level throughout drilling, and runs shall be completed without interruption, to the extent practical, so penetration rates (in feet per minute) can be determined.

Core samples shall be placed in core boxes with increasing depths aligned left to right and core runs separated by wood blocks. Man-made breaks shall be marked with a pen across the break. Wood blocks shall be labeled and placed at the end of each core run to indicate run. A wooden spacer shall be inserted if no sample is recovered and labeled "L.C." (lost core) with corresponding depth. Attachment 1 contains additional instructions for handling, packing, and labeling core.

- The supervising geologist or geotechnical engineer shall record the following parameters related to the core drilling process: penetration rates, drilling time, and core run length (i.e., minutes per foot);
- water loss; and
- drill type and size.

The following rock core characteristics shall be described in the field:

- lithology (rock type);
- friability/fissibility;
- color;
- strength of intact rock;
- thickness;
- weathered state;
- particle angularity/shape;
- voids;
- particle sizes;
- structure/bedding (bedding planes, joints, fractures);
- Rock Quality Designation (RQD);
- Rock core recovery length;
- description of discontinuities and fillings (including interpretation of natural vs. artificial bedrock fractures);
- formation name (if known);
- water content;
- texture;
- odors/discoloration;
- hardness;
- fossils;
- depth to water;
- Munsell color; and
- geologic contacts when observed.

A key to abbreviations that may be used when describing rock core descriptions is presented below. Additional information for describing rock structure, weathering states, and other rock descriptive terms to be used is presented in Attachment 3.

KEY TO CORE DESCRIPTION ABBREVIATIONS

BkN - broken

CAL - calcareous or calcite

cl - clay

F - foliation

Fe - iron staining on joint surface

GOG - gouge

HJ - horizontal joint

J - joint*

J//F - joint is parallel to foliation

JxF - joint crosses foliation

l - laminae

// - parallel

m - mud in opening

MB - mechanical break

N° - angle of fracture surface from horizontal, where N is the angle in degrees

QTZ -quartz

s - solution enlargement

S - stratification

sa - sand

si - silt

SZ - sheer zone

U - unfoliated or unstratified

v - vuggy

VJ - vertical joint

w - weathered

WZ - weathered zone

x - crossing

Z – zone

* “Joint” indicates any natural fracture.

The geologist/geotechnical engineer shall document drilling events in the field logbook. Documented drilling events will include:

- drilling start and finish dates;
- project name and location;
- project number and client;
- corehole numbers;
- sample number and depth;
- sample type and size;
- type of drilling equipment;
- casing size;
- names of contractor's drillers; and
- weather conditions.

It is advisable to photograph recovered core in the labeled core box. The core should be wet when photographed to improve contrast and visibility of rock features.

VII. Waste Management

Investigation-derived wastes, including soil cuttings and excess drilling fluids (if used), decontamination liquids, and disposable materials (well material packages, personal protective equipment [PPE], etc.), shall be placed in clearly labeled, appropriate containers, or managed as otherwise specified in the Work Plan.

VIII. Data Recording and Management

Coring activities shall be documented in a field logbook. Information shall include personnel present on site, times of arrival and departure, significant weather conditions, timing of well installation activities, rock descriptions and quantities of materials used.

IX. Quality Assurance

Determine whether equipment cleaning is required. If so, follow the Equipment Cleaning SOP. Take care not to break the core. If core is broken, mark the break as described in this SOP to show that the break was artificial. If pieces of core are removed for inspection, make sure to return them to the core box oriented the same way that they were when they were removed.

X. References

ASTM, 1999. *Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation,* D 2113-99.

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan - Newburgh Project.*

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation - Area A*

ATTACHMENT 1

Rock Core Handling And Packing

Handling of Core
The top of the core will be placed at the back left corner of the core box. The remaining core will be placed to the right of the preceeding section. The core box will be filled moving to the front sections of the box as needed. The begining of each run will be marked on the core and noted with a wooden block.

Core Labeling
The top of the core will be marked on each piece of core with an arrow. The arrow will indicate which end of core is nearer to ground surface. Other marks made on cores may include mechanical breaks and drilling footages.

Core Loss
Missing core will be shown by wood spacer blocks. The site geologist will insert the spacer and the core box in place of the missing section. The spacer should indicate the run number and footage of the missing section.

Core Box Storage
Core boxes from all wells will be moved from well heads on a regular basis and stored in a designated secure area. Whenever possible, the storage area should be inside.

Core Box Labeling
Labeling should include the following information:

- Outer core box cover
  - Project name, city, state, project number
  - Core information - Example

Monitoring Well (MW1)
Box 1 of 2
Core Run 2, 22.5' - 32.5'
Beginning Core Run 3, 32.5' - 40.5'

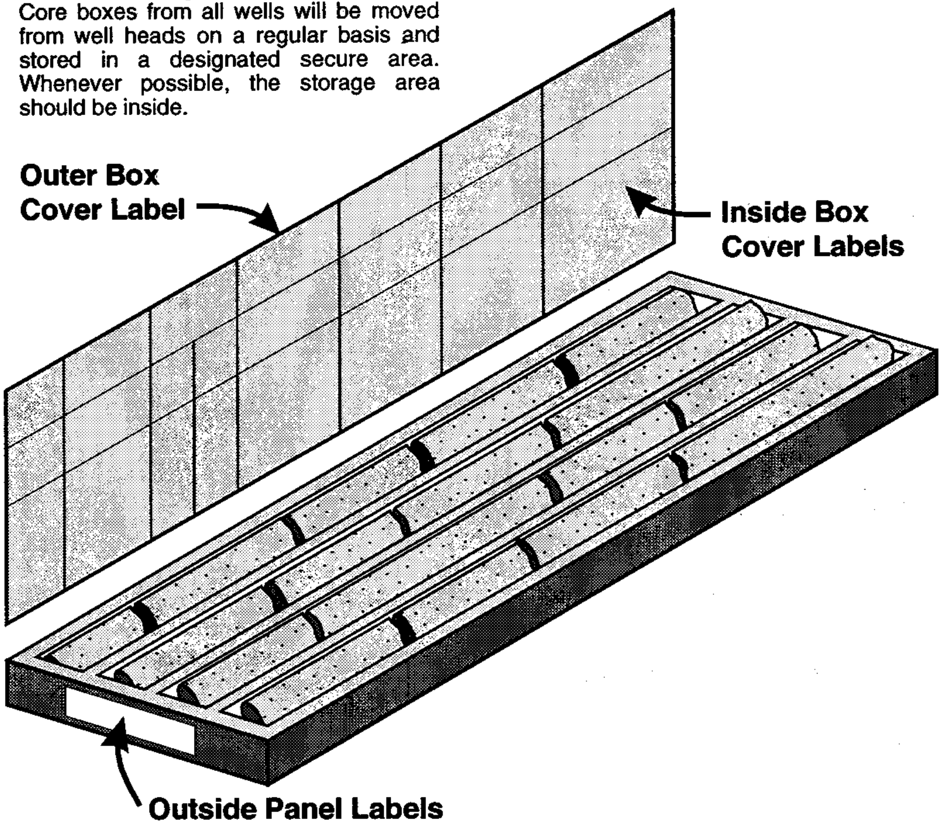
- Outside Panels:

Site Name __________	Well Number ______
Location __________	Box ___ of ______
Job Number __________	Run# ☐ ☐ ☐
	Footage ☐ ☐ ☐

- Inside Box Cover:

Boring Well No.	Run No.	Depth (Ft. BGS)		Actual Recovery	RQD %	FID/PID (ppm)	Comments
		From	To				

One row will be recorded for each core run or partial core run within the box.



ATTACHMENT 2

Rock Quality Designation (RQD) and Fracture Frequency

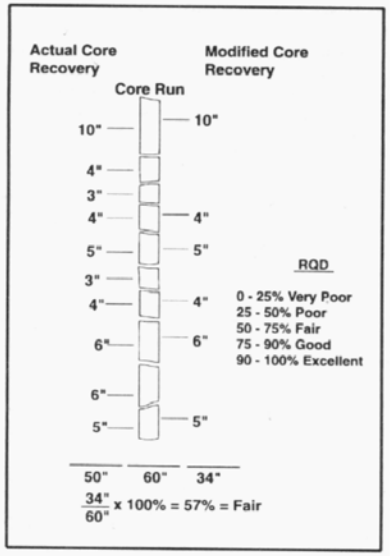
Core borings are a useful means of obtaining information about the quality of rock mass. The recoverable core indicates the character of the intact rock and the number and character of the natural discontinuities.

A quantitative index that has proved useful in logging NX core is a rock quality designation (RQD) developed by Deere (1963). The RQD is a modified core recovery percentage in which all the pieces of a sound NX core over 4 inches long are counted as recovery. The length of the core run is the distance to the nearest tenth of a foot from the corrected depth of the hole at the end of the subject run. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. The RQD is a more general measure of the core quality than is the fracture frequency. Core loss, weathered and soft zones, as well as fractures, are accounted for in this determination. The RQD provides a preliminary estimate of the variation of the in-situ rock mass properties of the "sound" portion of the rock core. Thus, a general estimate of the behavior of the rock mass can be made. An RQD approaching 100 percent denotes an excellent quality rock mass with properties similar to that of an intact specimen. RQD values ranging from 0 to 50 percent are indicative of a poor quality rock mass having a small fraction of the strength and stiffness measured for an intact specimen.

An example of determining the RQD from a core run of 60 inches measured from corrected depth to corrected depth is given in the adjacent figure. For this particular case, the core recovery was 50 inches and the modified core recovery was 34 inches. This yields an RQD of 57% (34"/60" x 100), classifying the rock mass in the fair category.

Problems arise in the use of RQD for determining the in-situ rock mass quality. The RQD evaluates fractures in the core caused by the drilling process, as well as in natural fractures previously existing in the rock mass. For example, when the core hole penetrates a fault zone or a joint, additional breaks may form that, although not natural fractures, are caused by natural planes of weakness existing in the rock mass. These fresh breaks occur during drilling and handling of the core and are not related to the quality of the rock mass. The skill of the driller will affect the amount of breakage and the core loss that occurs. Poor drilling techniques will "penalize" the rock by lowering its apparent quality. It is often difficult to distinguish between drilling breaks and those natural and incipient fractures that reflect the quality of the rock mass. In certain instances, it may be advisable to include all fractures when estimating RQD. Obviously, some judgement is involved in core logging.

Another problem with the use of the RQD index is that the determinations are not sensitive to the tightness of the individual joints, whereas in some instances, the in-situ deformation modulus may be strongly affected by the average joint opening.



RQD of a Single Core Run. Calculation is typical of a single core run. Note that the run is calculated from corrected depth to corrected depth. Rock core pieces which are included by the geologist as RQD should be marked with chalk, crayon, or marking pen so that RQD% can be checked and verified at a later time (i.e., after transit).

Engineering Classification of Rock Mass Quality

Term	RQD (%)	Velocity Index $(V_F/VI)^2$
Very Poor	0 - 25	0 - 0.2
Poor	25 - 50	0.2 - 0.4
Fair	50- 75	0.4 - 0.6
Good	75 - 90	0.6 - 0.8
Excellent	90 - 100	0.8 - 1.0

Strength of Intact Rock

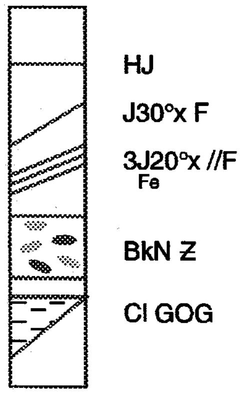
Term	Field Test	Approximate Range of Uniaxial Compressive Strength (kg/cm² or tsf)
Extremely Hard	Many blows with geological hammer required to break intact specimen.	>2,000
Very Hard	Hand held specimen breaks with hammer end of pick under more than one blow.	1,000 - 2,000
Hard	Cannot be scraped or peeled with knife; hand-held specimen can be broken with single, moderate blow with pick.	500 - 1,000
Moderately Hard	Can be scraped or peeled with knife. Indentation 1 mm to 3 mm shows in specimen with moderate blow with pick.	125 - 500
Moderately Soft	Material crumbles under moderate blow with sharp end of pick and can be peeled with a knife, but is too hard to hand-trim for triaxial test specimen.	50 - 125
Soft		12 - 50

ATTACHMENT 3
Additional Information for Describing Rock Core

Soil/Rock Structure Descriptions	
Term	**Description**
Pocket	Small erratic deposit, usually less than 1 foot in size
Fissures	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear to be polished or glossy, sometimes striated
Blocky	Cohesive soil can be broken down into small angular lumps with resist further breakdown
Lensed	Inclusions of small pockets of different materials, such as lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout
Laminated	Alternating layers less than 1/4" thick

Rock Weathering States		
Term	**Rock Mass**	**Soil Mass**
Fresh	No visible sign of decomposition or discoloration. Rings under hammer impact.	No visible sign of soil material weathering; perhaps slight discoloration on major discontinuity surfaces.
Slightly Weathered	Slight discoloration inward from open fractures; otherwise similar to fresh.	In fine soils, discoloration indicates weathering of soil materials and discontinuity surfaces; there is not a marked change in consistency of the discolored soil. Relics of fresh soil may be present. In coarse soils, individual fragments and discontinuities are discolored; there is no marked change in relative density.
Moderately Weathered	Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.	In fine soils, the soil is discolored; less than 35% of the soil shows marked change in consistency; relics of fresh and slightly weathered soil are present. In coarse soils, more than 35% of the soil has markedly lower relative density.
Highly Weathered	Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becomes indistinct, but fabric preserved.	In fine soils, the soil is discolored and more than 35% of the soil shows marked change in consistency; relics of fresh and slightly weathered soil are present. In coarse soils, more than 35% of the soil has markedly lower relative density.
Extremely Weathered	Minerals decomposed to soil, but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.	In fine soils, the soil is discolored, relics of slightly weathered soil are absent; the soil shows a marked change in consistency from the fresh soil. In coarse soils, there is a marked decrease in relative density.
Decomposed (Residual Soil)	Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed.	N/A

Rock Descriptive Terms			
	Term	**Defining Characteristics**	
Hardness	Soft	Scratched by a fingernail	
	Medium Hard	Scratched by a knife	
	Hard	Difficult to scratch with a penknife	
	Very Hard	Cannot be scratched with a penknife	
Bedding Planes	Laminated	<0.04 in.	<1 mm.
	Parting	0.04 in. - 0.24 in.	1 mm - 6 mm
	Banded	0.24 in. - 1 in.	6 mm - 3 cm
	Thin	1 in. - 4 in.	3 cm - 9.1 cm
	Medium	4 in. - 12 in.	30.5 cm - 1 M
	Thick	12 in. - 36 in.	30.5 cm - 1M
	Massive	>36 in.	>1 M
Joints and Fracture Spacing	Very Close	<2 in.	<5.1 cm
	Close	2 in. - 1 ft.	5.1 - 30.5 cm
	Moderately Close	1 ft. - 10 ft.	30.5 cm - 91.4 cm
	Wide	3 ft. - 10 ft.	91.4 cm - 3 M
	Very Wide	>10 ft.	>3M
Voids	Porous	Smaller than a pinhead. Their presence is indicated by the degree of absorbency.	
	Pitted	Pinhead size to 1/4 inch. If only thin walls separate the individual pits, the core may be described as honeycombed.	
	Vug	1/4 inch to the diameter of the core. The upper limit will vary with core size.	
	Cavity	Larger than the diameter of the core.	

Sample Rock Core Sketch	Sample Abbreviations/Symbols
	See key to core descriptions in SOP text.

Standard Operating Procedure – Equipment Cleaning

I. Scope and Application

The equipment cleaning procedures described herein include pre-field, in the field, and post-field cleaning of sampling equipment which will be conducted on site, as appropriate. Sampling equipment consists of soil sampling equipment and other activity specific sampling equipment. Non-disposable equipment will be cleaned after completing each sampling event, between sampling events, and prior to leaving the site. Cleaning procedures will be monitored through collection of rinsate blank samples as specified in the Work Plan.

II. Equipment List

The following materials, as required, will be available during field cleaning procedures:

- health and safety equipment (as required in the Health and Safety Plan);
- distilled/deionized water;
- non-phosphate soap;
- appropriate cleaning solvent (i.e., CitruSolv);
- rinsate collection containers;
- brushes;
- plastic sheeting;
- large heavy-duty garbage bags;
- spray bottles;
- resealable-type bags;
- handiwipes; and
- field notebook.

III. Field Cleaning Procedures

As practicable, a designated area will be established to conduct cleaning of sampling equipment in the field prior to and following sample collection. Equipment cleaning areas between sampling locations will be set up within or adjacent to the specific work areas. Equipment to be cleaned in the field may include stainless steel bowls, spatulas, etc.

Cleaning of Sampling Equivalent when Analyzing for Organic Constituents

1. Non-phosphate detergent and water wash to remove all visible particulate matter and any residuals.

2. Water rinse to remove the detergent solution.

3. Solvent rinse.

4. Distilled/deionized water rinse.

5. Repeat solvent and water rinse two more times (i.e., triple rinse) and allow to air dry.

IV. Disposal Methods

Rinse water, personal protective equipment, and other residuals generated during the equipment cleaning procedures will be placed in appropriate containers for subsequent management.

V. References

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan* - *Newburgh Project*.

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation* - *Area A.*

Standard Operating Procedures – Monitoring Well Development

I. Scope and Application

This Standard Operating Procedure (SOP) describes the procedures to be used to develop monitoring wells. Monitoring wells will be developed following installation to promote hydraulic connectivity with the surrounding formation. Prior to monitoring well development, each monitoring well will be checked for the presence of a floating non-aqueous phase liquid (NAPL) by checking the water table surface with an oil/water interface probe or a translucent bailer. If a separate phase is present, an attempt will be made to remove the NAPL prior to development. In addition, if a separate phase is present, efforts will be made to avoid significantly drawing the water table down in the well (and, thus avoid redistributing the separate phase to locations below the water table). These efforts will be contingent on the capacity of the formation to yield water to the monitoring well.

II. Personnel Qualifications

Field sampling personnel will have current health and safety training, including 40-hour training in accordance with the Occupational Safety and Health Administration (OSHA) Regulation 29CFR1910.120 (HAZWOPER), site supervisor training, current LPS training, and site-specific training, as needed.

III. Equipment List

The following materials, as required, will be available during monitoring well installation and development:

- Appropriate PPE (as required by the Health and Safety Plan)
- Well log form
- Appropriate Cleaning Equipment
- Bottom Loading Bailer
- Polypropylene Rope
- Plastic Sheeting
- Buckets to measure purge water
- Conductivity/temperature meter
- pH meter
- Turbidity meter
- DO meter
- Disposable Gloves
- Keys to wells
- Photoionization detector (PID)
- Pump/tubing/foot valve/surge block
- Power Source (generator or battery)
- Field book

IV. Health and Safety Considerations

Follow health and safety procedures outlined in the Health and Safety Plan.

V. Procedures

Development can be accomplished by evacuating water by bailing, however, development using an inertial-type pump (Watera pump) is recommended. The well will be developed until turbidity is reduced to the goal of 50 nephelometric turbidity units (NTUs) or less, or until relatively constant pH and conductivity measurements are obtained. A turbidity meter with a scale of 0-1000 NTUs will be used to monitor improvement in well development with respect to turbidity.

1. Review materials check list (Part II) to ensure the appropriate equipment has been acquired. Test all equipment prior to mobilizing to the Site to verify it is working.

2. Identify the site name and well ID, along with date, arrival time, and weather conditions in the field book. Identify the personnel and equipment utilized and other pertinent data requested on the groundwater sampling field book.

3. Don safety equipment, as required in the Health and Safety Plan.

4. Place plastic sheeting adjacent to well to use as a clean work area.

5. Establish the background reading with the PID and record the reading on the groundwater sampling field log. If the well headspace reading is less than 5 ppm, proceed; if the well headspace reading is greater than 5 ppm, screen the air within the breathing zone. If the PID reading in the breathing zone is below 5 ppm, proceed. If the PID reading is above 5 ppm, move upwind from the well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 ppm, don appropriate respiratory protection in accordance with the requirements of the HASP.

6. Begin removing water from the well by pumping or bailing. Continue pumping until the turbidity is reduced to 50 NTUs or less, or until relatively constant (within 10 percent) pH and conductivity measurements are obtained.

7. If well runs dry, shut off pump and allow well to recover.

8. Contain all water in appropriate containers.

9. When complete, secure the lid back on the well.

10. Place plastic sheeting and tubing in plastic bags for appropriate disposal and clean pump.

The procedures for developing a well using the bailer method are outlined below:

1. Don appropriate PPE (as required by the HASP).

2. Place plastic sheeting around the well.

3. Clean bailers and new rope.

4. Open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert PID probe approximately 4 to 6 inches into the casing or the well headspace and cover with gloved hand. Record the PID reading in the field notebook. If the well headspace reading is less than 5 ppm,

proceed; if the headspace reading is greater than 5 ppm, screen the air within the breathing zone. If the breathing zone reading is less than 5 ppm, proceed. If the PID reading in the breathing zone is above 5 ppm, move upwind from well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 ppm, don appropriate respiratory protection in accordance with the requirements of the site HASP. Record all PID readings. For wells that are part of the regular weekly monitoring program and prior PID measurements have not resulted in a breathing zone reading above 5 PID units, PID measurements will be taken monthly.

5. Determine depth of well by examining drilling log data and measuring a length of rope at least 10 feet greater than the total depth of the well.

6. Secure one end of the rope to the well casing and secure the other end to the bailer. Test the knots and make sure the rope will not loosen. Check bailers to be sure all parts are intact and will not be lost in the well.

7. Lower bailer into well until bailer reaches the bottom of the well.

8. Surge/purge by raising and lowering the bailer at 2-foot intervals at least 10 times.

9. Contain all water in appropriate containers.

10. Lower bailer back into the well and repeat surging/purging at an interval 2 feet above the previous interval.

11. Repeat Steps 8 and 9 until entire screen has been surged/purged and the purge water is relatively clear of silt.

12. Upon completing well surging, remove bailer and remove the rope from the bailer and the well.

13. Secure lid on well.

14. Place plastic sheeting and polypropylene rope in plastic bags for appropriate disposal and clean bailer.

VI. Data Recording and Management

Copies of all groundwater sampling logs will be maintained in the project file.

VII. References

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan - Newburgh Project.*

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation - Area A.*

Standard Operating Procedures – Handling and Storage of Investigation-Derived Waste

I. Scope and Application

The objective of this Standard Operating Procedure (SOP) is to describe the procedures to manage investigation-derived wastes (IDW) generated during drilling, well sampling, and decontamination procedures. IDW may include soil, groundwater, drilling fluids, decontamination liquids, personal protective equipment (PPE), and disposable sampling materials that may have come in contact with potentially impacted materials. All IDW will be collected at the point of generation and taken to a storage area onsite or to a disposal facility. Soil and water will be containerized in DOT-approved drums and analyzed for constituents of concern to evaluate proper disposal methods. PPE and disposable sampling equipment will be placed in DOT-approved drums prior to disposal. This SOP describes the necessary equipment, field procedures, materials, and documentation procedures necessary to do so, as well as the handling of these materials up to the time they are properly disposed. The procedures for handling IDW are based on the United States Environmental Protection Agency's Guide to Management of Investigation Derived Wastes (USEPA, 1992) and IDW is assumed to be hazardous waste unless analytical evidence indicates otherwise.

Pending characterization, IDW will be stored appropriately at a designated location at the Site. Under RCRA, "storage" is defined as "the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR 2690.10). The onsite waste staging area will be in a secure and controlled area. Waste characterization involves sending composite samples for each media to a laboratory for analysis.

II. Personnel Qualifications

Field sampling personnel will have current health and safety training, including 40-hour training in accordance with the Occupational Safety and Health Administration (OSHA) Regulation 29CFR1910.120 (HAZWOPER), site supervisor training, current LPS training, and site-specific training, as needed.

III. Equipment List

The following materials, as required, will be available for handling and storage IDW:

- Appropriate PPE (as required by the Health and Safety Plan)
- 55-gallon steel drums, DOT 1A2 or equivalent
- ¾-inch socket wrench
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self-adhesive)
- Polyethylene storage tank
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials as specified in the Field Sampling Handling, Packing, and Shipping SOP
- Indelible ink and/or permanent marking pens
- Plastic sheeting

- Appropriate sample containers, labels, and forms
- Stainless steel bucket auger
- Stainless steel spatula or knife
- Stainless steel hand spade
- Stainless steel scoop
- Field book

IV. Health and Safety Considerations

Follow health and safety procedures outlined in the Health and Safety Plan.

V. Procedures

Waste storage and handling procedures to be used depend on the type of generated waste. For this reason, IDW can be stored in a secure location onsite in separate 55-gallon storage drums, soil can be stockpiled onsite, and purge water may be stored in polyethylene tanks. Waste materials, such as broken sample bottles or equipment containers and wrappings, will be included in the 55-gallon drums unless they were not in contact with sample media.

Management of IDW

Minimization of IDW should be considered by the Project Manager during all phases of the project. Site Managers may want to consider techniques such as replacing solvent-based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), limitation of traffic between exclusion and support zones, and drilling methods and sampling techniques that generate little waste. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a direct-push technique, instead of coring (EPA 1993).

Drum Labeling

IDW drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. IDW drums will be labeled as follows:

- Appropriate waste characterization label
- Waste generator’s name (e.g., BBL)
- Project name (e.g., Newburgh Project Pre-Design Investigation - Area A)
- Name and telephone number of BBL Project Manager;
- Composition of contents (e.g., used oil, acetone 40%, toluene 60%);
- Media (e.g., solid, liquid);
- Accumulation start date; and
- Drum number of total drums.

Drill Soil Cuttings and Muds

Drill soil cuttings are solid to semi-solid soils generated during trenching activities, subsurface soil sampling, or installation of monitoring wells. Depending on the drilling method, drilling fluids known as “muds” may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Soil cuttings will be labeled and stored in 55-gallon drums with bolt-sealed lids. All 55-gallon steel drums will have a containment system that can contain at least 10% of the volume of the largest container, be closed during storage, and be in good condition in accordance with the *Guide to Management of Investigation-Derived Wastes* (USEPA, 1992).

Decontamination Solutions

Decontamination solutions are generated during decontamination of PPE and sampling equipment. Decontamination solutions may range from detergents, organic solvents, and acids used to decontaminate small field sampling equipment to steam cleaning rinsate used to wash heavy field equipment. These solutions are to be labeled and stored in 55-gallon drums with bolt-sealed lids.

Decontamination Equipment

Disposable equipment includes PPE and disposable sampling equipment such as trowels or disposable bailers. If the media sampled exhibits hazardous characteristics per results of waste characterization sampling, disposable equipment will also be disposed of as a hazardous waste. These materials will be stored onsite in labeled 55-gallon drums pending analytical results for waste characterization.

Purge Water

Purge water includes groundwater generated during well development, groundwater sampling, or aquifer testing. The volume of groundwater generated will dictate the appropriate storage procedure. Monitoring well development and groundwater sampling may generate three well volumes of groundwater or more. This volume will be stored in labeled 55-gallon drums. Aquifer tests may generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Therefore, large-volume portable polyethylene tanks will be considered for temporary storage pending groundwater-waste characterization.

VI. Waste Characterization Sampling

The need for characterization sampling will be determined based upon the selected disposal facility. Chain-of-custody and sample labels for wastes characterization samples will be filled out in accordance with Field Sampling Handling, Packing, and Shipping SOP.

VII. Data Recording and Management

Waste characterization sample handling, packing, and shipping procedures will be documented. Copies of chain-of-custody forms will be maintained in the project file.

VIII. References

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan - Newburgh Project.*

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation - Area A.*

Standard Operating Procedures – Fluid Level Measurement and Sampling for Monitoring Wells

I. Scope and Application

This Standard Operating Procedure (SOP) describes the procedures to be used to measure water levels in monitoring wells and collect groundwater samples. No wells will be sampled until well development has been performed in accordance with Monitoring Well Development SOP. During precipitation events, groundwater sampling will be discontinued until precipitation ceases. When a round of water levels is taken for the purpose of generating water elevation data, the water levels will be taken consecutively at one time prior to sampling or other activities.

II. Personnel Qualifications

Field sampling personnel will have current health and safety training, including 40-hour training in accordance with the Occupational Safety and Health Administration (OSHA) Regulation 29CFR1910.120 (HAZWOPER), site supervisor training, current LPS training, and site-specific training, as needed.

III. Equipment List

The following materials, as required, will be available during fluid level measurement and sampling:

- Sample pump
- Sample tubing
- Power source (i.e. generator)
- Photoionization detector (PID)
- Appropriate PPE (as required by the Health and Safety Plan)
- Plastic sheeting
- Dedicated or disposable bailers
- Polypropylene rope
- Buckets to measure purge water
- Oil-water level indicator
- 6’ rule with gradation in hundredths of a foot
- Conductivity/temperature meter
- pH meter
- Turbidity meter
- DO meter
- Hacksaw
- Appropriate water sample containers
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials
- Groundwater sampling logs
- Chain-of-Custody forms
- Indelible ink pens
- Site map with well locations and groundwater contours maps
- Peristaltic pump and dedicated tubing
- Keys to locks on well protective cover
- Field notebook

IV. Health and Safety Considerations

Follow health and safety procedures outlined in the Health and Safety Plan.

V. Procedures

1. Review materials check list (Part II) to ensure the appropriate equipment has been acquired. Test all equipment prior to mobilizing to the Site to verify it is working.

2. Identify the site name and well ID on sampling log sheets, along with date, arrival time, and weather conditions. Identify the personnel and equipment utilized and other pertinent data requested on the groundwater sampling field log.

3. Label the sample containers as described in the Work Plan. Cover the sample label with clear packaging tape to secure the label to the container.

4. Don safety equipment, as required in the Health and Safety Plan.

5. Place plastic sheeting adjacent to well to use as a clean work area.

6. Establish the background reading with the PID and record the reading on the groundwater sampling field log. If the well headspace reading is less than 5 ppm, proceed; if the well headspace reading is greater than 5 ppm, screen the air within the breathing zone. If the PID reading in the breathing zone is below 5 ppm, proceed. If the PID reading is above 5 ppm, move upwind from the well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 ppm, don appropriate respiratory protection in accordance with the requirements of the HASP.

7. Remove lock from well and if rusted or broken replace with a new brass lock (with similar key).

8. Unlock and open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert PID probe in the breathing zone above the well casing following instructions in the Health and Safety Plan.

9. Set out on plastic sheeting the dedicated or disposable sampling device and meters.

10. refer to Equipment Cleaning SOP).

11. Prior to sampling, measure the depth to groundwater in each monitoring well and the depth to the bottom of each monitoring well. The depth to groundwater (and depth to the bottom of the well) will be determined using an oil-water level probe. If a reference point on the well casing is not found, initiate a reference point by notching the inner casing (or outer if necessary) with a hacksaw. All downhole measurements will be taken from one reference point established at each well. Measurements will be recorded to the nearest hundredth of a foot, along with the height of the inner and outer casings from the reference point to ground level. The measurements and reference point will be recorded on a sampling log sheet. Clean the well probe before and after each use with a soapy (Alconox) water wash and a tap water rinse (refer to Equipment Cleaning SOP). [Note: water levels will be measured at all wells prior to initiating any sampling activities].

12. When checking the depth to groundwater in each well, check the water level probe for evidence of LNAPL.

13. Pump, safety cable, tubing, and electrical lines will be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well, or at a location determined to either be a preferential flow path, or zone where contamination is present. The pump intake must be kept at least two feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

14. Measure the water level again with the pump in well before starting the pump. Start pumping the well at 200 to 500 milliliters per minute. Ideally, the pump rate should cause little or no water level drawdown in the well (less than 0.3 feet and the water level should stabilize). The water level should be monitored every three to five minutes (or as appropriate) during pumping. Care should be taken not to cause pump suction to be broken or entrainment of air in the sample. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump. However, a steady flow rate should be maintained to the extent practicable. Sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples.

15. During purging of the well, monitor the field indicator parameters (pH, conductivity, dissolved oxygen, temperature, turbidity, etc.) every three to five minutes (or as appropriate). Groundwater samples will be collected for laboratory analysis following the stabilization of field parameters and the reduction of turbidity levels in the groundwater to less than 50 nephelometric turbidity units (NTUs). For the purpose of the RI, the field parameters will be considered to have stabilized after three consecutive readings are within the following values:

    - pH: ± 0.1;
    - Conductivity: ± 3%;
    - Oxidation/Reduction Potential (ORP): ± 10 mV;
    - Dissolved Oxygen: ± 10%; and
    - Turbidity: less than 50 NTU.

    If the field parameters have not stabilized after a reasonable effort has been made during the well purging, a sample will be collected based on the judgment of the field personnel. If the field parameters have stabilized, but the turbidity of the groundwater is not less than the 50 NTU goal, the pump flow rate will be decreased to no more than 100 mL/min, and additional purging will be conducted. The purging will continue until the 50 NTU turbidity goal is achieved or, if not possible, until reasonable effort has been made to reduce the turbidity to less than 50 NTUs.

16. After the appropriate purge volume of groundwater in the well has been removed, obtain the groundwater sample for analysis from the sampling device. Groundwater samples will be placed directly into the appropriate containers. When sampling for volatiles, collect water samples directly from a bottom-loading bailer into 40-mL vials with Teflon-lined septa. The bailer will be slowly lowered into the screened portion of the well to retrieve a filled bailer from the well causing minimal disturbance to the water and any sediments in the well. Groundwater sample containers will be collected in the following order:

    a. VOCs
    b. TOC (if sampled)
    c. SVOCs
    d. metals and cyanide
    e. others

17. Secure the caps on the sample containers. Place the sample containers on ice in an insulated transport container provided by the laboratory.

18. After all sampling containers have been filled, remove an additional volume of groundwater. Check the calibration of the meters and then measure and record on the field log physical appearance, pH, conductivity, dissolved oxygen, temperature, and turbidity.

19. If using a dedicated bailer, replace dedicated bailer in the well and replace the well cap and lock well.

20. Record the time sampling procedures were completed on the field logs.

21. Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in appropriately labeled containers.

22. Complete the procedures for packaging, shipping, and handling.

23. If new locks were installed, forward copies of the keys to the Project Manager (PM) at the end of the sampling activities.

VI. Data Recording and Management

Copies of all groundwater sampling logs will be maintained in the project file.

VII. References

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan - Newburgh Project.*

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation - Area A.*

Standard Operating Procedures – Soil Boring Installation and Soil Sampling

I. Scope and Application

This Standard Operating Procedure (SOP) describes the field procedures to install soil borings and to collect soil samples. Soil borings will be completed with a truck- or track-mounted hydraulic rotary drill rig using the hollow-stem-auger drilling method or direct-push equipment. Where site features limit access or shallow soil cores are desired, soil borings will be hand driven or completed with a portable power auger, depending on the required depth and subsurface conditions.

II. Personnel Qualifications

Field sampling personnel will have current health and safety training, including 40-hour training in accordance with the Occupational Safety and Health Administration (OSHA) Regulation 29CFR1910.120 (HAZWOPER), site supervisor training, current LPS training, and site-specific training, as needed. In addition, personnel observing soil borings will be experienced in soil boring installation and sampling at MGP sites.

III. Equipment List

The following materials, as required, will be available during install soil borings and to collect soil samples:

- Health and safety equipment (as required in the Health and Safety Plan)
- Drilling or direct push machinery
- Split spoon or macro-core sampler
- Stainless steel hand trowel
- Measuring tape
- Photoionization detector (PID)
- Particulate dust monitor (MIE pDR 1000 Dust Monitor or similar equipment)
- Camera
- Indelible ink pens
- Polyethylene bags (resealable-type)
- Plastic sheeting
- Wooden stakes
- Soil boring log
- Appropriate sample containers, labels, and chain-of-custody forms
- Insulated transport containers with ice or “blue ice” (if sampling is necessary)
- Field notebook

IV. Health and Safety Considerations

Follow health and safety procedures outlined in the Health and Safety Plan. Prior to commencing drilling activities, Underground Facility Protection Organization (UFPO) will be contacted to have appropriate utility representatives mark the location of underground lines at and in the vicinity of the proposed soil boring/monitoring well locations. The drilling subcontractor will survey the project area to determine the presence of known utilities at the project area, especially in those areas where drilling is proposed.

V. Soil Boring Activities

Soil samples will be collected continuously using standard 2-inch by 2-foot split barrels driven by a 140-pound hammer in accordance with ASTM Method D1586 or macro-core samplers. The samplers will be advanced to the depth specified in the project-specific work plan. Samplers will be cleaned between samples and drilling equipment will be cleaned between borings using procedures described in the Equipment Cleaning SOP.

Upon retrieval of each sampler, representative portions of each soil sample will be placed in the appropriate laboratory containers and a container for visual observations and headspace screening. The sample containers will be labeled with: 1) site; 2) boring number; 3) sample interval; 4) date; and 5) initials of sampling personnel. All split-barrel samples will be screened for detectable organic vapors with a PID using the procedures described in Section VI below. In addition, the on-site geologist will be on site during the drilling operations to visually/manually characterize each soil sample including the following:

- Percent Recovery
- Structure and degree of sample disturbance
- Soil type
- Principal and minor components
- Color
- Moisture and organic content
- Particle sizes, angularity and shape
- Density/consistency
- Plasticity of fines
- Cohesiveness
- Discoloration
- Mottling/staining
- Weathering
- Presence/absence of MGP residuals and/or noticeable odors
- Fill or geologic origin of deposit (local name of deposit, if known)
- Items that may indicate age of deposit (i.e., archaeological artifacts, newspapers, etc.)
- Fill component description (i.e., cinder, clay, metal, tires, etc.)
- PID headspace screening results

The descriptions will be recorded in a dedicated field notebook. The on-site geologist will also be responsible for recording the following information in the field notebook:

- Start and finish dates of drilling
- Name and location of project
- Project number, client, and project location
- Sample number and depth
- Blow counts and recovery
- Type and size of samples
- Depth to water
- Type of drilling equipment
- Size of casing
- Documentation of any elevated organic vapor emissions
- Names of contractor’s drillers, inspectors, or people at the project area
- Weather conditions

The drilling contractor will be responsible for obtaining accurate and representative samples, informing the on-site geologist of changes in drilling pressure and loss of circulation, and keeping a separate general log of soils encountered, including blow counts (i.e., the number of blows from a soil sampling drive weight [140 pounds] required to drive the split-barrel sampler in 6-inch increments).

VI. Field Screening Procedures

Field screening will be conducted on the headspace of soil samples with a PID. A representative portion of the sample will be obtained and placed in either an approximately one pint glass "driller's jar" or a re-sealable Ziploc-type plastic bag. If a driller's jar is used, the top of the jar will be covered with aluminum foil. These samples will be screened as follows:

1. Samples will be taken to a warm workspace and allowed to equilibrate to room temperature for at least one hour.

2. Prior to measuring the soil vapor headspace concentration, the 8-ounce jar will be shaken.

3. The PID probe will be inserted into the headspace of the jar through the aluminum foil covering or into a small opening in the top of the bag; and

4. The initial (peak) readings will be recorded in the field note book.

The PID meter will be calibrated to isobutylene at a minimum frequency of once per day prior to collecting readings. The time, date, and calibration procedure must be clearly documented in the field notebook and/or the calibration log book. If at any time the PID results appear erratic or inconsistent with field observations, then the unit will be recalibrated. If calibration is difficult to achieve, then the PID's lamp should be checked for dirt or moisture and cleaned. During humid or wet conditions, the unit should be calibrated on a more frequent basis as determined by field personnel. In addition, a blank and field duplicate will be performed every 10 samples. Maintenance and calibration records will be kept as part of the field quality assurance program.copied onto test pit logs.

VII. Procedures for Collecting Soil Samples for Laboratory Analysis (If Required)

As discussed in the Work Plan, soil samples collected may be submitted for laboratory analysis. In addition, if any of the samples recovered at a boring location exhibit staining, odors, MGP residuals, or elevated PID readings, then the sample exhibiting the highest PID reading or visible impacts will be submitted for laboratory analysis. Samples designated for laboratory analysis will be placed in the appropriate containers. Sample containers for volatile organic analysis will be filled first. The remaining soil will be homogenized by mixing in a stainless steel bowl with a clean stainless steel trowel, and distributed to the appropriate sample containers.

VIII. Data Recording and Management

Copies of soil boring logs will be maintained in the project file.

IX. References

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan - Newburgh Project.*

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation - Area A.*

Standard Operating Procedures – Test Pit Excavation

I. Scope and Application

This Standard Operating Procedure (SOP) describes the excavate test pits and collect soil samples from test pits at the Site. Test pits will be excavated using a decontaminated, rubber-tired backhoe or track-mounted excavator. The procedures that will be utilized to excavate test pits and collect soil samples are discussed below.

II. Personnel Qualifications

Field sampling personnel will have current health and safety training, including 40-hour training in accordance with the Occupational Safety and Health Administration (OSHA) Regulation 29CFR1910.120 (HAZWOPER), site supervisor training, current LPS training, and site-specific training, as needed. In addition, test pit observers will be experienced in test pit logging and sampling at MGP sites.

III. Equipment List

The following materials, as required, will be available during test pit excavation:

- health and safety equipment (as required in the Health and Safety Plan)
- rubber-tired backhoe or track-mounted excavator
- shovel
- stainless steel hand trowel
- measuring tape
- photoionization detector (PID)
- particulate dust monitor (MIE pDR 1000 Dust Monitor or similar equipment)
- camera
- indelible ink pens
- polyethylene bags (resealable-type)
- plastic sheeting
- wooden stakes
- hammer
- test pit log
- appropriate sample containers, labels, and chain-of-custody forms
- Insulated transport containers with ice or "blue ice" (if sampling is necessary)
- field notebook

IV. Health and Safety Considerations

Follow health and safety procedures outlined in the Health and Safety Plan.

V. Procedures

1. Identify the test pit location number in the field sampling notebook. Also, indicate the temperature, weather, date, time, and personnel at the site prior to test pit excavation.

2. Set up cleaning station and clean the backhoe and bucket prior to excavating test pits and between each test pit (if necessary, as determined by the onsite sampling personnel). Decontaminate reusable sampling equipment as described in Equipment Cleaning SOP and Work Plan (equipment Decontamination and Cleaning Procedures) prior to, between, and following the collection of soil samples.

3. Put on personal protective equipment (including a new pair of disposable inner and outer gloves) (as required by the Health and Safety Plan).

4. Screen ambient air to obtain background VOC and airborne particulate concentrations using a PID and particulate monitor prior to commencing test pit excavation. Air monitoring during the test pit excavation will be performed in accordance with the Site Health and Safety Plan.

5. If the test pit locations are covered by asphalt or concrete, the asphalt/concrete will be saw cut prior to test pit excavation.

6. The test pits will be excavated at 2-foot intervals using a rubber-tired backhoe or track-mounted excavator. The soil shall be staged on plastic sheeting. During excavation, soils that are observed to be visibly not impacted (i.e., absence of staining, sheens, odors, etc.) will be segregated separately from soil that exhibits potentially impacted material based on visible characterization (i.e., presence of visible staining, sheens, odors, etc.).

7. At each 2-foot interval, examine and classify the soils according to ASTM standard soils classification procedures. At each interval, collect approximately eight ounces of soil and place in a glass jar for PID headspace screening. Record in the field notebook observations, PID measurements, and the presence or absence of visible staining or odors noticed in the test pit.

8. The test pits will be excavated to the depths specified in the Work Plan.

9. Soil samples are to be collected from the test pits for laboratory analysis as specified in the Work Plan. Samples will be selected based on visual observations and/or elevated PID headspace screening measurements.

10. When soil sampling for laboratory analysis is required, soil samples will be collected from the sidewall of the test pit using a stainless-steel scoop or decontaminated hand bucket auger with an extension handle, depending on the depth of the test pit and stability of the sides of the test pit. Soil samples will be collected using procedures that maintain the samples relatively undisturbed.

11. Soil samples collected for laboratory analysis will be transferred into appropriate sample container(s), stored in a cooler at approximately 4ºC, and transferred to the subcontracted analytical laboratory for analysis.

12. Sampling activities and sample handling procedures used at the site will follow the protocols outlined in Sample Packing, Handling, and Shipping Procedures SOP.

13. Following completion of excavation and collection of soil samples, the test pit will be backfilled using the material removed from the test pit. The material excavated from the test pit will be placed into the excavation in reverse order that it was removed. Visibly non-impacted material (i.e., absence of staining, sheens, odors, etc.) will be used for backfilling the upper 2 feet of the test pit. If necessary, the upper 2 feet of the excavation will be backfill with an alternate non-impacted backfill material.

14. A labeled stake denoting the test pit number will be placed at the test pit location following backfilling of the excavation.

15. Each test pit location will be photographed before, during, and after excavation. The number and location of each photograph will be recorded in the field notebook. All four sides of the excavation as well as the bottom will be photographed prior to backfilling.

16. At the conclusion of the test pit activities, information recorded in the field book will be copied onto test pit logs.

VI. Data Recording and Management

Copies of test pit logs will be maintained in the project file.

VII. References

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan* - *Newburgh Project.*

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation* - *Area A.*

Standard Operating Procedures – Specific Capacity Testing

I. Scope and Application

Specific capacity tests will be conducted to estimate the transmissivity of the geologic formation immediately surrounding the screened or open interval of monitoring wells. This test consists of pumping water from a well at a constant rate and quantifying the pumping rate and the magnitude of groundwater drawdown inside the well after a known pumping duration.

The transmissivity of the geologic formation is calculated based on the following:

- Observed test pumping rates;
- Drawdown measured immediately before the end of pumping;
- Pumping duration;
- The effective radius of the monitoring well; and
- The estimated storativity of the aquifer.

II. Personnel Qualifications

Field sampling personnel will have current health and safety training, including 40-hour training in accordance with the Occupational Safety and Health Administration (OSHA) Regulation 29CFR1910.120 (HAZWOPER), site supervisor training, current LPS training, and site-specific training, as needed.

III. Equipment List

The following materials, as required, will be available during specific capacity testing:

- Health and safety equipment (as required in the Health and Safety Plan)
- Appropriate PPE (as required by the Health and Safety Plan)
- A pump (preferably submersible) equipped with a discharge line capable of pumping at a controlled rate between less than one gallon and 10 gallons per minute
- A power source for the pump
- A calibrated in-line totalizing flow meter or two graduated buckets
- An electronic water-level indicator and extra batteries
- Waterproof marker
- Engineers rule
- Cleaning supplies including non-phosphate laboratory grade detergent (Alconox or equivalent), solvents (pesticide grade methanol or hexane), brushes, buckets, tap water, aluminum foil, plastic sheeting, etc
- Garbage bags
- Disposable gloves
- Flashlight
- Stopwatch
- Field notebook

IV. Health and Safety Considerations

Follow health and safety procedures outlined in the Health and Safety Plan.

V. Procedures

1. Identify the site name and well ID in the field notebook along with the date, time, personnel, and weather conditions.

2. Make sure that all equipment that enters the well is cleaned before use (i.e., pump, cable, water level probe, etc.). Use new, clean materials when cleaning is not appropriate (polypropylene rope, disposable gloves, etc.). Document cleaning procedures in field notebook.

3. Place cleaned equipment and instruments on plastic sheeting near the well.

4. Measure the static water level of the well with a water level indicator to the nearest 0.01 feet relative to a specified datum at the top of the well casing. Record the water level and the time of measurement in the field notebook.

5. Calculate the depth to water corresponding to a drawdown of two feet. Ideally, the drawdown during a specific capacity test should not exceed three feet. Excessive drawdown may cause inefficient flow to the well and may cause an error to the transmissivity calculation.

6. Lower the pump to approximately five feet below the static water level, or within no less than one foot of the bottom of the well (to minimize sediment mobilization). Once the pump is in place, the water level in the well should be monitored until it has returned to within 0.01 feet of the static water level.

7. Hold the water level probe in the well just above the surface of the static water level. If an in-line totalizing flow meter is used, record the pre-test volume measurement in the field notebook. If no in-line flow meter is available, place the end of the discharge line from the pump in one of the two calibrated buckets. Record the total capacity of each bucket.

8. Simultaneously start the pump and the stop watch. Record the start time.

9. Immediately begin monitoring the water level in each well. If the drawdown rapidly approaches or passes the maximum suggested drawdown of two feet, reduce the pumping rate until the drawdown is approximately 0.5 to 1.0 feet. All pumping rate adjustments should be completed within one or two minutes of the beginning of pumping, after which, no adjustment should be made other than minor adjustments that may be necessary to maintain a steady pumping rate.

10. Continue to pump for at least 20 minutes, recording the water level every two minutes and field parameters every five minutes throughout the test. If an in-line flow meter is used, record the volume measurement on the totalizer gauge approximately every two minutes during the test. If calibrated buckets are used to measure the pumping rate, record the time which the bucket reaches its known, recorded volumetric capacity. Transfer the discharge line to the other empty bucket and record the time when it becomes full. Repeat this process for the duration of the test.

11. Pumping should continue for no less than 20 minutes. A longer pumping period may provide a slightly more reliable transmissivity estimate. Immediately prior to termination of pumping, record the final water level measurement plus the time of measurement.
12. Calculate and record the total volume of groundwater removed from the well during the test, and the total duration of the test. Divide the total volume (in gallons) by the total pumping duration (in minutes) to calculate and record the average test pumping rate (in gallons per minute).

13. Reduce the data obtained from the specific capacity test using the specific capacity test reduction spreadsheet program (QSTRANS) developed by BBL. QSTRANS iteratively solves for the value of transmissivity in the equation (Walton 1962):

    $$Q/s = T / [264 \log(Tt/2693rw2S) - 65.5]$$

    <u>where:</u>
    Q = Average test pumping rate in gallons per minute;
    s = Groundwater drawdown (in feet) within well after a known duration of pumping (t);
    (Q/s = Specific capacity of the well in gallons per minute per foot;)
    T = Transmissivity of the geologic formation surrounding the intake of the well (in square feet per minute);
    S = Estimated storativity of the aquifer (unitless);
    rw = Effective radius of the well (feet); and
    t = Time between the start of pumping and the time when drawdown is measured (minutes).

    For confined aquifers an estimated storativity of 0.0001 should be used. For a specific capacity test of less than one hour duration within an unconfined aquifer, an estimated storativity of 0.01 should be used.

    To calculate the estimated hydraulic conductivity for the formation surrounding the well, the estimated transmissivity is divided by the thickness of the water-bearing zone adjacent to the intake of the monitoring well. All calculations must be reviewed by a qualified hydrogeologist. Calculations will be provided with backup documentation such as raw data and graphs of the data.

VI. Data Recording and Management

Copies of field notes will be maintained in the project file.

VII. References

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan - Newburgh Project.*

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation - Area A.*

Standard Operating Procedure – Field Documentation

I. Scope and Application

Field documentation consists of field logbooks, field reconnaissance logs, field chain-of-custody forms, and photographs. The objective of field documentation and is to assure that samples are properly collected, appropriately classified, and labeled according to protocol.

II. Field Logbooks and Logs

Field logbooks and other Logs will provide the means of documenting the data collection activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could re-construct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned;
- logbook number;
- project name;
- project start date; and
- end date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather conditions, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed. Whenever a sample is collected or a measurement is made, a detailed description of the location will be recorded. The number of the photographs taken, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the appropriate SOP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. The sample identification number will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number (so that the location from which the duplicate sample was collected is only determined through use of the field notes), will be noted under sample description.

III. Field Chain-of-Custody Forms

Completed chain-of-custody forms will be required for all samples to be analyzed. Chain-of-custody forms will be initiated by the sampling crew in the field. The chain-of-custody forms will contain the sample's unique identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original chain-of-custody form will accompany the samples to the laboratory. Copies of the chain-of-custody forms will be made prior to shipment (or multiple copy forms used) for field documentation. The chain-of-custody forms will remain with the samples at all times. The samples and signed chain-of-custody forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (i.e., UPS) or courier, or hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Whenever samples are split with another party or a government agency, a separate Sample Receipt will be prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the other party or agency should request the representative’s signature acknowledging sample receipt. If the representative is unavailable or refuses to sign, this should be noted in the "Received By" space.

Standard Operating Procedures – Chain-of-Custody, Handling, Packing, and Shipping

I. Scope and Application

This Standard Operating Procedure (SOP) describes the chain-of-custody, handling, packing, and shipping procedures for the delivery of samples that are protected from cross-contamination, tampering, misidentification, and breakage, and are maintained in a controlled environment from the time of collection until receipt by the analytical laboratory.

II. Personnel Qualifications

Field sampling personnel will have current health and safety training, including 40-hour training in accordance with the Occupational Safety and Health Administration (OSHA) Regulation 29CFR1910.120 (HAZWOPER), site supervisor training, current LPS training, and site-specific training, as needed. In addition, field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, will be available during chain-of-custody, handling, packing, and shipping procedures:

- indelible ink pens;
- polyethylene bags (resealable-type);
- clear packing tape, strapping tape, duct tape;
- custody seal evidence tape;
- appropriate sample containers, labels, and chain-of-custody forms;
- large (e.g., 30 to 40 gallon) insulated coolers;
- ice;
- cushioning and absorbent material (e.g., vermiculite);
- thermometer; and
- field notebook.

IV. Health and Safety Considerations

Follow health and safety procedures outlined in the Health and Safety Plan.

V. Chain-of-Custody Procedures

1. Prior to collecting samples, complete the chain-of-custody form header information by filling in the project number, project name, and the name(s) of the sampling technician(s). (Note: it is important that chain-of-custody information is printed legibly using indelible ink).

2. After sample collection, enter the individual sample information by filling in the following chain-of-custody fields:

A. STA. NO. - Indicates the station number or location that the sample was collected. Appropriate values for this field are described in the Work Plan.

B. Date - Indicates the date that the sample was collected. The date format to be followed should be mm/dd/yyyy (e.g., 03/07/2000).

C. Time - Indicates the time at which the sample was collected. The time value should be presented using the military format. For example, 3:15 P.M. should be entered as 15:15.

D. Comp - This field should be marked with an “X” if the sample was collected as a composite.

E. Grab - This field should be marked with an “X” if the sample was collected as an individual grab sample.

F. Station Location - This field should represent the complete sample name; although, in some instances it may be similar to the STA. NO. field. Please note that it is very important that the use of hyphens in sample names and the depth units (i.e., feet or inches) remain consistent for all samples entered on the chain-of-custody form. Sample names may also use the abbreviations “MS/MSD”, “FB”, “TB”, and “DUP” as prefixes or suffixes to indicate that the sample is a matrix spike/matrix spike duplicate, field blank, trip blank, or field duplicate, respectively.

G. Number of Containers - This field represents the number of containers that were collected at the sampling location to be submitted for analysis.

H. Analytical Parameters - The analytical parameters that the samples are being analyzed for should be written legibly on the diagonal lines to the right of the “number of containers” column. As much detail as possible should be presented to allow the analytical laboratory to properly analyze the samples. Multiple methods and/or analytical parameters may be combined for each column. These columns should also be used to present project specific parameter lists. Quality Assurance/Quality Control (QA/QC) information may also be entered in a separate column for each parameter (e.g., MS/MSD) to identify a sample that the laboratory is to use for a specific QA/QC requirement. Each sample that requires a particular parameter analysis will be identified by placing an “X” in the appropriate analytical parameter column.

I. Remarks - The remarks field should be used to communicate special analytical requirements to the laboratory. These requirements may be on a per sample basis such as “extract and hold sample until notified” or may be used to inform the laboratory of special reporting requirements for the entire sample delivery group (SDG). Reporting requirements that should be specified in the remarks column include: 1) turn around time, 2) contact and address where data reports should be sent, 3) name of laboratory project manager, and 4) type of sample preservation that was utilized.

J. Relinquished By - This field should contain the signature of the sampling technician that relinquished custody of the samples to the shipping courier or the analytical laboratory.

K. Date - Indicates the date that the samples were relinquished. The date format should be mm/dd/yyyy (e.g., 03/07/2000).

L. Time - Indicates the time that the samples were relinquished. The time value should be presented using the military format. For example, 3:15 P.M. should be entered as 15:15.

M. Received By - This field should contain the signature of the sample courier or laboratory representative that received the samples from the sampling technician.

3. Complete as many chain-of-custody forms as necessary to properly document the collection and transfer of the samples to the analytical laboratory.

4. Upon completion of the chain-of-custody forms, forward two copies to the analytical laboratory and retain one for the field records.

VI. Sample Handling Procedures

1. After completing the sample collection procedures, record the following information in the field notebook with indelible ink:

   - project number and site name;
   - sample identification code and other sample identification information, if appropriate;
   - sampling method;
   - date;
   - name of sampler(s);
   - time;
   - location (project reference); and
   - any comments.

2. Fill in sample label with the following information in indelible ink:

   - sample type (e.g., surface water);
   - project number and site name;
   - sample identification code and other sample identification information, if applicable;
   - analysis required;
   - date;
   - time sampled;
   - initials of sampling personnel;
   - sample type (composite or discrete); and
   - preservative added, if applicable.

3. Cover the label with clear packing tape to secure the label onto the container.

4. Check the caps on the sample containers to ensure that they are tightly sealed.

5. Wrap the sample container cap with clear packing tape to prevent it from becoming loose.

6. Place a signed custody seal label over the cap such that the cap cannot be removed without breaking the custody seal. Alternatively, if shipping several containers in a cooler, custody seal evidence tape may be placed on the shipping container as described below.

VII. Packing Procedures

1. Using duct tape, secure the outside and inside of the drain plug at the bottom of the cooler that is used for sample transport.
2. Place each container or package in individual polyethylene bags (resealable-type) and seal. If a cooler temperature blank is supplied by the laboratory, it should be packaged following the same procedures as the samples. If the laboratory did not include a temperature blank, do not add one, since the sample temperature will be determined by the laboratory using a calibrated infrared thermometer.

3. Place 1 to 2 inches of cushioning material (e.g., vermiculite) at the bottom of the cooler.

4. Place the sealed sample containers upright in the cooler.

5. Package ice or blue ice in small resealable-type plastic bags and place loosely in the cooler. Do not pack ice so tightly that it may prevent addition of sufficient cushioning material. Samples placed on ice will be cooled to and maintained at a temperature of approximately 4°C.

6. Fill the remaining space in the cooler with cushioning material.

7. Place the completed chain-of-custody forms in a large resealable-type bag and tape the bag to the inside of the cooler lid.

8. Close the lid of the cooler and fasten with packing tape.

9. Wrap strapping tape around both ends of the cooler.

10. Mark the cooler on the outside with the following information: shipping address, return address, “Fragile” labels on the top and on one side, and arrows indicating “This Side Up” (Attachment D-4) on two adjacent sides.

11. Place custody seal label over front right and back left of the cooler lid and cover with clear plastic tape.

(Note: Procedure numbers 2, 3, 5, and 6 may be modified in cases where laboratories provide customized shipping coolers. These coolers are designed so the sample bottles and ice packs fit snugly within preformed styrofoam cushioning and insulating packing material.)

VIII. Shipping Procedures

All samples will be delivered by within 48 hours of sample collection. Alternatively, a laboratory courier may be used for sample pickup. If parameters with short holding times are being analyzed, sampling personnel will take precautions to assure that the maximum holding times for these parameters will not be exceeded.

The following chain-of-custody procedures will apply to sample shipping:

- Relinquish the sample containers to the laboratory via express carrier (FedEx or UPS) or laboratory courier. The signed and dated forms should be included in the cooler. The express carrier will not be required to sign the chain-of-custody forms.

- When the samples are received by the laboratory, the laboratory personnel shall complete the chain-of-custody by recording the data and time of receipt of samples, measure and record the internal temperature of the shipping container, and then check the sample identification numbers on the containers to ensure that they correspond to the chain-of-custody forms.

IX. Data Recording and Management

Copies of chain-of-custody forms will be maintained in the project file.

X. References

Blasland, Bouck & Lee, Inc. 2006. *Health and Safety Plan - Newburgh Project*.

Blasland, Bouck & Lee, Inc. 2006. *Newburgh Project Pre-Design Investigation - Area A.*

REPORT

Health and Safety Plan

Central Hudson Gas & Electric Corporation
Poughkeepsie, New York

April 2006

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

Appendix B

Health and Safety Plan

Table of Contents

Tables

Attachments

Q Daily Safety Meeting Log

Approvals and Acknowledgements

Approvals

I have read and approved this *Health and Safety Plan* (HASP) with respect to project hazards, regulatory requirements, and BBL procedures.

Project Name: Central Hudson Gas & Electric Corporation – Newburgh Project – Newburgh, New York

Project Number: 205.37

_________________________________ ____________________________________

Project Manager/Date Health and Safety Officer/Date

____

Health and Safety Supervisor/Date

Acknowledgments

The final approved version of this HASP has been provided to the Site supervisor. I acknowledge my responsibility to provide the Site supervisor with the equipment, materials and qualified personnel to implement fully all safety requirements in this HASP. I will formally review this plan with the Health and Safety Staff every 6 months until project completion.

____

Project Manager/Date

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

____

Site Supervisor/Date

Health and Safety Plan Acknowledgement

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

Name (Print)	**Signature**	**Representing**	**Date**

1. Introduction

1.1 Objective

This *Health and Safety Plan* (HASP) supports activities to be performed by Blasland, Bouck & Lee, Inc. (BBL) at the Central Hudson Gas & Electric Corporation (CHGE) Newburgh Project in Newburgh, Orange County, New York.

Field activities include the following tasks:

- Mobilization and Land Survey
- Installation of Land-Based Groundwater Monitoring Wells and Soil Borings
- Installation of Water-Based Piezometers and Soil Borings
- Monitoring Well Development and Hydraulic Capacity Testing
- Land-Based Field Sampling
- Sediment Sampling
- Soil Excavation
- Equipment Decontamination
- Demobilization

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

1.2 Site and Facility Description

Field activities will be performed at the former Newburgh Manufactured Gas Plant (MGP) site and adjacent areas (Site). The Project Area is located in the city of Newburgh, Orange County, New York. The former MGP is bounded to the north by South William Street, to the east by South Water Street, to the south by Renwick Street, and to the west by South Colden Street. The former MGP is approximately 1.8 acres in size and is enclosed by a fence. Currently, CHGE operates a natural gas regulator station and a propane peaking plant at the former MGP.

The remainder of the Project Area is located primarily east of the former MGP. These areas are bounded to the north by South William Street, to the east by the Hudson River, to the south by property owned by the city of Newburgh and the southern edge of Renwick Street, and to the west by the eastern boundary of the former MGP. Features within these areas include: South Water Street, a railroad corridor operated by Consolidate Rail Corporation (Conrail), River Street, and the City of Newburgh Sewage Treatment Plant (STP).

Previous Site investigation activities have identified the presence of MGP-related materials (including oils, coal tar, tar-saturated wood chips, purifier waste, light non-aqueous phase liquid [LNAPL], and dense non-aqueous phase liquid [DNAPL]) and elevated concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and inorganic constituents in soil and groundwater. Benzene, ethylbenzene, toluene, and xylenes (BTEX) are the primary VOCs of concern, and polynuclear aromatic hydrocarbons (PAHs) are the primary SVOCs of concern.

1.3 Policy Statement

Blasland, Bouck & Lee, Inc.'s (BBL's) policy is to provide a safe and healthful work environment. No aspect of operations is of greater importance than injury and illness prevention. A fundamental principle of safety management is that all injuries, illnesses, and incidents are preventable. BBL will take every reasonable step to eliminate or control hazards to minimize the possibility of injury, illness, or incident.

This HASP prescribes the procedures that must be followed while performing Site activities. Operational changes that could affect the health and safety of personnel, the community, or the environment will not be made without prior approval of the project manager (PM) and the health and safety officer (HSO). This document will be reviewed periodically to confirm that it is current and technically correct. Any changes in Site conditions and/or the scope of work will require a review of and modification to this HASP. Such changes will be completed in the form of an addendum or a revision to the HASP.

The provisions of this HASP are mandatory for all BBL personnel and BBL subcontractors assigned to the project. Subcontractors may prepare their own site-specific HASP that must meet the basic requirements of this HASP. All visitors to BBL work areas at the Site must abide by the requirements of this HASP.

This HASP complies with applicable Occupational Safety and Health Administration (OSHA) regulations, United States Environmental Protection Agency (USEPA) *Standard Operating Safety Guidelines* (USEPA, 1992) and BBL's *Health and Safety Policies and Procedures Manual* (BBL, 2006). This HASP follows the guidelines established in the references listed in Section 1.5.

1.4 Definitions

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

- *Acceptable Entry Conditions* - Means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within.

- *Attendant* - Means an individual stationed outside on or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in.

- *Authorized Entrant* - Means an employee who is authorized by the employer to enter a permit space.

- *Blanking or Blinding* - Means the absolute closure of a pipe, line or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line or duct with no leakage beyond the plate.

- *Confined space* - means a space that:

  (1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and

(2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers)

(3) Is not designed for continuous human occupancy.

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

- *Emergency* - Any occurrence (including any failure of hazard control or monitoring equipment) or event (internal or external) that could endanger employees.

- *Engulfment* - means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

- *Entry* - The action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

- *Entry Permit* - The written or printed document that is provided by the employer to allow and control entry into a permit space.

- *Entry Supervisor* - Means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.

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

- *Hazardous Atmosphere* - Means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is escape unaided from a permit space), injury or acute illness from one or more of the following causes:

  (1) Flammable gas, vapor or mist in excess of 10% of its lower flammable/explosive limit (LFL/LEL);

  (2) Airborne combustible dust at a concentration that meets or exceeds its LEL. (NOTE: This concentration my be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m or less);

  (3) Atmospheric oxygen concentration below 19.5% or above 23.5%;

  (4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published; and

  (5) Any other atmospheric condition that is immediately dangerous to life or health.

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

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

- *Non-permit Confined Space* - A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm

- *Oxygen Deficient Atmosphere* - Means an atmosphere containing less than 10.5% oxygen by volume.

- *Oxygen Enriched Atmosphere* - Means an atmosphere containing more than 23.5% oxygen by volume.

- *Permit-required Confined Space* - Means a confined space that has one or more of the following characteristics:

  (1) Contains or has a potential to contain a hazardous atmosphere;

  (2) Contains a material that has the potential for engulfing an entrant;

  (3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

  (4) Contains any other recognized serious safety or health hazard.

- *Permit-required Confined Space Program* - Means the employer's overall program for controlling, and, where appropriate, for protecting employees from permit space hazards and for regulating employee entry into permit spaces.

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

- *Retrieval System* - The equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

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

- *Subcontractor* - Includes contractor personnel hired by BBL.

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

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

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

1.5 References

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

- *Standard Operating Safety Guides*, USEPA (Publication 9285.1-03, June 1992).
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, NIOSH, OSHA, USCG, USEPA (86116, October 1985).
- *Title 29 of the Code of Federal Regulations* (CFR), Part 1910.
- *Title 29 of the Code of Federal Regulations* (CFR), Part 1926.
- *Pocket Guide to Chemical Hazards*, DHHS, PHS, CDC, NIOSH (2003).
- *Threshold Limit Values*, ACGIH (2006).
- *Guide to Occupational Exposure Values*, ACGIH (2006).
- *Quick Selection Guide to Chemical Protective Clothing*, Forsberg, K. and S.Z. Mansdorf, 2nd Ed. (1993).
- *Health and Safety Policies and Procedures Manual*, BBL (2006).
- *Loss Prevention System Handbook*, BBL (2005)

2. Roles and Responsibilities

2.1 All Personnel

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

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

The roles of BBL personnel and subcontractors are outlined in the following sections. Key project personnel and contacts are summarized in Table 2-1.

TABLE 2-1
KEY PERSONNEL

Title/Role	Name	Address/Telephone Number
Key Central Hudson Gas & Electric Corporation Personnel		
CHGE Project Manager	Tera Stoner	284 South Avenue Poughkeepsie, NY 12601 Office: 845-486-5464 Cell: 845-518-7560
Key BBL Personnel		
Project Manager	Doug Weeks	25 Walker Way, Suite 3A Albany, NY 12205 (518) 452-7082, ext. 11 (914) 671-4858 (cell)
Health and Safety Supervisor	To Be Determined	
Site Supervisor	To Be Determined	
Health and Safety Officer	Jay D. Keough, CIH	8 South River Road Cranbury, NJ 08512 (609) 860-0590, ext. 101
Health and Safety Manager	Chuck Webster, CSP	6723 Towpath Road P.O. Box 66 Syracuse, NY 13214 (315) 446-2570, ext. 19297
Project Officer	Mark Gravelding, P.E.	6723 Towpath Road P.O. Box 66 Syracuse, NY 13214 (315) 446-2570, ext. 19235

2.2 Stop Work Authority

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

2.3 Short Service Employee (SSE) Program

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

- BBL employees new to the industry and new to BBL will be designated SSEs for 6 months.
- BBL employees experienced in the industry but new to BBL will be designated SSEs for 3-months.

Additionally, the following apply:

- A crew of two to three may have one SSE on-site;
- A crew of five may have two SSEs on-site; and
- A crew of 10 or more may have no more than three SSEs on-site.

2.4 BBL Personnel Responsibilities

2.4.1 Project Officer

The Project Officer (PO) is responsible for providing resources to assure project activities are completed in accordance with this HASP, and for meeting all regulatory and contractual requirements. The PO has the ultimate responsibility for Loss Prevention System (LPS) Stewardship. The LPS is a system to prevent or reduce losses using behavior-based tools and proven management techniques

2.4.2 Health and Safety Officer

The Health and Safety Officer (HSO) (or his designee, the Health and Safety Manager) has overall responsibility for the technical health and safety aspects of the project, including review and approval of this HASP. Inquiries regarding BBL health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSO or his designee must approve changes or addenda to this HASP. The HSO will provide the process measures for implementation of LPS.

2.4.3 Project Manager

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

- consult with the HSO on-site health and safety issues;
- verify that subcontractors meet health and safety requirements prior to commencing work;
- validate, via questioning, the performance of SPSAs;
- participate in LPO feedback sessions;
- review Incident Prevention Observation (LPO) forms;
- verify that all incidents are thoroughly investigated;
- report all Near-Misses to the HSO within 24 hours; validate that Near-Miss Investigation (NMI) corrective actions are implemented within the same time period;
- contact the PO immediately with 24 hours of notification of an injury or accident to schedule a Incident Investigation conference call;
- approve, in writing, addenda or modifications of this HASP; and
- suspend work or modify work practices, as necessary, for personal safety, protection of property, and regulatory compliance.

2.4.4 Health and Safety Supervisor

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

- provide on-site technical assistance, if necessary;
- participate in all incident investigations (IIs) and ensure that they are reported to the HSM/HSO, Client, PIC and PM immediately;
- report all Near-Misses to Project Manager within 24 hours; begin NMI immediately and implement corrective actions;
- coordinate Site and personal air monitoring as required, including equipment maintenance and calibration;
- conduct site safety orientation training and safety meetings;
- verify that BBL personnel and subcontractors have received the required physical examinations and medical certifications;

- review Site activities with respect to compliance with this HASP;
- maintain required health and safety documents and records;
- assist the SS in instructing field personnel on project hazards and protective procedures;
- validate, via questioning, the performance of SPSAs;
- participate in LPO feedback sessions; and
- review LPO forms.

For the purposes of confined space entries the HSS (or a person designated by the HSS) will act as the authorized entry supervisor. Authorized entry supervisors must be trained as entry supervisors and must:

- Know and understand the potential hazards associated with entry into the permit-required confined space, including information on the mode, signs, symptoms, and consequences of exposures to hazards potentially present in the confined space.
- Review and coordinate emergency communication and rescue assistance procedures with the authorized entrants, attendants, and rescue personnel.
- Coordinate confined space entry operations when contractor employees, subcontractor employees, or facility visitors may be conducting activities that may affect entry conditions inside a confined space or when facility employees may be conducting activities that will affect entry conditions inside a confined space when contractor employees, subcontractor employees, or facility visitors are conducting entry activities.
- Verify that the permit-required confined space entry permit is completed and contains the required information prior to authorizing entry.
- Verify that all conditions will allow for safe entry into the permit space prior to authorizing entry.
- Verify isolation of the permit space has been completed prior to authorizing entry (lockout/tagout, blanking, blinding, etc.).
- Verify that entry operations remain consistent with the parameters of the permit, and that safe entry conditions are maintained by initially verifying acceptable entry conditions and periodically monitoring entry activities.
- Cancel the entry permit and terminate entry activities if any of the following conditions exist:

  (1) Acceptable entry conditions are not present;

  (2) The attendant observes a conditions that is not allowed or addressed in the entry permit;

  (3) Attendant detects behavioral effects of hazard exposure;

  (4) A situation outside the space exists that could endanger the entrant(s);

(5) An uncontrolled hazard is detected within the permit space;

(6) The attendant must leave the work area or focus attention on something other than the permit space being entered; or

(7) Entry activities covered by the entry permit have been completed.

- Implement measures to return the confined space to pre-entry conditions and prevent entry by unauthorized personnel.
- Remove unauthorized personnel who are in and/or near the permit space.
- Review activities to be conducted by entrants into non-permit confined spaces to ensure that the activities do not create a potential hazard in the confined space.

The authorized entry supervisor may also serve as attendant, providing the entry supervisor is trained as an attendant and can adequately execute the associated duties.

2.4.5 Site Supervisor

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

- consult with the HSS on-site health and safety issues;
- conduct LPOs at the Site and complete the LPO forms;
- participate in all incident investigations (IIs) and ensure that they are reported to the HSS, HSM and PM immediately;
- report all Near-Misses to Project Manager within 24 hours; begin NMI immediately and implement corrective actions;
- validate, via questioning, the performance of SPSAs;
- stop work, as necessary, for personal safety, protection of property, and regulatory compliance;
- obtain a Site map and determine and post routes to medical facilities and emergency telephone numbers;
- notify local public emergency representatives (as appropriate) of the nature of the Site operations, and post their telephone numbers (i.e., local fire department personnel who would respond for a confined space rescue);
- observe on-site project personnel for signs of ill health effects;

- investigate and report any incidents to the HSS;

- verify that all on-site personnel have had applicable training;

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

- issue/obtain any required work permits (hot work, confined space, etc.).

2.5 Subcontractors

Subcontractors and their personnel must understand and comply with applicable regulations and Site requirements established in this HASP. Subcontractors may prepare their own site-specific HASP that must be consistent with the requirements of this HASP.

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

2.6 All On-site Personnel

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

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

All on-site personnel must perform a Safe Performance Self-Assessment (SPSA) prior to beginning each work activity. The SPSA process is presented in Section 4.1.1. This process must be performed prior to beginning each activity, and must be performed after any near-miss or other incident in order to determine if it is safe to proceed. On-site personnel will immediately report the following to the SS or HSS:

- personal injuries and illnesses no matter how minor;
- unexpected or uncontrolled release of chemical substances;
- symptoms of chemical exposure;
- unsafe or hazardous situations;
- unsafe or malfunctioning equipment;
- changes in Site conditions that may affect the health and safety of project personnel or the community;
- damage to equipment or property;
- situations or activities for which they are not properly trained; and
- near misses.

2.7 Visitors

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

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

2.8 Near-Miss Reporting

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

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

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

Callers will be prompted to provide the following information:

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

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

3. Project Hazards and Control Measures

3.1 Introduction

Field activities will include the following tasks:

- Mobilization and Land Survey
- Installation of Land-Based Groundwater Monitoring Wells and Soil Borings
- Installation of Water-Based Piezometers and Soil Borings
- Monitoring Well Development and Hydraulic Capacity Testing
- Land-Based Field Sampling
- Sediment Sampling
- Soil Excavation
- Equipment Decontamination
- Demobilization

3.2 Job Hazard Assessment

A job hazard assessment identifies potential safety, health, and environmental hazards associated with each type of field activity. Because of the complex and changing nature of field projects, supervisors must continually inspect the work site to identify hazards that may harm Site personnel, the community, or the environment. The SS must be aware of these changing conditions and discuss them with the HSS and the PM whenever these changes impact employee health, safety, the environment, or performance of the project. The SS will keep BBL and BBL subcontractor personnel informed of the changing conditions. A member of BBL's Corporate Health and Safety staff will write or approve addenda or revisions to this HASP as necessary. Specific JSAs for field activities are located in Attachment A.

3.3 Field Activities, Hazards, Control Procedures

The following sections discuss general safety hazards associated with specific field activities outlined in the scope of work for this project. BBL has also specified minimum safety precautions for various field activities. Each BBL subcontractor must review these activities and safety procedures with respect to their own standard safe operating procedures. Each subcontractor may utilize their own standard safe operating procedures provided the minimum requirements set forth in this HASP, 29 CFR 1910, and 29 CFR 1926 are met. Each subcontractor is responsible for operating in a safe and healthful manner in order to protect their personnel and all Site personnel.

3.3.1 Mobilization and Land Survey

Site mobilization and the land survey may include the following activities:

- Determine the location of any overhead or other physical hazards;
- Survey of sample locations;

- Establish work areas; and
- Identifying and locating surface and subsurface utilities and structures.

A break area will be set up outside of regulated work areas. Mobilization may involve clearing areas for the SZ and CRZ. During this initial phase, project personnel will walk the Site to confirm the existence of anticipated hazards and identify safety and health issues that may have arisen since the writing of this HASP.

3.3.1.1 Hazards

The hazards of this phase of activity are associated with:

- Manual materials handling;
- Installing temporary on-site facilities; and
- Manual site preparation.

Manual materials handling and manual site preparation may cause blisters, sore muscles, and joint and skeletal injuries; manual materials handling may also present eye, contusion, and laceration hazards. Installing temporary field office and support facilities may expose personnel to electrical hazards, underground and overhead utilities, and physical injury due to manually lifting and moving materials. Conducting a subsurface structure investigation presents slip/trip/fall exposures as well as the potential for contact with various flora and fauna. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces, and unstable soil.

Environmental hazards include:

- Plants, such as poison ivy and poison oak;
- Aggressive fauna, such as ticks, fleas, mosquitoes, wasps, spiders, and snakes;
- Weather, such as sunburn, lightning, rain, and heat- or cold-related illnesses; and
- Pathogens, such as rabies, Lyme disease, and blood-borne pathogens.

3.3.1.2 Control

In the event that work must be conducted in close proximity to a public roadway, site personnel must isolate the work area with barricades, signs, cones, caution tape, or other appropriate means to alert passing motorists to the presence of an active work area. Also, personnel who are exposed to vehicular traffic must wear an outer layer of orange warning garments, such as vests, jackets, or shirts. If work is performed in darkness, workers will be outfitted with reflective garments in either orange, white (including silver-coated reflective coatings or elements that reflect white light), yellow, fluorescent red-orange, or fluorescent yellow-orange.

Additional control procedures are discussed in Section 4, General Safety Practices.

3.3.2 Installation of Land-Based Groundwater Monitoring Wells and Soil Borings

This task will consist of installing soil borings, monitoring wells, and/or piezometers at various locations at the Site. Following installation of groundwater monitoring wells, the wells will be developed using standard operating procedures. Installing soil borings to collect soil samples may involve the use of conventional drill rig or direct-push-type boring equipment (Geoprobe® or equivalent). The equipment poses a hazard if it is not properly operated. Direct-push equipment is hydraulically powered and uses static force and dynamic percussion force to advance small-diameter sampling tools. The presence of overhead utilities and underground obstacles poses a hazard if boring equipment contacts them. As the hazards are similar to those encountered when using a conventional drill rig, the required control procedures are also the same as a conventional rig and are included in the following sections.

3.3.2.1 Drilling Hazards

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

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

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

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

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

3.3.2.2 Drilling Safety Procedures

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

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

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

- vehicle condition;
- proper storage of equipment;
- condition and/or operation of all controls, wire rope, and hydraulic lines;

- fire extinguisher; and
- first aid kit.

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

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

Control of vehicular traffic hazards is presented in Section 4.10 - Traffic Safety.

Combustible gas readings of the general work area will be made regularly (see Section 8 - Site Monitoring).

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

Personnel shall not be permitted to ride the traveling block or elevators, nor will the cat line be used as a personnel carrier.

Overhead Electrical Clearances: If drilling is conducted in the vicinity of overhead power lines, the lines must be de-energized, or the equipment must be positioned such that no part, including the rig boom can come within the minimum clearances as follows:

TABLE 3-1
MINIMUM OVERHEAD ELECTRICAL CLEARANCES (ALL EQUIPMENT)

Nominal System Voltage	Minimum Required Clearance
0-50kV	10 feet
51kV-100kV	12 feet
101kV-200kV	15 feet
201kV-300kV	20 feet
301kV-500kV	25 feet
501kV-750kV	35 feet
751-1000kV	45 feet

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

Rig Setup: The driller shall inspect all proposed well sites prior to drilling operations to verify a stable surface exists for the setup of the drill rig. This is especially important in areas where soft, unstable terrain is common.

All rigs will be properly blocked and leveled prior to raising the derrick. Blocking provides a more stable drilling structure by evenly distributing the weight of the rig. Proper blocking ensures that differential settling of the rig does not occur. When the ground surface is soft or otherwise unstable, wooden blocks, at least 24 inches by 24 inches and 4 inches to 8 inches thick, shall be placed between the jack swivels and the ground. The emergency brake shall be engaged, and the wheels that are on the ground shall be chocked.

Hoisting Operations: Drillers shall not engage the rotary clutch without watching the rotary table, and ensuring it is clear of personnel and equipment.

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

Auger strings or casing shall be picked up slowly.

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

The driller shall test the brakes on the cable hoist mechanism of the drill rig each day. The brakes shall be thoroughly inspected by a competent individual each week.

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

Workers shall not stand near the borehole whenever any wire line device is being run.

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

Cat Line Operations: Only experienced personnel will be allowed to operate the cat head controls. The kill switch must be clearly labeled and operational prior to operation of the cat line. The cat head area must be kept free of obstructions and entanglements.

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

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

Employees rigging loads on cat lines shall:

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

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

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

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

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

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

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

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

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

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

Auger Handling: Auger sections shall be transported by cart or carried by two persons. Individuals should not carry auger sections without assistance. Personnel carrying augur sections shall use proper lifting techniques.

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

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

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

3.3.3 Monitoring Well Development and Hydraulic Capacity Testing

Field operations will consist of developing the well after installation to remove material or contaminants from the well prior to its being placed in service. Hydraulic capacity testing will then be performed to determine subsurface conditions.

3.3.3.1 Hazards

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

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

3.3.3.2 Control

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

3.4 Field Sampling

The following field sampling activities will be undertaken during this project:

- Groundwater sampling and NAPL monitoring/recovery.
- Land-based soil sampling.
- Water-based soil, sediment, and surface water sampling.

This section describes the hazards and controls associated with each of these field sampling activities.

3.4.1 Groundwater Sampling and NAPL Monitoring/Recovery

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

3.4.1.1 Hazards

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

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

3.4.1.2 Control

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

3.4.2 Land-based Soil Sampling

This task will include the collection of soil samples from soil borings and/or test pits. The physical hazards of these operations are primarily associated with the sample collection methods and procedures used. Soil samples will be taken via shovel or trowel from the surface samples and either out of the excavator bucket or from a spoil pile for the test pits. In addition, personnel may be exposed to hazards associated with working in or near excavations and heavy equipment.

3.4.2.1 Hazards

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

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

3.4.2.2 Control

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

3.4.3 Water-based Sediment/Water Column Sampling

Water-based sediment and water-column sampling operations involve collecting samples for subsequent laboratory analysis. The physical hazards of water-based soil sampling related to soil borings are primarily associated with the sample collection methods, drill rigs, procedures used, and the environment itself. Working on or near water also presents the risk of drowning, if proper procedures are not instituted. The physical hazards of sediment sampling are primarily associated with the sample collection methods, procedures used, and the environment itself. Working on or near water also presents the risk of drowning, if proper procedures are not instituted. Water-based soil sampling will be performed either from a barge with a drill rig. Water column sampling will be done either from within the creek with the technician wearing waders or, from the banks of the creek and/or bridge crossings. Sediment probing and sampling will be performed either from within the creek by personnel wearing waders or from a boat.

3.4.3.1 Hazards

Inhalation and absorption of COCs through the skin are the primary routes of entry associated with water-based soil, sediment and water-column sampling due to the manipulation of sample media and equipment, manual transfer of media into sample container, and proximity of operations to the breathing zone. The primary hazards associated with specific sampling procedures are not potentially serious; however, other operations in the area or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with sediment sampling procedures are generally limited to strains or sprains and potential eye hazards. Potential chemical hazards may include contact with media (water and sediment/soil) containing Site COCs and potential contact with chemicals used for equipment decontamination. In addition to the safety hazards specific to sample collection, hazards associated with working on, in, or near water or in a boat or barge will be a concern. Of particular concern may be boating safety, drill rigs operation (see section 3.5.1), utilities installed in the river, and operation of other support equipment.

The flora and fauna of the Site may present hazards of poison ivy, poison oak, ticks, fleas, mosquitoes, wasps, spiders, and snakes. Poisonous snakes, including water moccasins, likely inhabit the waterways at the Site. The work area presents slip, trip, and fall hazards from irregular walking surfaces, particularly near the creek banks, which are steep in places and have the potential to be wet. Precipitation may cause wet, muddy, slick walking surfaces and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

3.4.3.2 Controls

To control dermal exposure during sediment sampling activities, a minimum of Level D protection will be worn. To protect against snake bites, waders resistant to penetration or appropriate snake boots must be worn. If necessary, based on field observations and Site conditions, air monitoring may be conducted during sediment sampling activities. If the results of air monitoring indicate the presence of airborne contaminants in a concentration causing concern, the work will be suspended and the PM will be notified. Section 6.1, Air Monitoring, describes air monitoring requirements and action levels. Each level of personal protection is described in Section 5, Personal Protective Equipment. Control procedures for environmental and general hazards are discussed in Section 4, General Safety Practices. Section 3.7 provides general safety procedures for boat-based sampling, wader use, and working near water. In addition, the items on the Sediment/Surface Water Sampling Checklist (Attachment C) must be addressed and the checklist must be in the possession of the SS prior to initiating water-based soil, sediment or water-column sampling activities. Utilities will be cleared in the river, if present, by contacting Dig Safely New York prior to mobilization. Any utilities that may be present will be clearly demarcated prior to drilling activities.

3.5 Water and Boating Hazards and Safety Precautions

BBL personnel working over, adjacent to, or near water (within 6 feet of the edge), where the danger of drowning exists, must wear a United States Coast Guard- (USCG-) approved life jackets or buoyant work vests. Prior to and after each use, the buoyant work vests or life preservers must be inspected for defects that would alter their strength and buoyancy. Defective units must be removed from service. Ring buoys and/or emergency throw lines with at least 50 feet of line must be provided and readily available of emergency rescue operations. Distance form lifesaving devices must not exceed 200 feet. At least one boat must be immediately available at locations where employees are working over or adjacent to water.

Working from a boat presents the obvious hazard of drowning, but several other hazards exist. Powered craft carry a fuel supply, with the potential for fire or explosion if vapors accumulate and reach an ignition source. Weather, currents, and other watercraft may also pose significant hazards to the crew.

In land-based field operations, proper training and equipment are essential to completing a project efficiently and safely. This also holds true for operations conducted on or adjacent to bodies of water. BBL is strongly committed to familiarizing all employees that operate boats or conduct work adjacent to bodies of water with the hazards of water operations and the proper protective measures that must be taken to prevent injury. This section outlines the precautions that will be taken to maintain the safety of BBL personnel.

Should a small craft advisory or warning be posted by the National Weather Service, all working vessels will immediately return to shore. Likewise, if a warning or advisory is already in place at the start of the day, on-boat work will not be commenced until the advisory or warning has expired.

At a minimum, each employee working from a boat is required to participate in a boating safety training session conducted during the daily safety meeting. The training session must provide instruction on the following topics:

- Proper boat and safety equipment inspections;
- Content and frequency of equipment safety inspections;
- Proper use of on-board safety equipment (e.g., fire extinguisher, radio or cellular phone, flares, horn);
- Appropriate boating “rules-of-the-road;”

- Emergency procedures in the event of capsizing or being thrown overboard; and
- Different types of personal floatation devices (PFDs), and their proper inspection and use.

Prior to each day or shift of operations, a boat inspection must be conducted by the boat operator/skipper/SS. This inspection must be conducted in accordance with applicable state boating safety inspection procedures. See Attachment D for the vessel inspection checklist. The inspection must verify that necessary safety equipment is aboard, functioning properly, and that all crew members are aware of proper procedures that are to be followed on the water. In addition, this information must be reviewed during the daily tailgate safety meeting to confirm that the procedures have been followed and all crew members are satisfied as to its completion.

It will be the responsibility of the SS to confirm that daily boat and equipment inspections are completed and documented, daily tailgate safety meetings are conducted and daily float plan (Attachment E) is filed. The following safety procedures must be observed at all times:

- Boat(s) must not be overloaded with equipment or personnel.
- Loads must be distributed evenly throughout the boat.
- PFD Types I, II, or III must be worn at all times when working on or adjacent to the water.
- All PFDs must be properly inspected to confirm that appropriate USCG approvals and ratings information is available.
- At least one Type IV PFD (seat cushion, ring buoy) must be available on board.
- An audible signal or alarm (capable of being heard up to ½ mile away) must be maintained in each boat.
- Each boat must be equipped with a ship-to-shore radio, cellular phone, and/or “walkie-talkie” capable of contacting the onshore station to call for help in an emergency.
- Each boat must be equipped with some type of visual display signal or device (e.g., flares or appropriate distress flag).
- All powerboats must have a valid state registration. This registration must be maintained on the boat and, as necessary, be made available for inspection.
- At a minimum, each powerboat must be equipped with a Type 4-A, 10-B, C-rated fire extinguisher.
- Boats must not be operated at night without proper lighting and the capability for making visual distress signals.

In addition to PFDs, personnel who are working in boats over water when water temperatures are below 50ºF must be equipped with proper thermal-protective clothing. The thermal-protective clothing must be adequate to protect personnel from hypothermic effects of immersion in water at the temperatures encountered. Water-proof clothing should be worn if possible to keep personnel dry during the operations.

3.6 Soil Excavation

During field activities, BBL personnel may be working in areas of active excavations. Excavation activities will be conducted in accordance with this section, and appropriate federal and state regulations.

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

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

The following control procedures are required during soil sampling activities:

- Activities must be performed without entering the excavation whenever feasible.
- Noise also may present a hazard. Heavy equipment operation frequently results in noise levels exceeding 85 dBA, requiring the use of hearing protection.
- At the end of each workday, open excavations will be backfilled and equipment will be moved to a location away from high-voltage electrical equipment and away from routes necessary to access high-voltage electrical equipment.
- Airborne concentrations of COC in the Site soil and the dust from the excavation procedure pose the potential for inhalation exposure. PPE for this phase is described in Section 5, Personal Protective Equipment. Airborne particulate generation will be controlled during excavations. Dry, dusty soil will be wetted with a water spray from a potable water source to control the generation of dust. Soil will not be wetted to a degree that will cause runoff or erosion.
- Before excavation activities commence, the existence and location of underground pipe, electrical equipment, and gas lines must be determined. The Dig Safely New York must be contacted at least 1 week, but no more than 2 weeks, prior to subsurface activities. The SS will meet with electrical and CHGE natural gas locators on-site prior to marking out the underground utilities. During this meeting, the SS will provide the electric and natural gas locators with a Site figure that shows the locations where excavation and drilling activities will be completed. The SS will conduct a Site walkover with the electrical and natural gas locators to visually identify each location where excavation and drilling activities are to be completed during Site operations. The Underground/Overhead Utility Checklist (see Attachment B) must be used to document that nearby utilities have been marked on the ground, and that the excavation and drilling areas have been cleared. The completed Underground/Overhead Utility Checklist will be in the possession of the SS prior to commencing any intrusive investigation.
- If excavation operations are located near underground installations, the exact location of the installations must be determined by safe and acceptable means. Subsurface work conducted near expected utility locations will be conducted with a hand auger or shovel until utilities can be located. While the excavation is open, underground installations must be protected, supported, or removed as necessary to safeguard employees.

3.6.1 Inspections by a Competent Person

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

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

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

3.6.2 Soil Classification

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

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

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

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

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V). Short-term exposure means a period of time less than or equal to 24 hours that an excavation is open. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from Table 3-2, below. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope that is at least one-half horizontal to one vertical (½H:1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope and confirm that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P, Appendix B.

TABLE 3-2
MAXIMUM ALLOWABLE SLOPES
(29 CFR 1926 SUBPART P APPENDIX B)

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

(Source: Table B-1, 29 CFR 1926 Subpart P Appendix B, Maximum Allowable Slopes.)

Notes:

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

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

[3] A short-term maximum allowable slope of ½H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be ¾H:1V (53°).

3.6.3 Overhead Electrical Clearances

If excavation activities are conducted in the vicinity of overhead power lines, the power to the lines must be de-energized, tested de-energized, marked up, and guaranteed, or the equipment must be positioned such that no part, including the excavation boom, can come within the minimum clearances outlined in Table 3-1.

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

3.6.4 Excavation Entry Procedure

BBL Employees will not enter any excavations. All sampling will be done without entry into the excavation (e.g., out of the excavator bucket).

3.6.5 Heavy Equipment Operation

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

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

Audible Alarms

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

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

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

Equipment Inspection and Maintenance

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

- service brakes, including trailer brake connections;
- parking system (hand brake);
- emergency stopping system (brake);

- tires;
- horn;
- steering mechanism;
- coupling devices;
- seat belts;
- operating controls; and
- safety devices.

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

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

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

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

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

Equipment Parking and Loading

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

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

Equipment Fueling

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

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

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

Additional Safety Requirements

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

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

- Prior to operating any heavy equipment, the authorized operator must conduct a pre-operation inspection to determine if the heavy equipment is in safe operating condition prior to each work shift.
- All mobile equipment must be equipped with an audible back-up alarm.
- Personnel will not be allowed to stand or pass under the elevated portion of any heavy equipment, whether loaded or empty.
- Personnel will not place arms and legs between pinch or scissor points of the equipment, or outside the operator enclosure.
- A safe distance must be maintained from the edge of excavations, ditches, ramps, or platforms.
- Operators will maintain sufficient clearance under overhead utilities, installations, lights, pipes, etc.
- Heavy equipment must never be used for lifting or transporting personnel.
- The operator is required to look in the direction of, and maintain a clear view of the path of travel.
- Heavy equipment must not be operated without an overhead guard and roll-over protection to protect the operator against falling objects and equipment roll-over.
- Heavy equipment must not be driven up to anyone standing in front of any object.
- Stunt driving and horseplay are strictly prohibited.
- Operators will yield the right-of-way to other Site vehicles.

- Other heavy equipment traveling in the same direction at intersections, blind spots, or other dangerous locations, must not be passed.

- A safe distance must be maintained from other heavy equipment, and the equipment must be kept under control at all times.

- The heavy equipment operator must slow down for wet and slippery conditions. Under all travel conditions, the equipment will be operated at a speed that will permit it to be brought to a stop safely.

- Operators will avoid running over loose objects on operating surfaces.

- Grades and ramps must be ascended and descended slowly.

- On all grades, the load will be tilted back and raised only as far as necessary to clear the operating surface.

- The operator will slow down and sound the horn at intersections, when entering buildings, and other locations where vision may be obstructed.

- If the load being carried obstructs forward view, the operator will travel with the load trailing.

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

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

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

3.7 Confined Space Entry Procedures

A confined space is defined as a space large enough or so configured that an employee can bodily enter and perform assigned work, has limited means for entry or exit, and is not designed for continuous employee occupancy. Some confined space work may pose additional hazards such as air contamination, flammable or explosive atmospheres, oxygen deficiency, and engulfment. Personnel must be properly trained in order to supervise and participate in confined space entry procedures or serve as standby attendants.

3.7.1 Confined Space Entry Attendant

The confined space entry attendant is responsible for implementation of this HASP in relation to permit required confined spaces, including communication of Site requirements to all on-site project personnel (including subcontractors). Other responsibilities include:

- Consultation with the HSS on Site safety and health issues;
- Completion of a LPO during confined space activities.

Personnel who are authorized to serve as attendants for entry into permit-required confined spaces will receive training concerning the specific duties which they will be required to execute as defined below. Training is required prior to participation in entry operations.

Authorized Attendants must:

- Know and understand the potential hazards associated with entry into the permit-required confined spaces, including information on the mode, signs, symptoms, and consequences of exposures to hazards potentially present in the space.
- Be stationed and remain stationed outside of the permit space at all times during entry activities unless relieved by another authorized attendant.
- Maintain an accurate count of all authorized entrants in the permit space.
- Maintain constant visual, verbal, and/or radio contact with all authorized entrants in the confined space.
- Monitor activities inside and outside of the confined space to assure acceptable entry conditions are maintained and the continued safety of authorized entrants.
- Order evacuation of the confined space if any of the following occur:
  - (1) A hazard develops inside or outside of the permit space that could endanger the entrant(s);
  - (2) The attendant observes behavioral effects of hazard exposure among entrant(s);
  - (3) Attendant observes a condition that is not allowed or addressed in the entry permit;
  - (4) A situation outside the space exists that could endanger the entrant(s);
  - (5) An uncontrolled hazard is detected within the permit space;
  - (6) The attendant must leave the work area or focus attention on something other than the permit space being entered; or
  - (7) Entry activities covered by the entry permit have been completed.
- Prevent the unauthorized entry and remove unauthorized personnel from in and/or near the permit space.

- Summon rescue or other emergency services immediately upon determining that an emergency situation exists.

- Never attempt to rescue entrants by entering a confined space. Authorized attendants may only attempt non-entry retrieval with the use of retrieval devices.

3.7.2 Confined Space Entrant

Other than the obvious duty of completing assigned work activities the duties of an entrant must:

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

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

- Alert the attendant whenever:

  (1) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation; or
  (2) The entrant detects a prohibited condition.

- Exit from the permit-required confined space (permit space) as quickly as possible whenever:

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

3.7.3 Confined Space Identification and Designation

The BBL Confined Space Entry Supervisor/HSS is responsible to confirm the location of all designated confined and permit required confined spaces, as well as identifying spaces that BBL may deem confined or permit-required confined spaces. Entry is considered to have occurred as soon as any part of the entrant’s body breaks the plane of an opening into the space. The client is responsible to identify and provide information as to contents, expected atmosphere, and rescue procedures for all confined spaces on his/her property. If a space is not considered permit required by the client but meets the criteria of this procedure, it shall be considered permit required for BBL-managed entries.

A space meets the criteria of a confined space if it is large enough and so configured that an employee can bodily enter and perform assigned work, and has limited or restricted means for entry or exit. A space meets the criteria of a permit-required confined space if it contains or has a potential to contain a hazardous atmosphere, contains a material that has the potential for engulfing an entrant, has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section, and contains any other recognized serious safety or health hazard.

The permit-required confined spaces for this project may include (but are not limited to) catch basins, sumps, crawl-spaces, enclosures/pits, outfalls, and drains.

3.7.4 Procedures for Confined Space Entry

Acceptable Entry Conditions - The acceptable entry conditions for each entry are outlined in Table 6-1.

Isolation Requirements - If isolation is not practical or possible, therefore, entry conditions must be continuously monitored.

Atmospheric Hazard Control - Atmospheric hazards must be eliminated or controlled to meet the requirements specified in Table 6-1. Ventilation equipment may be needed to maintain these conditions.

Inspecting and Testing Procedures – A Muliti RAE™ instrument with a PID, oxygen, LEL, carbon monoxide, and hydrogen sulfide sensors shall be available for testing each confined space.

Equipment shall be maintained and calibrated as listed in Section 6, Air Monitoring

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

Permit-required confined spaces shall be tested continuously to detect if conditions change. Priority for atmospheric hazard testing shall be Oxygen, combustible gases, the toxic gases.

Communications - Provisions for continuous communication between entrants and attendants shall consist of powered communication equipment (radios/closed circuit television) or remaining within visual and verbal contact at all times.

Personal Protective Equipment (see Section 5, Personal Protective Equipment for PPE descriptions)

- Level D Minimum.

- A chest or parachute harness with approved lifelines at least ½ inch in diameter and rated at 2000 lbs. minimum. All life-lines shall be secured to a mechanical device or fixed point outside the confined space. Mechanical devices shall be used for all vertical entry permit spaces greater than five (5) feet deep.

3.7.5 Permit System

If a space meets the criteria of a permit-required confined space then a permit must be completed. Before entry is authorized, the HSS will ensure that the Confined Space Entry Permit (Attachment G) and the client's Confined Space Entry Permit (if required) is completed. The HSS will complete the Confined Space Entry Checklist (Attachment H) to document that all pre-entry requirements have been met and that acceptable entry conditions exist.

All permits are valid for a maximum of one (1) work shift, and shall be cancelled by the HSS when the shift ends, confined space operations are complete, or whenever a prohibited condition arises in or near the space. All spaces shall be securely closed or barricaded whenever the permit is cancelled. Each permit must be completely executed and include all required information listed on the permit.

3.7.6 Emergency Procedures

BBL will comply with client emergency contact procedures Listed in Section 9 Emergency Procedures.

3.7.7 Specialized Training for Confined Spaces

Prior to assignment to confined space entry work, all employees shall receive training in the hazards of confined spaces, work practices to control these hazards and duties to be performed. Employee proficiency shall be established by testing and/or practical demonstration. Additionally, all personnel must attend the client's safety training.

Entrants, attendants and supervisors will attend a training course fulfilling the requirements of 29CFR 1910.146, which include:

- How to identify confined and permit required confined spaces;
- Instruction in calibration, operation, and use of air monitoring equipment;
- Instruction in non-entry rescues;
- Duties and responsibilities of client's, entrants, attendants and supervisors; and
- Emergency procedures.

3.8 Equipment Decontamination

All equipment is decontaminated before leaving the Site. In addition, all operations that have the potential to generate or release hazardous material will be conducted in a controlled area using the appropriate engineering controls. Specific decontamination techniques will be established based on Site conditions. Decontamination procedures will be reviewed with all personnel on-site. A decontamination pad on a suitable surface with polyethylene sheeting or other appropriate containment system will be established. Pressure washing with manual scrub brushing as needed will be used to decontaminate equipment. COC-impacted equipment will be determined "clean" by visually inspecting all equipment.

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

Personnel involved in decontamination activities may be exposed to skin contact with contaminated materials and chemicals brought to the Site as part of the project work. All personnel will review the operating procedures and PPE prior to decontamination. Personnel involved in decontamination activities must wear PPE that is appropriate for the task, and no more than one level below the level worn by personnel working in the EZ.

3.9 Demobilization

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

3.9.1 Hazards

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

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

3.9.2 Control

Control procedures for these hazards are discussed in Section 4.

3.9.3 Chemical Hazards

The chemical hazards associated with Site operations are related to inhalation, ingestion, and skin exposure to Site COCs including PAHs (coal tar pitch volatiles), and BTEX.

Concentrations of airborne COCs during Site tasks may be measurable, and will require air monitoring during intrusive operations. Air monitoring requirements for Site tasks are outlined in Section 6.1.

Hexane, Nitric Acid, Hexanol, detergents and degreasers will be used to decontaminate equipment and sampling apparatus. These materials also present dermal and inhalation exposure hazards.

The potential for inhalation of Site COCs is moderate. The potential for dermal contact with soil containing Site COCs during soil sampling operations is moderate. Material Safety Data Sheets (MSDS) for the COCs are included in Attachment I. The Chemical Hazard Information Table located at Attachment J lists the chemical, physical, and toxicological properties of major Site COCs.

4. General Safety Practices

4.1 General Safety Rules

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

- At least one copy of this HASP must be in a location at the Site that is readily available to personnel, and all project personnel shall review the plan prior to starting work.

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

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

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

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

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

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

- Remove PPE as required in the CRZ to limit the spread of COCs.

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

- Removing soil containing Site COCs from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air is prohibited.

- Inspect all non-disposable PPE for contamination in the CRZ. Any PPE found to be contaminated must be decontaminated or disposed appropriately.

- Recognize emergency signals used for evacuation, injury, fire, etc.

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

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

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

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

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

- The presence or consumption of alcoholic beverages or illicit drugs during the workday, including breaks, is strictly prohibited. If you must take prescription or over the counter medications that indicate precautions against operating heavy equipment or the potential for drowsiness you should notify your supervisor.

- Remain upwind during Site activities whenever possible.

4.1.1 Job Safety Analysis

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

4.1.2 Safe Performance Self-Assessment

All on-site personnel are required to perform a Safe Performance Self-Assessment (SPSA) prior to beginning any activity. This three-step process requires each individual to:

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

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

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

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

- *act* to control the risk and perform the task safely.

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

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

4.1.3 Incident Investigation

An incident is any of the following events: first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions. All incidents shall be investigated within 24 hours and reported to the PM, the PO and the HSO. In the event that one of those individuals cannot be contacted, a voice message should be left and the next individual in the chain should be contacted. Follow-up with the absent individual should occur as soon as possible (refer to the flowchart below).

The purpose of an Incident Investigation (II) is to prevent the recurrence of a similar hazardous event. An II ensures that all incidents are investigated in the same manner. Using the information gathered during an II, appropriate measures will be taken to protect personnel from the hazard in question. The Incident/Near Miss Investigation Form is included as Attachment K.

4.1.4 Loss Prevention Observations

The SS or the HSS will perform Loss Prevention Observations (LPOs). An LPO form is provided as Attachment L. The purpose of an LPO is to identify and correct potential hazards, and to positively reinforce behaviors and practices that are correct. The SS or HSS must identify potential deviations from safe work practices that could possibly result in an incident, and take prompt corrective action. The LPO process steps are:

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

4.2 Buddy System

On-site personnel must use the buddy system as required by operations. Use of the “buddy system” is required during all operations requiring Level C to Level A PPE, and when appropriate, during Level D operations.

Crew members must observe each other for signs of chemical exposure, and heat or cold stress. Indications of adverse effects include, but are not limited to:

- changes in complexion and skin coloration;
- changes in coordination;
- changes in demeanor;
- excessive salivation and pupillary response; and
- changes in speech pattern.

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

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

- headaches;
- dizziness;
- nausea;
- blurred vision;
- cramps; and
- irritation of eyes, skin, or respiratory tract.

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

4.3 Heat Stress

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

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

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

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

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

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

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

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

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

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

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

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

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

4.3.1 Heat Stress Safety Precautions

Heat stress monitoring and work rest cycle implementation should commence when the ambient adjusted temperature exceeds 72°F. Screening criteria for heat stress exposure are described in Table 4-1 and examples of activities within metabolic rate categories are provided in Table 4-2.

TABLE 4-1
SCREENING CRITERIA FOR HEAT STRESS EXPOSURE
(FOR 8-HOUR WORK DAY FIVE DAYS PER WEEK WITH CONVENTIONAL BREAKS)

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

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

TABLE 4-2

EXAMPLES OF ACTIVITIES WITHIN METABOLIC RATE CATEGORIES

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

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

4.3.1.1 Heat Stress Safety Precautions

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

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

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

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

4.4 Cold Stress

Cold stress normally occurs in temperatures at or below freezing, or under certain circumstances in temperatures of 40°F. Extreme cold for a short time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death. Body areas that have high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible. Two factors influence the development of a cold-weather injury: ambient temperature and wind velocity. For instance, a temperature of 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at 18°F. An equivalent chill temperature chart relating the actual dry-bulb temperature and wind velocity is presented in Table 4-3, below.

Table 4-3
CHILL TEMPERATURE CHART

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

(This chart was developed by the U.S. Army Research Institute of Environmental Medicine, Natick, MA [Source: ACGIH *TLV Handbook, ACGIH, 2002a*]).

Local injury resulting from cold is included in the generic term "frostbite." There are several degrees of tissue damage associated with frostbite. Frostbite of the extremities falls into the following categories:

- *Frost Nip or Incipient Frostbite*—Characterized by sudden blanching or whitening of skin.

- *Superficial Frostbite*—Skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.

- *Deep Frostbite*—Tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. It can be fatal. Its symptoms are usually exhibited in five stages:

1) Shivering;

2) Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F;

3) Unconsciousness, glassy stare, slow pulse, and slow respiratory rate;

4) Freezing of the extremities; and

5) Death.

Trauma sustained in freezing or sub-zero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing for first-aid treatment. To avoid cold stress, site personnel must wear protective clothing appropriate for the level of cold and physical activity. In addition to protective clothing, preventive safe work practices, additional training, and warming regimens may be used to prevent cold stress.

4.4.1 Cold Stress Safety Precautions

The following safety precautions should be followed to prevent cold stress:

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

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

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

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

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

4.4.2 Safe Work Practices

The following safe work practices must be employed to prevent cold stress:

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

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

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

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

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

4.5 Biological Hazards

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

4.5.1 Tick Borne Diseases

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

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

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

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

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

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

4.5.2 Poisonous Plants

Poisonous plants such as poison ivy, poison oak, and poison sumac may be present in the work area. Personnel should be alerted to its presence, and instructed on methods to prevent exposure.

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

4.5.3 Snakes

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

Control – To minimize the threat of snakebites, personnel walking through vegetated areas must be aware of the potential for encountering snakes, and the need to avoid actions that increase the potential for encounters, such as turning over logs and placing hands in dark places such as behind equipment or in corners of equipment sheds or enclosures. If a snakebite occurs, an attempt should be made to safely identify the snake via size, color, and markings. The victim must be transported to the nearest hospital within 30 minutes; first aid consists of applying a constriction band, and washing the area around the wound to remove any unabsorbed venom.

4.5.4 Spiders

Personnel may encounter spiders during work activities.

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

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

4.5.5 Mosquitoes

Personnel may be exposed to mosquitoes during work activities.

Typical exposure to mosquitoes does not present a significant hazard. However, if West Nile virus is prevalent in the area, exposure to this virus is increased. West Nile virus results in flu-like symptoms and can be serious if not treated or if it occurs in immune-compromised individuals. There have been confirmed cases of West Nile virus in the Northeast.

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

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

If dead birds are detected near the Site, report them to the local County Health Department. If flu-like symptoms are present, contact your doctor or the Health and Safety Officer for more information.

4.6 Noise

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

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

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

4.7 Spill Control

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

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

4.8 Sanitation

Site sanitation will be maintained according to OSHA requirements.

4.8.1 Break Area

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

4.8.2 Potable Water

The following rules apply to all field operations:

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

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

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

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

4.8.3 Sanitary Facilities

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

4.8.4 Lavatory

If permanent toilet facilities are not available, an appropriate number of portable chemical toilets will be provided. This requirement does not apply to mobile crews or to normally unattended Site locations so long as employees at these locations have transportation immediately available to nearby toilet facilities.

4.9 Emergency Equipment

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

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

4.10 Lock-out/Tag-out Procedures

Only fully qualified and trained personnel will perform maintenance procedures. Before maintenance begins, lock-out/tag-out procedures per OSHA 29 CFR 1910.147 will be followed.

Lockout is the placement of a device that uses a positive means, such as lock, to hold an energy or material-isolating device such that the equipment cannot be operated until the lockout device is removed. If a device cannot be locked out, a tag-out system shall be used. Tag-out is the placement of a warning tag on an energy or material isolating device indicating that the equipment controls may not be operated until the tag is removed by the personnel who attached the tag. Attachment M presents the Lock-out/Tag-out Form.

4.11 Electrical Safety

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

General electrical safety requirements include:

- All electrical wiring and equipment must be a type listed by Underwriters Laboratories (UL), Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency.
- All installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or USCG regulations.

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

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

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

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

- All circuits must be protected from overload.

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

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

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

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

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

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

4.12 Lifting Safety

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

- Consider the size, shape, and weight of the object to be lifted. A mechanical lifting device or additional persons must be used to lift an object if it cannot be lifted safely alone.

- The hands and the object should be free of dirt or grease that could prevent a firm grip.

- Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, or rough or slippery surfaces.

- Fingers must be kept away from points that could crush or pinch them, especially when putting an object down.

- Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear.

- The load should be kept as low as possible, close to the body with the knees bent.
- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.
- A worker should not carry a load that he or she cannot see around or over.
- When putting an object down, the stance and position are identical to that for lifting; the legs are bent at the knees, and the back is straight as the object is lowered.

4.13 Ladder Safety

When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least 3 feet above the upper landing surface to which the ladder is used to gain access; or, when such an extension is not possible because of the ladder's length, then the ladder shall be secured at its top to a rigid support that will not deflect, and a grasping device, such as a grabrail, shall be provided to assist employees in mounting and dismounting the ladder. In no case shall the extension be such that ladder deflection under a load would, by itself, cause the ladder to slip off its support.

- Ladders shall be maintained free of oil, grease, and other slipping hazards.
- Ladders shall not be loaded beyond the maximum intended load for which they were built, nor beyond their manufacturer's rated capacity.
- Ladders shall be used only for the purpose for which they were designed.
- Non-self-supporting ladders shall be used at an angle such that the horizontal distance from the top support to the foot of the ladder is approximately one-quarter of the working length of the ladder (the distance along the ladder between the foot and the top support).
- Wood job-made ladders with spliced side rails shall be used at an angle such that the horizontal distance is one-eighth the working length of the ladder.
- Fixed ladders shall be used at a pitch no greater than 90 degrees from the horizontal, as measured to the back side of the ladder.
- Ladders shall be used only on stable and level surfaces unless secured to prevent accidental displacement.
- Ladders shall not be used on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental displacement. Slip-resistant feet shall not be used as a substitute for care in placing, lashing, or holding a ladder that is used upon slippery surfaces, including, but not limited to, flat metal or concrete surfaces that are constructed so they cannot be prevented from becoming slippery.
- Ladders placed in any location where they can be displaced by workplace activities or traffic, such as in passageways, doorways, or driveways, shall be secured to prevent accidental displacement, or a barricade shall be used to keep the activities or traffic away from the ladder.
- The area around the top and bottom of ladders shall be kept clear.

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

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

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

- The top, top step, or the step labeled that it or any step above it should not be used as a step.

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

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

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

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

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

- Single-rail ladders shall not be used.

- When ascending or descending a ladder, the user must face the ladder.

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

- An employee shall not climb any ladder while carrying items in his or her hands.

4.14 Traffic Safety

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

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

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

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

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

4.15 Hot Work Procedures

All welding, cutting, and hot work will be completed as per OSHA 29 CFR 1910.251 and site-specific procedures. Only fully qualified and trained personnel will perform hot work procedures. Before hot work begins, the BBL Hot Work Permit or equivalent site-specific form will be completed and approved by the Site contact and BBL HSS. The Site Hot Work Form can be found in Attachment N. Contact the HSM/HSO prior to the start of any hot work activities.

5. Personal Protective Equipment

5.1 Levels of Protection

PPE is required to safeguard Site personnel from various hazards. Varying levels of protection may be required depending on the levels of COCs and the degree of physical hazards. This section presents the various levels of protection and defines the conditions of use for each level. A summary of the levels is presented in Table 5-1 in this section.

5.1.1 Level D Protection

The minimum level of protection that is required of BBL personnel and subcontractors at the Site is Level D, which is worn when no dermal exposure hazard exists and Site conditions or air monitoring indicates that no inhalation hazard exists. Level D protection includes the following equipment:

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

5.1.2 Modified Level D Protection

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

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

- Tyvek® or KleenGuard®coveralls when skin contact with COC-impacted media is anticipated;

- Hard hat, meeting ANSI Z89, when falling object hazards are present;

- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used); and

- PFD if working on or near the water.

5.1.3 Level C Protection

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

- Full-face, National Institute for Occupational Safety and Health- (NIOSH-) approved, air-purifying respirator with combination organic vapor cartridges;

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

- Nitrile outer gloves worn over nitrile surgical gloves;

- Steel-toe work boots, meeting ANSI Z41;

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

- Hard hat, meeting ANSI Z89;

- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used) and;

- PFD if working on or near the water.

5.2 Selection of PPE

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

5.3 Site Respiratory Protection Program

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

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

- All on-site personnel who may use respiratory protection will have been fit tested and trained in the use of a full-face air-purifying respirator within the past 12 months.

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

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

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

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

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

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

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

5.4 Using PPE

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

5.4.1 Donning Procedures

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

- Remove bulky outerwear. Remove street clothes and store in clean location;
- Put on work clothes or coveralls;
- Put on the required chemical protective coveralls;
- Put on the required chemical protective boots or boot covers;
- Tape the legs of the coveralls to the boots with duct tape;
- Put on the required chemical protective gloves;
- Tape the wrists of the protective coveralls to the gloves;
- Don the required respirator and perform appropriate fit check (Level C);
- Put hood or head covering over head and respirator straps and tape hood to face piece (Level C); and
- Don remaining PPE, such as safety glasses or goggles and hard hat.

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

5.4.2 Doffing Procedures

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

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

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

5.5 Selection Matrix

The level of personal protection selected will be based on air monitoring of the work environment and an assessment by the SS and HSS of the potential for skin contact with COC. The PPE selection matrix is presented in Table 5-1. This matrix is based on information available at the time this plan was written. The Airborne Contaminant Action Levels in Table 6-1 should be used to verify that the PPE prescribed in these matrices is appropriate.

TABLE 5-1
PPE SELECTION MATRIX

Task	Level of Protection
Mobilization, Land Survey	Level D
Soil Investigation	Modified Level D/Level C
Groundwater Investigation	Modified Level D
NAPL monitoring/recovery	Modified Level D
Soil excavation	Modified Level D/Level C
On-site observation	Level D
Sediment sampling	Modified Level D
Equipment Decontamination	Modified Level D
Demobilization	Level D

6. Air Monitoring

6.1 Air Monitoring

Air monitoring will be conducted to evaluate airborne levels of COCs. The monitoring results will dictate work procedures and the selection of PPE for BBL employees and BBL visitors only. The monitoring devices to be used, at a minimum, are an MIE PDR 1000 particulate monitor (or equivalent) and a combination lower explosive limit/oxygen/hydrogen sulfide/carbon monoxide/photoionization detector (PID) with an **11.7 eV** lamp. The RAE Systems MultiRae is an example of this type of instrument. Colorimetric detector tubes for Benzene may be needed if organic vapor action levels are met.

Monitoring for organic vapors and particulates will be conducted in the exclusion zone during all ground intrusive activities. Monitoring data will be recorded on the Air Monitoring Form (Attachment O).

6.2 Noise Monitoring

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

6.3 Monitoring Equipment Maintenance and Calibration

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

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

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

6.4 Action Levels

Table 6-1 presents airborne contaminant action levels that will be used to determine the procedures and protective equipment necessary based on conditions as measured at the Site.

TABLE 6-1
AIRBORNE CONTAMINANT ACTION LEVELS

Parameter	Reading in Breathing Zone (BZ)	Action
Total Organic Vapors[1]	0 ppm to < 1 ppm	Normal operations; record breathing zone monitoring measurements every hour
	> 1 ppm to 5 ppm	Increase recording frequency to at least every 15 minutes and use benzene Drager tube to screen for the presence of benzene
	∃ 5 ppm to # 50 ppm	Upgrade to level C PPE, continue screening for benzene
	> 50 ppm	Stop work; evacuate work area, investigate cause of reading, reduce through engineering controls, contact HSO
Benzene (as determined by colorimetric tube)	∃ 1 ppm to 10 ppm	Upgrade to Level C PPE
	>10 ppm	Stop work; evacuate confined spaces/work area, investigate cause of reading; contact HSO
Total Particulate	0 to 0.100 mg/m^3 above background	Normal operations
	> 0.100 mg/m^3 above background	Initiate wetting of work area to control dust; upgrade to Level C if dust control measures do not control dust within 15 minutes, monitor downwind impacts.
	> 0.15 mg/m^3 in breathing zone or at downwind perimeter of work area	Stop work; investigate cause of reading; contact PM and HSO
Oxygen	> 19.5% to < 23.5 %	Normal operations
	# 19.5 % or ∃ 23.5 %	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
Carbon Monoxide	0 ppm to # 20 ppm	Normal operations
	> 20 ppm	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
Hydrogen Sulfide	0 ppm to # 5 ppm	Normal operations
	> 5 ppm	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
Flammable Vapors (LEL)	< 10% LEL	Normal operations
	∃ 10% LEL	Stop work; ventilate area; investigate source of vapors

[1] Note:

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

6.5 On-site Monitoring Plan and Response Activities

Soil borings and test pits will be completed at on-site locations as part of the field investigation activities. These activities have the potential to generate organic vapors and particulates. As mentioned above, air monitoring will be conducted in the worker breathing zone to determine the level of protection required for personnel observing completion of test pits and soil borings. If action levels in the worker breathing zone are exceeded for organic vapors or particulates, air monitoring will be required at various on-site/perimeter locations to determine appropriate response activities that are protective of personnel on-site who are not directly involved with the investigation, personnel at adjacent commercial sites, and the surrounding community. If action levels for the remaining monitoring parameters listed in Table 6-1 are exceeded, work will stop, the HSO will be contacted, and perimeter monitoring will be performed. Additional monitoring (and appropriate response activities) to be implemented if the total organic vapor and particulate levels in the worker breathing zone exceed action levels as discussed below.

Total Organic Vapors

If the sustained level of total organic vapors in the worker breathing zone exceeds 1 ppm above background, then the level of total organic vapors will be manually recorded at the downwind perimeter of the work area (i.e., exclusion zone) at 15 minute intervals. If the sustained level of total organic vapors at the downwind perimeter of the work area exceeds 1 ppm above background, then work activities will be halted and additional downwind monitoring will be performed. Efforts will be undertaken to mitigate the source of organic vapors. The exclusion zone will be enlarged, if necessary, to mitigate the potential for people who are not involved with the investigation from being exposed to organic vapor levels exceeding 1 ppm above background.

During the investigation, it is possible that the downwind perimeter of the work area will coincide with the Site perimeter. If, at any time, the sustained level of total organic vapors adjacent to the downwind Site perimeter reaches 5 ppm above background, then the level of total organic vapors adjacent to the nearest downwind occupied building or property from the work zone will be monitored. If after 30 minutes, the total organic vapor level adjacent to the nearest occupied building or property has not subsided below 1 ppm above background, then the HSS will inform the local emergency response contacts listed in Section 9.8 and persons who may be exposed will be notified to evacuate occupied buildings or properties. These persons will not be permitted to return to the properties until after the level of total organic vapors on the properties subsides to below 1 ppm above background.

Particulates

If the level of particulates in the worker breathing zone exceeds 100 $\mu g/m^3$ above background for 1 minute, then the level of particulates will be manually recorded at the downwind perimeter of the work area at 15 minute intervals. If the level of particulates at the downwind perimeter of the work area is 150 $\mu g/m^3$ or greater, then work activities will cease and dust suppression techniques must be employed to maintain particulate levels below 150 $\mu g/m^3$. In addition, the exclusion zone will be enlarged if necessary to keep the public from being exposed to particulate levels greater than 150 $\mu g/m^3$.

6.6 Odor Control

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

7. Work Zones and Decontamination

7.1 Work Zones

7.1.1 Authorization to Enter

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

7.1.2 Site Orientation and Hazard Briefing

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

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

7.1.3 Certification Documents

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

7.1.4 Entry Log

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

7.1.5 Entry Requirements

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

7.1.6 Emergency Entry and Exit

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

7.1.7 Contamination Control Zones

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

7.1.7.1 Exclusion Zone

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

7.1.7.2 Contamination Reduction Zone

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

7.1.7.3 Support Zone

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

7.1.8 Posting

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

7.1.9 Site Inspections

The SS will conduct a daily inspection of Site activities, equipment, and procedures to verify that the required elements are in place. The Health and Safety Inspection Form in Attachment P may be used as a guide for daily inspections. LPOs will be conducted per the project schedule and entered into the BBL LPS Database for review.

7.2 Decontamination

7.2.1 Personnel Decontamination

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

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

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

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

7.2.2 Equipment Decontamination

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

7.2.3 Personal Protective Equipment Decontamination

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

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

8. Training and Medical Surveillance

8.1 Training

8.1.1 General

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

8.1.2 Basic 40-Hour Course

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

- LPS refresher training;
- general safety procedures;
- physical hazards (fall protection, noise, heat stress, cold stress);
- names and job descriptions of key personnel responsible for Site health and safety;
- safety, health, and other hazards typically present at hazardous waste sites;
- use, application, and limitations of PPE;
- work practices by which employees can minimize risks from hazards;
- safe use of engineering controls and equipment on-site;
- medical surveillance requirements;
- recognition of symptoms and signs which might indicate overexposure to hazards;
- worker right-to-know (Hazard Communication OSHA 1910.1200);
- routes of exposure to contaminants;
- engineering controls and safe work practices;
- components of a health and safety program and a site-specific HASP;
- decontamination practices for personnel and equipment;
- confined-space entry procedures; and
- general emergency response procedures.

8.1.3 LPS Training

All BBL Employees must have an initial 8-hour LPS training. It is instructor led with various forms of media. A yearly refresher is required. Typically the initial training includes:

- Introduction to the principals of the LPS;
- SPSA's and the SPSA process;
- JSA's and the JSA development process;

- LPO procedures.

8.1.4 Supervisor Course

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

- general site safety and health procedures;
- PPE programs; and
- air monitoring techniques.

8.1.5 Site-Specific Training

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

8.1.6 Daily Safety Meetings

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

8.1.7 First Aid and CPR

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

8.2 Medical Surveillance

8.2.1 Medical Examination

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

8.2.2 Pre-placement Medical Examination

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

- medical and occupational history questionnaire;
- physical examination;
- complete blood count, with differential;
- liver enzyme profile;
- chest X-ray, at a frequency determined by the physician;
- pulmonary function test;
- audiogram;
- electrocardiogram for persons older than 45 years of age, or if indicated during the physical examination;
- drug and alcohol screening, as required by job assignment;
- visual acuity; and
- follow-up examinations, at the discretion of the examining physician or the corporate medical director.

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

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

8.2.3 Other Medical Examinations

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

- at employee request after known or suspected exposure to toxic or hazardous materials; and

- at the discretion of the HSS, HSO, or occupational physician in anticipation of, or after known or suspected exposure to toxic or hazardous materials.

8.2.4 Periodic Exam

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

8.2.5 Medical Restriction

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

9. Emergency Procedures

9.1 General

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

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

9.2 Emergency Response

If an incident occurs, the SS or HS should take the following steps:

- Evaluate the incident and assess the need for assistance and/or evacuation;
- Call for outside assistance as needed;
- Confirm that the PM is notified promptly of the incident; and
- Take appropriate measures to stabilize the incident scene.

9.3 Fire

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

9.4 Contaminant Release

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

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

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

9.5 Medical Emergency

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

- Confirm that the injured employee receives prompt first aid and medical attention.
- In emergency situations, the worker is to be transported by appropriate means to the nearest urgent care facility (normally a hospital emergency room).
- If the injured person is a BBL employee, notify BBL Human Resources at 315-446-9120, ext. 19336 as soon as possible after the employee has been safely evacuated from the Site.

9.6 Emergency Care Steps

Upon entering an accident area, Site personnel must follow these emergency care steps:

- Survey the scene. Determine if it is safe to proceed. Try to determine if the conditions that caused the incident are still a threat. Protect yourself from exposure before attempting to rescue the victim.
- Do a primary survey of the victim. Check for airway obstruction, breathing, and pulse. Assess likely routes of chemical exposure by examining the eyes, mouth, nose, and skin of the victim for symptoms.
- Phone emergency medical services (EMS). Give the location, telephone number used, caller's name, what happened, number of victims, victim's condition, and help being given.
- Maintain airway and perform rescue breathing as necessary.
- Perform CPR as necessary.
- Do a secondary survey of the victim. Check vital signs and do a head-to-toe exam.
- Treat other conditions as necessary. If the victim can be moved, take him or her to a location away from the work area where EMS can gain access.

9.7 First Aid—General

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

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

9.7.1 First Aid—Inhalation

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

9.7.2 First Aid—Ingestion

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

9.7.3 First Aid—Skin Contact

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

9.7.4 First Aid—Eye Contact

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

9.7.5 Reporting Injuries, Illnesses, and Near-Miss Incidents

Injuries and illnesses, however minor, will be reported to the SS immediately. The SS or PM will notify Tera Stoner of CHGE immediately upon learning of a near-miss, injury or illness. The SS will complete an injury report and submit it to the HSM/HSO, PIC and the PM within 24 hours.

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

9.8 Emergency Information

The means to summon local public response agencies such as police, fire, and ambulance will be reviewed in the daily safety meeting. These agencies are identified in Table 9-1.

TABLE 9-1
EMERGENCY CONTACTS

Title/Role	Address/Telephone Number
Police	911 or 845-562-3131
Fire	911 or 845-562-1212
Ambulance	911
St. Luke's Hospital	845-561-4400
BBL Project Manager: Doug Weeks	518-452-7082 ext. 11 914-671-4858 (cell)
Health and Safety Supervisor: To Be Determined	To Be Determined
Site Supervisor: To Be Determined	To Be Determined
CHGE Project Manager: Tera Stoner	845-486-5464 845-518-7560 (cell)

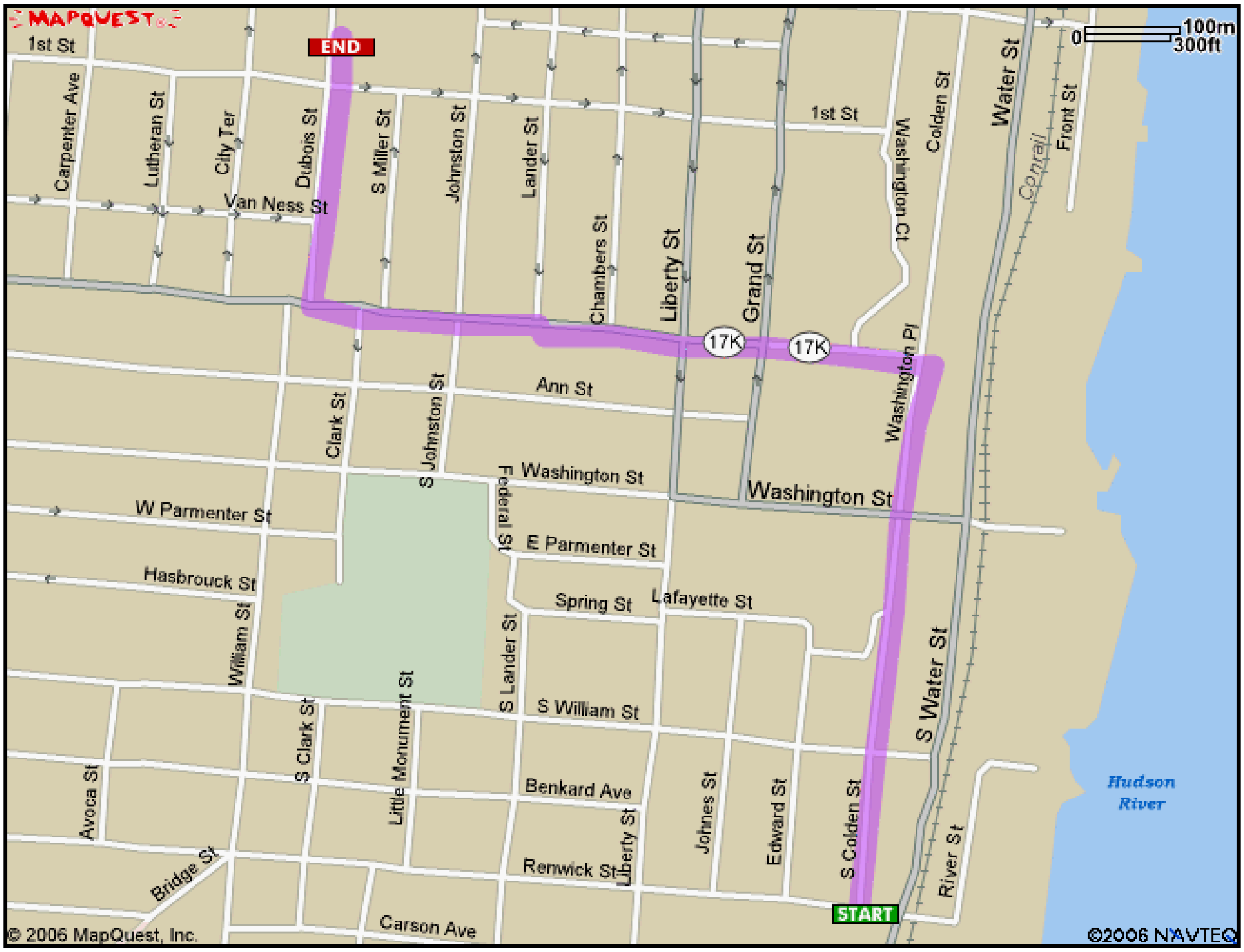
The Hospital Route Map is on the following page. It is the responsibility of the HSS to verify the hospital directions prior to the start of work.

DIRECTIONS TO THE HOSPITAL

Directions to St. Luke's Hospital, 70 Dubois Street, Newburgh, New York:

1. Travel North on Colden Street for 0.3 miles;
2. Turn Left onto NY-17K/Broadway;
3. Travel 0.4 miles on NY-17K/Broadway;
4. Turn Right onto Dubois Street;
5. Hospital on your Right at 70 Dubois Street.

See the following page for a map to the St. Luke's Hospital.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Colden St
Water St
Conrail
Front St
Van Ness St
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17K
Washington Pl
Ann St
Clark St
S Johnston St
Washington St
Washington St
Federal St
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E Parmenter St
Hasbrouck St
Spring St
Lafayette St
William St
S Lander St
S William St
S Water St
S Clark St
Little Monument St
Avoca St
Benkard Ave
Liberty St
Johnes St
Edward St
S Colden St
River St
Hudson River
Bridge St
Renwick St
Carson Ave
© 2006 MapQuest, Inc.
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10. Acronyms and Abbreviations

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

ACGIH	American Conference of Governmental Industrial Hygienists
BBL	Blasland, Bouck & Lee, Inc.
CAMP	Community Air Monitoring Program
CFR	Code of Federal Regulations
COC(s)	Constituent(s) of Concern
CPR	Cardiopulmonary Resuscitation
CRZ	Contamination-Reduction Zone
DEET	diethyltoluamide
DOT	Department of Transportation
EMS	Emergency Medical Services
EZ	Exclusion Zone
FID	Flame Ionization Detector
FM	Factory Mutual Engineering Corporation
GFCI	Ground-Fault-Circuit Interrupter
HASP	Health and Safety Plan
HSO	Health and Safety Officer
HSS	Health and Safety Supervisor
II	Incident Investigation
JSA	Job Safety Analysis
kV	Kilovolts
LEL	Lower Explosive Limit
LFL	Lower Flammable Limit
LPO	Loss Prevention Observation
LPS	Loss Prevention System
mph	Miles Per Hour
MSDS	Material Safety Data Sheet
NEC	National Electrical Code
NESC	National Electrical Safety Code
NIOSH	National Institute for Occupational Safety and Health
NRR	Noise Reduction Rating
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PID	Photoionization Detector
PM	Project Manager
PO	Project Officer

PPE	Personal Protective Equipment
RMSF	Rocky Mountain Spotted Fever
SPSA	Safe Performance Self Assessment
SS	Site Supervisor
SZ	Support Zone
Ta adj	Adjusted Air Temperature
TLV	Threshold Limit Value
UFPO	Underground Facility Protection Organization
UL	Underwriters Laboratory
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency

Attachment A

Task Specific Job Safety Analysis Forms

Job Safety Analysis

JSA Type: ☒ Env Operations ☐ Transport ☐Office ☐ Construction | X New Revised | Date: 8/04

Co: BBLES Dept: Div: 61 Org Unit: Loc:

Work Type: Environmental | Work Activity: Field Sampling

Personal Protective Equipment (PPE):

Minimum PPE is Level D including: safety glasses or goggles, hard hat, steel-toed and shank boots, hearing protection, and gloves (type dependent on job-specific requirements – nitrile glove required for contact with contaminated soil or water)

Additional PPE may be required in the Health & Safety Plan (HSP). Also refer to the HSP for required traffic control, air monitoring, and emergency procedures.

Development Team	Position/Title	Reviewed By	Position/Title	Date

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

❶ Job Steps	❷ Potential Hazard	❸ Critical Actions
Clear drilling locations.	Traffic hazards, overhead and underground installations, product releases, property damage, dealer inconvenience	Reference Borehole Clearance Review form and coordinate with Station Manger (or designee) to minimize potential conflicts. Review proposed locations against available construction drawings and known utilities, tanks, product lines, etc. Mark out the proposed borehole locations. Call underground utility locating service for public line location clearance and get list of utilities being contacted. If necessary, coordinate private line locator for private property.
Working outdoors	Environmental hazards: sun, heat, cold, insects, hazardous plants	Avoid work in extreme weather conditions, stop work if extreme weather is imminent, inspect area for hazardous plants & insects. Wear appropriate clothes for the area: long sleeves and gloves in overgrown areas, use sunscreen and hat. Monitor for heat and cold stress.
Mobilize with proper equipment/supplies for drilling, geoprobe or sample collection.	Vehicle accident. Lifting hazards. Delay or improper performance of work due to improper equipment onsite.	Follow safe driving procedures; obey traffic laws and signs, maintain safe distance, inspect vehicle prior to driving. Use proper lifting techniques – lift with the legs, avoid twisting and jerky movements. Verify that subcontractors are aware of their responsibilities for labor, equipment and supplies. Review HSP and permit conditions, and gather necessary PPE.
Visually clear proposed drilling locations.	Underground and overhead installations.	Complete Pre-Mobilization section of Borehole Clearance Review form and adjust drilling locations as necessary.
Set up necessary traffic control.	Struck by vehicle during placement. Vehicle accident as a result of improper traffic control equipment placement.	Use buddy system for placing traffic control, place cones around area, park vehicles to block traffic, check for specific requirements based on permits. Wear vest.
Assist with set up of rig.	Vehicle accident during rig movement. Damage caused by rig while accessing set-up location. Contact with overhead installations. Soft terrain. Rig movement.	Verify clear pathway to drilling location and clearance for raising mast. Provide as-needed hand signals and guidance to driver to place rig. Visually inspect rig (fire extinguisher on board, no oil or other fluid leaks, cabling and associated equipment in good condition, pressurized hoses secured with whip-checks or adequate substitute, jacks in good condition?). If necessary, use wooden blocks under jacks to spread load. Chock wheels.
Set up exclusion zone(s) and work stations (drilling and logging/sample collection).	Struck by vehicle during set up. Slip/fall hazards.	Implement exclusion zone set-up instructions of HSP. Set up work stations with clear walking paths to and from rig. Place containment materials and decon equipment.
Clear upper five feet of direct push	Back strain, exposure to chemical hazards,	Don required PPE and initiate air quality monitoring in

location using post-hole digger or bucket auger.	hitting an underground utility, repetitive motion.	accordance with the HSP. Use proper lifting techniques and tools. Complete the Pre-Drilling section of the Borehole Clearance Review form.
Commence direct-push drilling.	Cross-contamination from previous hole. back strain, heat or cold, eye injury, noise, exposure to chemical hazards, hitting an underground utility, trip and fall, equipment failure	Decontaminate sampling after collecting a sample and decontaminate drilling equipment after each borehole. Use proper lifting techniques. Use PPE and monitoring in accordance with HSP (especially note ear protection). Monitor drilling progress. Keep work area clear of tripping or slipping hazards. Perform periodic visual inspections of drill rig.
Collect samples in accordance with sampling plan.	Cross-contamination, improper labeling or storage, exposure to site contaminants.	Decontaminate sampling equipment between each sampling run. Use soil core cutting tool. Label samples in accordance with sampling plan. Keep samples stored in proper containers, at correct temperature, and away from work area. Perform air monitoring and wear proper PPE.
Store cuttings (if any) properly in accordance with site-specific requirements.	Exposure to public. Traffic hazard or obstruction/inconvenience to station operation. Improper storage or disposal.	Have proper storage containment and labeling available onsite. Place materials in isolated location away from traffic and other site functions. Coordinate proper disposal offsite (where applicable).
Backfill borehole.	Improper grouting can lead to future vertical conduit for contaminant migration. Back strain, trip hazards, eye injury from splashing or release of pressurized grout. Unauthorized backfilling causes extra work.	Mix grout to specification (avoid dust generation, use gloves) and completely fill the hole. Use proper lifting techniques and wear proper PPE. Keep work area clear of tripping hazards. Verify presence or other authorization by required inspectors for grouting.
Dispose or store purge water (if any) onsite.	Back strain. Exposure to contaminants. If disposing through onsite treatment system, damage or injury from improper use of equipment. Improper storage or disposal.	Use proper equipment to transport water (pumps, drum dollies, etc.). Wear PPE in accordance with HSP. Review instructions for use of onsite treatment systems. Label storage containers properly, and locate in isolated area away from traffic and other site functions. Coordinate offsite disposal (where applicable).
Clean site/demobilize.	Traffic. Safety hazard left on site. Lifting hazards.	Use buddy system as necessary to remove traffic control. Leave site clean of refuse and debris. Clearly mark/barricade any borings that need later topping off or curing. Notify station personnel of departure, final well locations and any cuttings/purge water left onsite. Use proper lifting techniques
Package and deliver samples to lab.	Bottle breakage, back strain.	Handle and pack bottles carefully (bubble wrap bags are helpful). Avoid contact with tape cutter, or cut away from the hand and body if using knife. Use proper lifting techniques, limit weight of each cooler.

Job Safety Analysis

BBL

JSA Type: ☒ Env Operations ☐ Transport ☐Office ☐ Construction | X New Revised | Date: 8/04

Co: Dept: Div: Org Unit: Loc:

Work Type: Environmental | Work Activity: Excavation and Construction Observation

Personal Protective Equipment (PPE):

Minimum PPE is Level D including: safety glasses or goggles, hard hat, steel-toed and shank boots, hearing protection, and gloves (type dependent on job-specific requirements)

Additional PPE may be required in the Health & Safety Plan (HSP). Also refer to the HSP for required traffic control, air monitoring, and emergency procedures.

Development Team	Position/Title	Reviewed By	Position/Title	Date

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

❶ Job Steps	❷ Potential Hazard	❸ Critical Actions
Working outdoors	Environmental hazards: sun, heat, cold, insects, hazardous plants	Avoid work in extreme weather conditions, stop work if extreme weather is imminent, inspect area for hazardous plants & insects. Wear appropriate clothes for the area: long sleeves and gloves in overgrown areas, use sunscreen and hat. Monitor for heat and cold stress.
Clear excavation locations.	Traffic hazards, overhead and underground installations, product releases, property damage, dealer inconvenience	Reference Overhead and Underground Utility Checklist, and complete and Client Specific clearance documents, coordinate with local contact to minimize potential conflicts. Review proposed locations against available construction drawings and known utilities, tanks, product lines, etc. Mark out the proposed excavation locations. Call underground utility locating service for public line location clearance, and get list of utilities being contacted. If necessary, coordinate private line locator for private property.
Set up necessary traffic control.	Struck by vehicle during placement. Vehicle accident as a result of improper traffic control equipment placement.	Use buddy system for placing traffic control, place cones around area, park vehicles to block traffic, check for specific requirements based on permits. Wear vest.
Set up exclusion zone(s), stockpile area and establish work areas/heavy equipment pathways.	Injury or exposure to public or other onsite personnel. Slip/fall hazards. Onsite vehicular accident with heavy equipment.	Implement exclusion zone set-up instructions of HSP. Set up clear walking paths between work stations.
Hand digging/pot-holing where necessary to expose and protect underground installations as needed.	Damage to lines (and associated physical hazards or property damage). Back strain. Injury or vehicle damage from falling into holes.	Use hand tools whenever possible. Use proper lifting techniques – avoid heavy loads, use two person lifts. Barricade/cover holes until job is complete.
Assist with set up of heavy equipment.	Damage caused by heavy equipment while accessing set-up location. Struck by equipment.	Verify clear pathway to excavation and stockpiling locations. Provide as-needed hand signals and guidance to driver to place rig. Visually inspect equipment (fire extinguisher on board, no oil or other fluid leaks, cabling and associated equipment in good condition, pressurized hoses secured with whip-checks or adequate substitute, jacks in good condition?). Maintain eye contact with operator.

Commence excavation	Heat or cold exposure, exposure to chemical hazards, hitting an underground or overhead utility, flammable or oxygen-deficient atmosphere from accumulated vapors, trip and fall, side wall cave in, equipment failure, noise.	Monitor weather conditions and take breaks as needed for cold or hot weather. Use PPE and monitoring in accordance with HSP. Include Lower Explosive Limit (LEL) and oxygen monitoring. If >10% LEL or $O_2 <$ 19.5%, discontinue work or ventilate area with explosion-proof equipment. Maintain required excavation set-backs for workers and equipment and monitor condition of side walls and surrounding ground conditions. Keep work area clear of tripping or slipping hazards. Perform periodic visual inspections of heavy equipment and keep it at least 5 ft from excavation edge. Perform necessary soil classification by competent person – document inspection on BBL Excavation Inspection Form. Slope/bench walls or shore excavation to prevent cave in. Keep all spoils > 2 ft from excavation edge. Keep excavation entry controlled and equipped with required ladders and crosswalks.
Collect samples in accordance with sampling plan.	Cave in of side walls if entering excavation. Injury from heavy equipment. Exposure to site contaminants.	Stay out of excavation whenever possible (collect samples from backhoe bucket). If entry is required, excavation must: 1) be properly sloped, benched or shored, 2) be properly ventilated, 3) not have free-standing water or have water entering the hole, 4) have adequate entry/egress pathways (see OSHA and applicable state requirements). Use agreed-upon hand signals with heavy equipment operators. Monitor air in and around excavation.
Store excavated materials properly in accordance with site-specific requirements.	Exposure to public. Traffic hazard or obstruction/inconvenience to station operation. Improper storage or disposal.	Have proper storage containment and labeling available onsite. Place materials in isolated location away from traffic and other site functions. Cover and barricade access to waste in accordance with local regulations. Coordinate proper disposal offsite (where applicable).
Dewater excavation (if necessary).	Exposure to contaminants. Explosion from static electricity. Collapse of side walls. Electrical shock.	Wear PPE in accordance with HSP. Ground dewatering equipment (vacuum trucks are commonly used). Maintain safe setback from excavation walls. Use GFCI and inspect cords.
Backfill excavation	Struck by heavy equipment. Side wall collapse. Future damage or accidents resulting from subsidence.	Use agreed-upon hand signals with heavy equipment operators. Only enter excavation in compliance with OSHA and associated requirements. Compact soils to meet specifications. Maintain eye contact with equipment operators.
Clean site/demobilize	Traffic. Safety hazard left on site. Lifting hazards.	Use buddy system as necessary to remove traffic control. Leave site clean of refuse and debris. Notify site personnel of departure. Use proper lifting techniques or use mechanical assistance.
Package and deliver samples to lab.	Bottle breakage (if any), back strain.	Handle and pack bottles carefully (bubble wrap bags are helpful). Avoid contact with tape cutter, or cut away from the hand and body if using knife. Use proper lifting techniques, limit weight of each cooler.

Job Safety Analysis

JSA Type: ☒ Env Operations ☐ Transport ☐Office ☐ Construction | X New Revised | Date: 8/04

Co: BBL Dept: Div: 61 Org Unit: Loc:

Work Type: Environmental | Work Activity: Soil Boring/Monitoring Well Installation

Personal Protective Equipment (PPE):

Minimum PPE is Level D including: safety glasses or goggles, hard hat, steel-toed and shank boots, hearing protection, and gloves (type dependent on job-specific requirements – nitrile gloves must be used during potential contact with contaminated water or COCs)

Additional PPE may be required in the Health & Safety Plan (HSP). Also refer to the HSP for required traffic control, air monitoring, and emergency procedures.

Development Team	**Position/Title**	**Reviewed By**	**Position/Title**	**Date**
Greg Ertel	Health and Safety			

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, permitting, access agreements, and notification to required contacts (e.g. site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Safe Performance Self Assessment (SPSA) procedures must be used during field activities. Also consider weather conditions (heat, cold, rain, lightning).

❶ Job Steps	**❷ Potential Hazard**	**❸ Critical Actions**
Clear drilling locations.	Traffic hazards, overhead and underground installations, product releases, property damage, dealer inconvenience	Reference BBL Underground Utility Checklist and client specific requirements to minimize potential conflicts. Review proposed locations against available construction drawings and known utilities, tanks, product lines, etc. Mark out the proposed borehole locations. Call underground utility locating service for public line location clearance, and get list of utilities being contacted. If necessary, coordinate private line locator for private property.
Working outdoors	Environmental hazards: sun, heat, cold, insects, hazardous plants	Avoid work in extreme weather conditions, stop work if extreme weather is imminent, inspect area for hazardous plants & insects. Wear appropriate clothes for the area: long sleeves and gloves in overgrown areas, use sunscreen and hat. Monitor for heat and cold stress.
Mobilize with proper equipment/supplies for drilling.	Vehicle accident. Lifting hazards. Delay or improper performance of work due to improper equipment onsite.	Follow safe driving procedures; obey traffic laws and signs, maintain safe distance, inspect vehicle prior to driving. Use proper lifting techniques – lift with the legs, use two-person lift for greater than 50 lbs, avoid twisting and jerky movements. Verify that subcontractors are aware of their responsibilities for labor, equipment and supplies. Review HASP and permit conditions, and gather necessary PPE.
Visually clear proposed drilling locations.	Underground and overhead utilities/obstructions.	Complete Underground Utility Checklist and adjust drilling locations as necessary.
Set up necessary traffic control.	Struck by vehicle during placement. Vehicle accident as a result of improper traffic control equipment placement.	Use buddy system for placing traffic control, place cones around area, park vehicles to block traffic, check for specific requirements based on permits. Wear high visibility vest.
Assist with set up of drill rig.	Vehicle accident during rig movement. Damage caused by drill rig while accessing set-up location. Overhead utilities and structures. Soft terrain. Rig movement.	Verify clear pathway to drilling location and clearance for raising mast. Provide as-needed hand signals and guidance to driver to place rig. Visually inspect rig (fire extinguisher on board, no oil or other fluid leaks, cabling and associated equipment in good condition, pressurized hoses secured with whip-checks or adequate substitute, jacks in good condition). Verify Emergency Stop switch is accessible and functions. If necessary, use wooden blocks under jacks to spread load. Chock wheels.

Set up exclusion zone(s) and work stations (drilling and logging/sample collection).	Struck by vehicle. Slip/fall hazards.	Implement exclusion zone set-up instructions of HSP. Set up work stations with clear walking paths to and from rig. Place containment materials and decon equipment.
Clear upper five feet of borehole using post-hole digger or bucket auger.	Back strain, exposure to chemical hazards, hitting an underground utility, repetitive motion.	Don any additional PPE and initiate air quality monitoring in accordance with the HSP. Use proper lifting techniques and tools. Complete the Underground Utility Checklist.
Commence drilling borehole.	Cross-contamination from previous hole. back strain, heat or cold, eye injury, exposure to chemical hazards, hitting an underground utility, trip and fall, equipment failure, lifting hazards, overhead hazards.	Decontaminate sampling equipment after collecting a sample and decontaminate drilling auger/rods after drilling a borehole. Use proper lifting techniques. Use PPE and monitoring in accordance with HSP. Monitor drilling progress. Keep work area clear of tripping or slipping hazards. Perform periodic visual inspections of drill rig.
Collect samples in accordance with sampling plan.	Cross-contamination, improper labeling or storage, exposure to site contaminants.	Decontaminate sampling equipment between each sampling run. Label samples in accordance with sampling plan. Keep samples stored in proper containers, at correct temperature, and away from work area. Perform air monitoring and wear proper PPE.
Store cuttings properly in accordance with site-specific requirements.	Exposure to public. Traffic hazard or obstruction/inconvenience to station operation. Improper storage or disposal.	Have proper storage containment and labeling available onsite. Place materials in isolated location away from traffic and other site functions. Coordinate proper disposal offsite (where applicable).
Construct well.	Back strain, eye injury, trip hazard. Cross-contamination. Non-approved well construction.	Use proper lifting techniques and PPE. Keep pathways from well supplies to borehole clear of tripping hazards. Make sure casing and other materials are clean before going into borehole. Verify presence or other authorization by any required inspectors for well installation/grouting.
Cut pavement to set well vault.	Moving blade, eye hazards, exhaust from motor, noise, back strain. Traffic hazards.	Wear proper PPE. Employ proper lifting techniques or mechanical assistance. Keep work area clear of debris. Maintain traffic control and face oncoming traffic.
Install well vault and set in concrete.	Back strain, eye injury, skin exposure to concrete, particulate inhalation, trip hazard. Traffic hazards.	Use proper lifting technique and equipment to install well vault and in concrete preparation. Wear proper PPE . Complete well vault smooth to grade to eliminate trip hazard (if slightly elevated to prevent storm water intrusion, slope concrete skirt gradually). Maintain traffic control and face oncoming traffic.
Develop well	Physical injury from mechanical failure or drill rig or air compressor. Trip hazard. Exposure to contaminants. Cross-contamination. Electric shock.	Make sure equipment is in good working order and pressurized hoses are whip-checked. Wear PPE in accordance with HSP. Keep work area orderly. Decontaminate all equipment going into well. Generators must be equipped with GFCI circuit.
Dispose or store purge water (if any) onsite	Back strain. Exposure to contaminants. If disposing through onsite treatment system, damage or injury from improper use of equipment. Improper storage or disposal.	Use proper equipment to transport water (pumps, drum dollies, etc.). Wear PPE in accordance with HSP. Review any instructions for use of onsite treatment systems. Label storage containers properly and locate in isolated area away from traffic and other site functions. Coordinate offsite disposal (where applicable).
Clean site/demobilize	Traffic. Safety hazard left on site. Lifting hazard.	Use buddy system as necessary to remove traffic control. Leave site clean of refuse and debris. Clearly mark/barricade any well heads that need later work or concrete curing. Notify station personnel of departure, Map well locations, site structures, and location of drilling wastes. Use proper lifting techniques.
Package and deliver samples to lab.	Bottle breakage, back strain.	Handle and pack bottles carefully (bubble wrap bags are helpful). Avoid contact with tape cutter, or cut away from the hand and body if using knife. Use proper lifting techniques, limit weight of each cooler.

Job Safety Analysis

BBL

JSA Type: ☒ Env Operations ☐ Transport ☐Office ☐ Construction	X New Revised	Date: 10/04

Co: Dept: Div: Org Unit: Loc:

Work Type: Environmental	Work Activity: Driving

Personal Protective Equipment (PPE):

Minimum PPE is Level D including: safety glasses or goggles, hard hat, steel-toed and shank boots, hearing protection, and gloves (type dependent on job-specific requirements)

Additional PPE may be required in the Health & Safety Plan (HSP). Also refer to the HSP for required traffic control, air monitoring, and emergency procedures.

Development Team	Position/Title	Reviewed By	Position/Title	Date

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

❶ Job Steps	❷ Potential Hazard	❸ Critical Actions
PRE-TRIP Review SPSA Card. Check weather conditions prior to start of trip	Consider worse case outcomes of vehicle operations. (blowout, collision, injury or death) Inclement weather; snow, ice, rain, fog, severe weather, high winds significantly increase accident risk	Assess the potential hazards. Analyze how to reduce the risk. Act to ensure safe operation of the vehicle. Evaluate weather conditions prior to start of trip and during trip. Consider cancellation or postponement of trip if severe weather is imminent when appropriate. Review map and route prior to starting trip.
Perform perimeter walk around of vehicle to inspect for damage or unusual conditions.	Flat tire, leaking fluids, impaired vision, collision, injury or death.	Assure tires are properly inflated and there is sufficient tread. Assure there are no cuts or bulges in the sidewalls. Assure windshield and window glass is clean. Lift wiper arms and check wiper blades for damage or deterioration. Check behind vehicle for obstructions.
Check and adjust seat and mirrors, check turn signals and windshield wipers/washers. Check lights, headlights and tail-lights for correct operation.	Back or body strain. Blind spots. Inability to signal intentions. Streaked windshield, impaired vision. Insufficient light for night driving or adverse conditions, inability to signal stop.	Adjust seat so back is fully supported, upper arms close to body, pedals within easy reach. Lower steering wheel so hands are below shoulders and shoulders are relaxed. Check mirror adjustments each time vehicle is re-started. Test operation of turn signals. Locate and test operation of windshield wiper and washer. Locate switch and test headlights and tail-lights for operation.
Fasten seat belts	Increased risk of mores serious injury of death in collision.	Assure seat belt is in good condition, works correctly and fastened. Assure all passenger seat belts are in good working condition and fastened.
Lock doors.	Ejection from vehicle. Unwanted intrusion.	Lock all doors to vehicle.
Start engine	Unexpected movement	Assure transmission is in Park and that emergency brake is set.

Check gauges and warning lights	Overheated engine or breakdown due to lack of critical fluids. Brake failure.	Assure there is sufficient gas/diesel, oil, and other critical fluids. If brake light is on do not drive vehicle until condition is thoroughly analyzed and fixed.
Pull out of parking space.	Collision with other vehicles, pedestrians, or stationary objects	Check mirrors and over the shoulder in all directions prior to pulling out of parking space.
DURING TRIP - Keep eyes moving	Collision, injury or death to occupants or other parties.	Move eyes at least every 2 seconds. Scan major and minor intersections before entry (left-right-left). Check mirrors when slowing or stopping vehicle. Scan mirrors frequently, at least one mirror every 5-8 seconds. Avoid staring while evaluating road conditions.
Aim high in steering	Collision, injury or death to occupants or other parties.	Maintain 15 second eye lead time (1 1/2 blocks in city traffic or 1/4 mile in highway traffic). Assess information from distant objects. Adjust eye lead distance to speed.
Leave yourself an out	Collision, injury or death to occupants or other parties.	Maintain safety cushion around vehicle (front, sides, rear). Adjust vehicle space and speed to avoid unsafe intrusion by other drivers. At signal controlled intersections, stop 10 feet behind crosswalks or behind other vehicles. At stop sign controlled intersections, approach stop sign cautiously. Stop at or just behind limit line or crosswalk. When stopped, allow vehicle in front to move for 2 seconds before accelerating. Observe approaching merge areas and choose lane of least resistance. Cede right of way and allow other vehicles to merge, change lanes, make turns, etc.
Get the big picture Adjust speed for weather and road conditions.	Collision, injury or death to occupants or other parties. Excessive speed for conditions can cause loss of control and injury or death to occupants. Hazard to other drivers by loss of control. Distracted driving; use of cell phone, eating drinking, adjusting radio.	Avoid being unnecessarily boxed in. Avoid sudden acceleration and deceleration. Maintain a minimum 4 seconds following distance, adjust speed to traffic conditions, scan immediate and adjacent lanes before merging. Maintain safe speed for weather and road conditions. Adjust following distances when wet or icy conditions exist. Do not use cell phone when driving, pull to side of road before answering, avoid eating or drinking while driving, limit adjustments of seats, mirrors, or radio and keep eyes and attention focused on the road and driving the vehicle.
Make sure they see you.	Collision, injury or death to occupants or other parties..	Seek eye contact with other drivers. Cover or use horn when conditions warrant. Before changing lanes, signal well in advance, check mirrors and over shoulder, and allow adequate space before changing lanes. Break early to activate brake lights. Stay out of blind spots. gently sound horn or flash lights if unsure other driver sees you.
Backing up	Collision, injury or death to occupants or other parties..	Make all backing maneuvers slowly and cautiously. When parking, look for pull through parking to avoid backing.
Parking	Collision, injury or death to occupants or other parties..	Park away from other cars. back into parking spot when possible and safe. Maintain cushion of safety from fixed objects. Set parking brake.

Attachment B

Underground/Overhead Utilities Checklist

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

Underground / Overhead Utility Checklist

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

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

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

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

Reviewed By

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

Attachment C

Sediment/Surface Water Sampling Checklist

SEDIMENT/SURFACE WATER SAMPLING CHECKLIST

Project Name/Number____ Date________

Location____

Prepared By______________________________ Project Manager________________________

This checklist must be completed for any sediment or surface water sampling. It documents that the required, permits, notifications, procedures and equipment are in place prior to commencing sampling activities. The Project Manager shall identify the need for and arrange to obtain sampling permits, clearance or right-of-way access from the appropriate entity during project planning.

Procedure

Prior to any work on a navigable waterway or any activity that requires access the following items will be completed:

Activity:	Required for project:	Completed:	Comments:
Access rights to property	YES NO	YES NO	
Activity planned that impedes traffic on navigable waterway	YES NO	YES NO	
Notification and approval obtained from United States Coast Guard and/or other regulating authority (County, US Parks Service, EPA)	YES NO	YES NO	
Buoys, signs markings or other forms of notification present	YES NO	YES NO	
Other (Specify)			

Boating/Water Safety Checklist:

Activity:	Required for project:	Requirement:	Comments:
Working on over or near water (within 6 feet)	YES NO	PFD Available for all personnel	
Boat has been current registration, has been inspected and loaded safely	YES NO	Capacity, load distribution PFDs and throwable floatation device available Fire extinguisher on board	
Boat operator has appropriate training (USCG Boating Safety Course or equivalent)	YES NO		
Sampling on or near water below 50 degrees Fahrenheit	YES NO	Cold water immersion suit for affected personnel	
Method of communication available	YES NO	Radio, cell phone or scheduled check-in	

Client Representative____ Date____________

BBL Project Manager____ Date____________

BBL Site Supervisor____ Date____________

Attachment D

Vessel Inspection Check List

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Daily Boat Inspection List

Date:

Boat:

Operator:

CHECKLIST BEFORE DEPARTURE	OK	NEEDS REPAIR	COMMENTS
Documentation and Training			
Boat has current registration on board			
Boat operator has appropriate training (United States Coast Guard [USCG] Boating Safety Course or equivalent)			
Acquaint all passengers with use and location of safety equipment, radio, plans for day, etc.			
Float plan filed			
Personal Flotation Devices (PFDs)			
One USCG approved device per passenger			
Inspect all PFDs for tears/holes, discolored or weakened material, insecure straps, zippers, buckles or labels that are no longer readable			
Throw ring on vessel			
Explain the location and use of all PFDs to passengers and crew that may be new to the vessel			
If sampling on or near water below 50EF, cold water immersion suit for affected personnel			
Sound Producing Devices			
Must have a horn capable of producing 4-second blast audible for at least ½ mile. If a portable air horn, have a spare can of air or an alternate device.			
Lights, Navigation, Distress Signals			
All navigation lights, as required, in working order. Instrumental lights working.			
Accessible flares, day signals, etc. stored in a dry location and available at all times			
Inform crew members and passengers of their location and use.			
Tools and Spares			
Plug in bottom of boat			
Oars or paddles in boat			
Basic tool box onboard and a bucket for bailing.			
Box of spares aboard (e.g., fuel filter, through hull			

plugs, etc.)			
Fire Extinguishers and First Aid			
Accessible fire extinguisher located on boat and operational			
Mounts are secure and functional			
First aid kit present and stocked			
Spill kit			
Fuel, Oil, and Battery			
Tanks topped-off; if not adequate fuel for boat usage			
Check engine oil level			
If dual charging system, is selector switch in proper position and power on to vessel			
Spare batteries for accessories (e.g., radio, flashlight)			
If batteries are rechargeable, are they charged			
Weather Forecast			
Check weather forecasts			
Weather band radio present and operational			
Docking and Anchoring			
At least one anchor setup and bent-on to anchor line			
Two to three extra docklines in case of unusual conditions dockside			
Visually inspect lines			
Communication			
Cell phones available			
Marine radio present and operational			
Trailer Checks			
Check tire pressure and wheel bearings			
Make sure hitch is secure and safety chains attached/functional			
Make sure boat is tied down properly			
Check all lights and signals			
Look before backing up			

Notes:
1. Checklist should be completed each day prior to use of boat(s).
2. Portion of checklist obtained from Nautical Know How, Inc. 1998.

Attachment E

Daily Float Plan

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Float Plan

Complete this page, before going boating and leave it with a reliable person who can be depended upon to notify the Coast Guard or other rescue organization, should you not return as scheduled.
Do not file this plan with the Coast Guard.

1. Name of person reporting and telephone number: ____________________________________
____

2. Description of boat:

Type________________________ Color_____________________ Trim___________________
Registration No.________________________________Length__________________________
Name_____________________ Make_________________ Other Info.____________________

3. Engine type:___________________________________ H.P.__________________________
No. of engines_____________________________ Fuel Capacity________________________

4. Survival equipment (check as appropriate):

☐ PFDs
☐ Smoke Signals
☐ Paddles
☐ Anchor
☐ Flares
☐ Flashlight
☐ Water
☐ Raft or Dinghy
☐ Mirror
☐ Food
☐ Others
☐ EPIRB

5. Radio ☐ yes ☐ no Type____________________ Freqs.____________________

6. Automobile License:____
Type__________________________________Trailer License__________________________
Color_______________________________ and make of auto___________________________
Where parked____

7. Persons aboard:
Name Age Address & Telephone No.
____
____
____

8. Do any of these persons aboard have a medical problem? ☐ yes ☐ no
If yes, what?____

9. Trip Expectations: Leave at_________________ From_________________________________
Going to________________________________expect to return by__________________(time)
and not later than ____

10. Any other pertinent info.____

11. If not returned by_____________________________(time) call the COAST GUARD, or (local authority)____

12. Telephone numbers____
____
____
____

Attachment F

Daily/Periodic Excavation Inspection Form

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Daily / Periodic Excavation Inspection Checklist

Project Name:

Date / Time:

Project Number:

Location:

Prepared By:

Project Manager:

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

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

Soil Classified On: By:

Type of Protective System in Use: Sloping Shoring Other _______________

Description:

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

BBL Excavation Competent Person:

Date/Time:

Attachment G

Confined Space Entry Permit

BLASLAND, BOUCK & LEE, INC.
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Confined Space Entry Permit

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

Location and Description of Confined Space:

Rescue Contact and Phone Number:

Entry Objectives:

Equipment / Materials Required for Entry:

Time of Entry:	Expiration of Entry:

Required Respirator for Entry:

Required Protective Clothing for Entry:

Monitoring Interval: **Continuous** **5 minutes** **10 minutes** **15 minutes** **30 minutes**

Air Monitoring Requirements

Monitor For	Monitoring Equipment	Calibrated	
		Date / Time	By
% O_2			
% of LEL			
H_2S			
CO			
Other:			
Other:			

Entrants and Attendants

Number of Entrants:	Number of Attendants:
Names of Entrants	**Names of Attendants**

Entry Supervisor Authorizing Confined Space Entry Permit

Print:	Date:	Time:
Signature:	Date:	Time:

Entry Supervisor Canceling Confined Space Entry Permit

Print:	Date:	Time:
Signature:	Date:	Time:

Attachment H

Confined Space Entry Checklist

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Confined Space Entry Checklist

Permit #:

Project:

ALL COPIES OF PERMIT MUST REMAIN AT JOB SITE UNTIL THE ENTRY IS COMPLETE

Location and Description of Confined Space:

Checklist	YES	NO	N/A	COMMENT
Are all lines to and from confined space blanked, capped, or isolated?				
Electrical service locked out (entrant with key)?				
Are mechanical devices / systems restrained and locked out?				
Is explosion-proof electrical equipment in use?				
Are ladders secured at top?				
Is the ground fault circuit interrupter checked and functioning?				
Are all ignition sources identified and isolated?				
Are respirators and air supply equipment in proper condition?				
Are safety harnesses and lifelines in proper condition?				
Is required PPE being used?				
Is monitoring equipment calibrated and functioning properly?				
Is atmospheric testing completed?				
Is a trained attendant on standby?				
Is emergency equipment ready for use?				
Are rescue provisions in place?				
Are warning signs posted?				
Is ventilation equipment functioning properly?				
Is the retrieval system functioning properly?				
Communication device for entrance and attendants?				
Is the area secured to eliminate unauthorized entry?				
Are entry personnel trained for confined space entry?				
Is the confined space entry permit completed and posted?				
Are the permanent ladder rungs in safe condition?				

Monitoring Frequency: **Continuous** **5 min.** **10 min.** **30 min.**

Monitor's Name: ________________________________

Time of Reading	**Confined Space Air Monitoring Parameters**			
	% Oxygen>19.5%	**% LEL <10%**	**CO <20 ppm**	**Other**
Pre-Entry				

Entry Supervisor ____
Print Name

Signature Date Time

Air Monitor ____
Print Name

Signature Date Time

Attachment I

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

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.

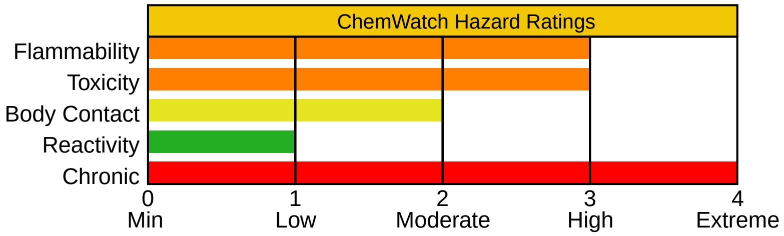
ACGIH TLV
TWA: 10 ppm; 32 mg/m^3.

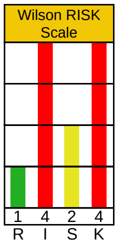
NIOSH REL
TWA: 0.1 ppm. STEL: 1 ppm.

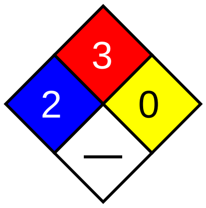
IDLH Level
500 ppm.

Section 3 - Hazards Identification

HMIS	
Health	3
Flammability	3
Reactivity	0







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.

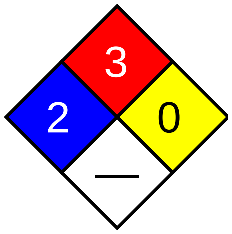
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients. Consider complete blood count. Evaluate history of exposure.

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

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 Diamond

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

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear 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 - I
Inhalation (human) TC_{Lo}: 100 ppm
Reproductive effector in rats

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

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

Section 12 - Ecological Information

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

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

Henry's Law Constant: 5.3×10^{-3}

BCF: eels 3.5

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

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

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

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

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

Ethylbenzene
MSDS 385
ETH3050

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Ethylbenzene **CAS Number:** 100-41-4

Chemical Formula: C_8H_{10}

Structural Chemical Formula: $C_6H_5{\bullet}C_2H_5$

Synonyms: AETHYLBENZOL; BENZENE,ETHYL-; EB; ETHYL BENZENE; ETHYLBENZEEN; ETHYLBENZENE; ETHYLBENZOL; ETILBENZENE; ETYLOBENZEN; PHENYLETHANE

General Use: Used in the manufacture of cellulose acetate, styrene and synthetic rubber; solvent or diluent; component of automotive and aviation gasoline.

Component of many petroleum hydrocarbon solvents, thinners.

The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethylbenzene	100-41-4	>95

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

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 125 ppm; 545 mg/m^3.

ACGIH TLV
TWA: 100 ppm; 434 mg/m^3;
STEL: 125 ppm; 543 mg/m^3.

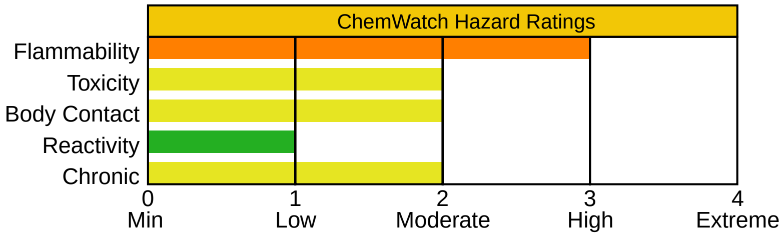
NIOSH REL
TWA: 100 ppm; 435 mg/m^3.
STEL: 125 ppm; 545 mg/m^3.

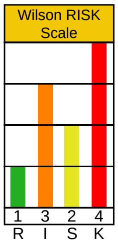
IDLH Level
800 ppm; LEL.

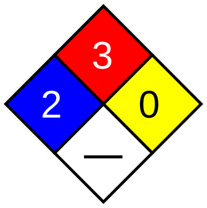
DFG (Germany) MAK
TWA: 100 ppm; 440 mg/m^3.

Section 3 - Hazards Identification

HMIS
2 Health
3 Flammability
0 Reactivity







Fire Diamond

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Primary Entry Routes: inhalation, skin contact, eye contact

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

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.

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

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

Inhalation of vapor may aggravate a pre-existing respiratory condition such as asthma, bronchitis, emphysema.

When humans were exposed to the 100 and 200 ppm for 8 hours about 45-65% is retained in the body. Only traces of unchanged ethyl benzene are excreted in expired air following termination of inhalation exposure.

Humans exposed to concentrations of 23-85 ppm excreted most of the retained dose in the urine (mainly as metabolites).

Guinea pigs that died from exposure had intense congestion of the lungs and generalized visceral hyperemia. Rats exposed for three days at 8700 mg/m^3 (2000 ppm) showed changes in the levels of dopamine and noradrenaline in various parts of the brain.

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

The vapor is discomforting to the eyes.

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

Two drops of the material in to the conjunctival sac produced only slight irritation of the conjunctival membrane but no corneal injury.

Skin: The liquid is discomforting to the skin if exposure is prolonged and is capable of causing skin reactions which may lead to dermatitis.

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

The mean rate of absorption of liquid ethyl benzene applied to 17.3 cm2 area of the forearm of seven volunteers for 10-15 minutes was determined to be 38 mg/cm2/hr. Immersion of the whole hand in aqueous solutions of ethyl benzene (112-156 mg/l) for 1 hour yielded mean absorption rates of 118 and 215.7 ug/cm2/hr. The rate of absorption is thus greater than that of aniline, benzene, nitrobenzene, carbon disulfide and styrene.

Repeated application of the undiluted product to the abdominal area of rabbits (10-20 applications over 2-4 weeks) resulted in erythema, edema and superficial necrosis. The material did not appear to be absorbed through the skin in sufficient quantity to produce outward signs of toxicity.

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

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

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

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

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

Industrial workers exposed to a maximum level of ethyl benzene of 0.06 mg/l (14 ppm) reported headaches and irritability and tired quickly. Functional nervous system disturbances were found in some workers employed for over 7 years whilst other workers had enlarged livers.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

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

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

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

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

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

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. DO NOT induce vomiting.

Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.

Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink.

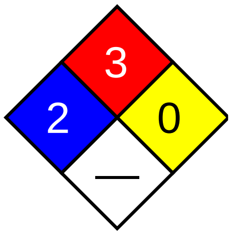
Transport to hospital or doctor without delay.

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

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

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

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 12.8 °C Closed Cup
Autoignition Temperature: 432 °C
LEL: 1.6% v/v
UEL: 7% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

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

If contamination of drains or waterways occurs, advise emergency services.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

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

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

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

Hands/Feet: Barrier cream with polyethylene gloves or Nitrile gloves.
Protective footwear.

Respiratory Protection:
Exposure Range >100 to <800 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 800 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Eyewash unit.

Glove Selection Index:

VITON	A
TEFLON	A

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid; floats on water. Aromatic solvent odor. Soluble in alcohol, benzene, carbon tetrachloride and ether.

Physical State: Liquid
Vapor Pressure (kPa): 1.333 at 25.9 °C
Vapor Density (Air=1): 3.66
Formula Weight: 106.17
Specific Gravity (H_2O=1, at 4 °C): 0.8670 at 20 °C
Water Solubility: 0.01% by weight
Evaporation Rate: Fast

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

Section 10 - Stability and Reactivity

Stability/Polymerization: Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

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

TOXICITY
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 x10^{-3}

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): theoretical 2.8%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 3.15

Soil Sorption Partition Coefficient: K_{oc} = 164

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHYLBENZENE
Hazard Class: 3.1
ID No.: 1175
Packing Group: II
Label: Flammable Liquid [3]

Additional Shipping Information: PHENYL ETHANE

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4); per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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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.

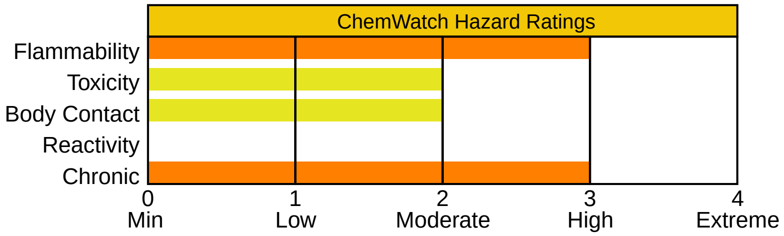
NIOSH REL
TWA: 100 ppm; 375 mg/m^3. STEL: 150 ppm; 560 mg/m^3.

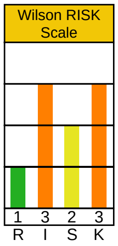
IDLH Level
500 ppm.

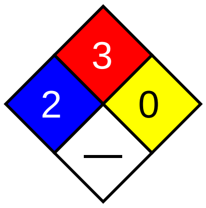
DFG (Germany) MAK
TWA: 50 ppm; 190 mg/m^3.

Section 3 - Hazards Identification

HMIS	
2	Health
3	Flammability
0	Reactivity







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.

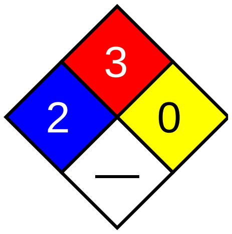
BIOLOGICAL EXPOSURE INDEX - BEI

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



Fire Diamond

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-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 wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

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

Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:

PE/EVAL/PE	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
Hazard Class: 3.1
ID No.: 1294
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information: TOLUOL

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

Issue Date: 2000-07

Xylene
MSDS 318
XYL2260

Section 1 - Chemical Product and Company Identification 54.1

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

Section 2 - Composition / Information on Ingredients

Name	CAS	%
xylene	1330-20-7	> 95

OSHA PEL
TWA: 100 ppm; 435 mg/m³.

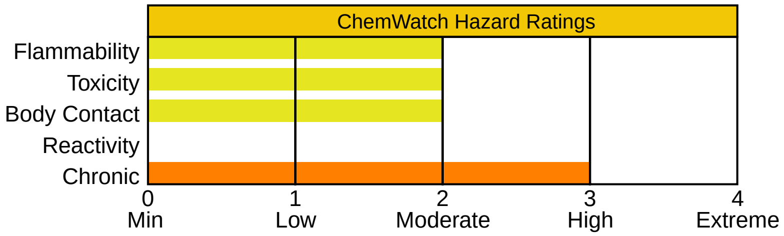
ACGIH TLV
TWA: 100 ppm; 434 mg/m³;
STEL: 150 ppm; 651 mg/m³.

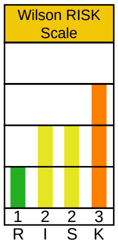
NIOSH REL
TWA: 100 ppm; 435 mg/m³.
STEL: 150 ppm; 655 mg/m³.

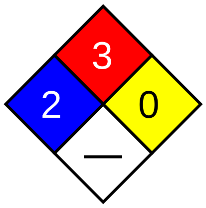
DFG (Germany) MAK
TWA: 100 ppm; 440 mg/m³.

Section 3 - Hazards Identification

HMIS	
2	Health
3	Flammability
0	Reactivity







Fire Diamond

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

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

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

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

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

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

The vapor is highly discomforting to the eyes.

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

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

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

Toxic effects may result from skin absorption.

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

The material may accentuate any pre-existing skin condition.

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

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

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

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

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

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

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

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

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

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

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

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

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

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

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

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

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

1.Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended. The use of charcoal and cathartics is equivocal.

2.Pulmonary absorption is rapid with about 60-65% retained at rest.

3.Primary threat to life from ingestion and/or inhalation is respiratory failure.

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

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

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

7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.

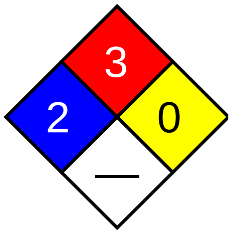
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

BIOLOGICAL EXPOSURE INDEX - BEI

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

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

Section 5 - Fire-Fighting Measures



Fire Diamond

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

Section 6 - Accidental Release Measures

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

Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

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

Section 7 - Handling and Storage

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

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment

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

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

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

Glove Selection Index:

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

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

PVC..C

Section 9 - Physical and Chemical Properties

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

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

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

Section 10 - Stability and Reactivity

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

Section 11 - Toxicological Information

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

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

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

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

Section 12 - Ecological Information

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

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

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

Additional Shipping Information: XYLOLS

Section 15 - Regulatory Information

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

Section 16 - Other Information

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

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Material Safety Data 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.

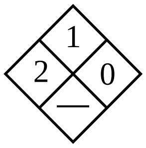
After first aid, get appropriate in-plant, paramedic, or community medical support.

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

Genium



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 semiannual basis for employees 45 yr of age or older or with 10 or more years of exposure to coal tar pitch volatiles. Train workers about the hazards of benzo(a)pyrene and the necessary protective measures to prevent exposure. Periodically inspect lab atmospheres, surfaces such as walls, floors, and benches, and interior of fume hoods and air ducts for contamination. Post appropriate signs and labels on doors leading into areas where benzo(a)pyrene is used.

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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Issue Date: 2000-07

Unleaded Gasoline
MSDS 467
AUT5000

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Unleaded Gasoline **CAS Number:** 8006-61-9
Chemical Formula: Mixture of hydrocarbons
Synonyms: AUTOMOTIVE GASOLINE, LEAD-FREE; GASOLINE; MOTOR FUEL; MOTOR SPIRITS; NATURAL GASOLINE; PETROL; UNLEADED PETROL
General Use: Lead free motor fuel for internal combustion engines, 2-stroke and 4-stroke.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
gasoline	8006-61-9	>90
benzene	71-43-2	5 max.

OSHA PEL
No data found.

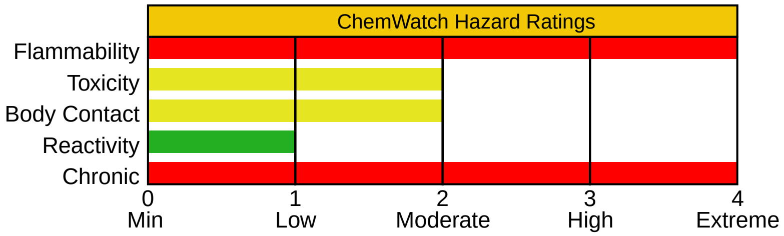
NIOSH REL
No data found.

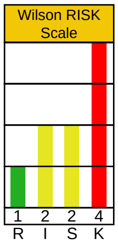
OSHA PEL Vacated 1989 Limits
TWA: 300 ppm; 900 mg/m^3;
STEL: 500 ppm; 1500 mg/m^3.

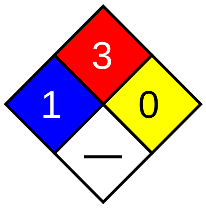
ACGIH TLV
TWA: 300 ppm; 890 mg/m^3;
STEL: 500 ppm; 1480 mg/m^3.

Section 3 - Hazards Identification

HMIS
② Health
③ Flammability
① Reactivity







Fire Diamond

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear liquid; distinctive odor. Irritating to eyes/skin/respiratory tract. Also causes: dizziness, drunkenness, unconsciousness. Absorbed through skin. Chronic: dermatitis. Possible cancer hazard. Flammable. Can form explosive mixtures in air.

Potential Health Effects

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

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract and may be harmful if exposure is prolonged. 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. WARNING: Intentional misuse by concentrating/inhaling contents may be lethal. High inhaled concentrations of mixed hydrocarbons may produce narcosis characterized by nausea, vomiting and lightheadedness. Inhalation of aerosols may produce severe pulmonary edema, pneumonitis and pulmonary hemorrhage. Inhalation of petroleum hydrocarbons consisting substantially of low molecular weight species may produce irritation of mucous membranes, incoordination, giddiness, nausea, vertigo, confusion, headache, appetite loss, drowziness, tremors and anesthetic stupor. Massive exposures may produce central nervous system depression with sudden collapse and deep coma; fatalities have been recorded. Irritation of the brain and/or apneic anoxia may produce convulsions. Although recovery following overexposure is generally complete, cerebral micro- hemorrhage of focal post-inflammatory scarring may produce eleptiform seizures some months after the exposure. Pulmonary episodes may include chemical pneumonitis with edema and hemorrhage. The lighter hydrocarbons may produce kidney and neurotoxic effects. Liquid paraffins may produce anesthesia and depressant actions leading to weakness, dizziness, slow and shallow respiration, unconsciousness, convulsions and death. C_{5-7} paraffins may also produce polyneuropathy. Aromatic hydrocarbons accumulate in lipid-rich tissues (typically the brain, spinal cord and peripheral nerves) and may produce functional impairment manifested by nonspecific symptoms such as nausea, weakness, fatigue, vertigo; severe exposures may produce inebriation or unconsciousness. Many of the petroleum hydrocarbons are cardiac sensitizers and may cause ventricular fibrillations.

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. Petroleum hydrocarbons may produce pain after direct contact with the eyes. Slight, but transient, disturbances of the corneal epithelium may also result. The aromatic fraction may produce irritation and lachrymation. The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The material is moderately discomforting to the skin if exposure is prolonged. The material contains a component that may be absorbed through the skin and may cause drying of the skin, which may lead to dermatitis from repeated exposures over long periods. 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 dermatitis condition.

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. Ingestion of petroleum hydrocarbons may produce irritation of the pharynx, esophagus, stomach and small intestine with edema and mucosal ulceration. Resulting symptoms include a burning sensation in the mouth and throat. Large amounts may produce narcosis with nausea and vomiting, weakness or dizziness, slow and shallow respiration, swelling of the abdomen, unconsciousness and convulsions. Myocardial injury may produce arrhythmias, ventricular fibrillation and electrocardiographic changes. Central nervous system depression may also occur. Light aromatic hydrocarbons produce a warm, sharp, tingling sensation on contact with taste buds and may anesthetize the tongue. Aspiration into the lungs may produce coughing, gagging, and a chemical pneumonitis with pulmonary edema and hemorrhage.

Carcinogenicity: NTP - Not listed; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: 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. Chronic poisoning may occur from vapor inhalation or skin absorption. The most significant toxic effect is insidious and irreversible injury to the blood-forming tissue by benzene. Leukemia may develop. Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes. Gasoline "sniffing" has caused severe nerve damage. Repeated or prolonged exposure to mixed hydrocarbons may produce narcosis with dizziness, weakness, irritability, concentration and/or memory loss, tremor in the fingers and tongue, vertigo, olfactory disorders, constriction of visual field, paresthesias of the extremities, weight loss and anemia and degenerative changes in the liver and kidney. Chronic exposure by petroleum workers to the lighter hydrocarbons has been associated with visual disturbances, damage to the central nervous system, peripheral neuropathies (including numbness and paresthesias), psychological and neurophysiological deficits, bone marrow toxicities (including hypoplasia, possibly due to benzene) and hepatic and renal involvement. Chronic dermal exposure to petroleum hydrocarbons may result in defatting which produces localized dermatoses. Surface cracking and erosion may also increase susceptibility to infection by microorganisms.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital, or doctor.

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

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

Ingestion: Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

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.

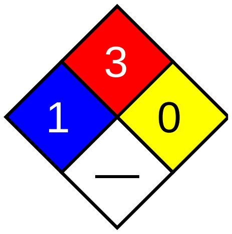
Section 5 - Fire-Fighting Measures

Flash Point: -43 °C

Autoignition Temperature: 280 °C

LEL: 1.4% v/v

UEL: 7.6% v/v



Fire Diamond

Extinguishing Media: 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).

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

Fire-Fighting Instructions: Alert 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 water ways. If safe, switch off electrical equipment until vapour 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. Alert 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 water ways. No smoking, naked 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 labelled 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. If inhalation risk of overexposure exists, wear a NIOSH approved organic-vapor respirator. Correct respirator fit is essential to obtain adequate protection. In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus. Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

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

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

Respiratory Protection:
Exposure Range >300 to 1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1000 to 15,000 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >15,000 to 300,000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >300,000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Purple, highly flammable, volatile liquid with characteristic sharp odor. Floats on water. Consists of a complex mixture of hydrocarbons with small amounts of residual benzene from the refining operations.

Physical State: Liquid
Vapor Pressure (kPa): 53.33 at 20 °C
Vapor Density (Air=1): > 2
Formula Weight: Not applicable.
Specific Gravity (H_2O=1, at 4 °C): 0.72-0.735 at 15 °C
Water Solubility: Insoluble
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 38.89 °C (102 °F)
Freezing/Melting Point Range: Not available
Volatile Component (% Vol): 100
Decomposition Temperature (°C): Not available.

Section 10 - Stability and Reactivity

Stability/Polymerization: Presence of incompatible materials. 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	IRRITATION
Oral (rat) LD50: 18800 mg/kg	Skin (rabbit): 500 mg/24h mild

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
Biochemical Oxygen Demand (BOD): 8%, 5 days

Section 13 - Disposal Considerations

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

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: MOTOR SPIRIT OR GASOLINE OR PETROL
Hazard Class: 3.1
ID No.: 1203
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information: PETROL

Section 15 - Regulatory Information

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

Section 16 - Other Information

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

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Issue Date: 2000-07

n-Hexane
MSDS 397
HEX6400

Section 1 - Chemical Product and Company Identification 54.1

Material Name: n-Hexane **CAS Number:** 110-54-3

Chemical Formula: C_6H_{14}

Structural Chemical Formula: $H_3C(CH_2)_4CH_3$

Synonyms: DIPROPYL; ESANI; GETTYSOLVE-B; HEKSAN; HEXANE; N-HEXANE; N-HEXANE; HEXANEN; HEXYL HYDRIDE; NORMAL HEXANE; NORMAL-HEXANE; SKELLYSOLVE-B; SKELLYSOLVE B

General Use: An incidental component of many aliphatic solvent mixes used as lacquer, paint and enamel thinners, also in ink reducers and cleaning solvents.
Also used for solvent extraction of oil seeds and in pesticide residue analysis and gas chromatography.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
n-hexane	110-54-3	> 95

OSHA PEL
TWA: 500 ppm; 1800 mg/m³.

OSHA PEL Vacated 1989 Limits
TWA: 50 ppm; 180 mg/m³.

ACGIH TLV
TWA: 50 ppm; 176 mg/m³.

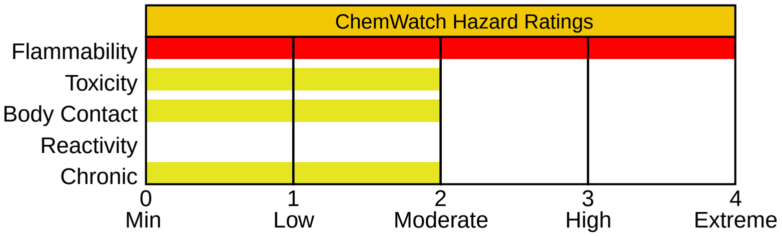
NIOSH REL
TWA: 50 ppm; 180 mg/m³.

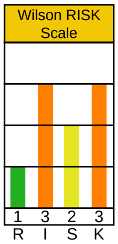
IDLH Level
1100 ppm; LEL.

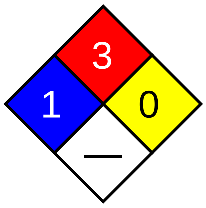
DFG (Germany) MAK
TWA: 50 ppm; 180 mg/m³.

Section 3 - Hazards Identification

HMIS
② Health
③ Flammability
⓪ Reactivity







Fire Diamond

ANSI Signal Word

Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; sweet/gasoline odor. Irritating to eyes/skin/respiratory tract. Also causes: dizziness, fatigue, muscle weakness, hallucinations. Chronic: peripheral neuropathy (muscle weakness, motor loss, sensory disturbances). Flammable.

Potential Health Effects

Primary Entry Routes: inhalation, skin contact/absorption, eyes, ingestion

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

Acute Effects

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

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

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

Eye: The liquid is highly discomforting to the eyes and is capable of causing 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 irritating to the eyes and may cause smarting, painand redness.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Skin: The liquid is discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.
Toxic effects may result from skin absorption.
Ingestion: The liquid is highly discomforting and harmful if swallowed.
Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.
Considered an unlikely route of entry in commercial/industrial environments.
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.
Chronic Effects: Chronic inhalation or skin exposure to n-hexane may cause peripheral neuropathy, which is damage to nerve ends in extremities, e.g. fingers, with loss of sensation and characteristic thickening. Nerve damage has been documented with chronic exposures of greater than 500 ppm.
Improvement in condition does not immediately follow removal from exposure and symptoms may progress for two or three months. Recovery may take a year or more depending on severity of exposure, and may not always be complete.
Exposure to n-hexane with methyl ethyl ketone (MEK) will accelerate the appearance of damage, but MEK alone will not cause the nerve damage.
Other isomers of hexane do not cause nerve damage.

Section 4 - First Aid Measures

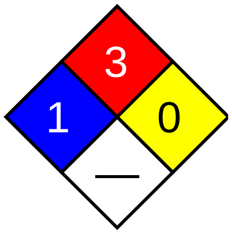
Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.
Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Following acute or short-term repeated exposures to n-hexane:
1.Large quantities of n-hexane are expired by the lungs after vapor exposure (50-60%). Humans exposed to 100 ppm demonstrate an n-hexane biological half life of 2 hours.
2. Initial attention should be directed towards evaluation and support of respiration. Cardiac dysrhythmias are a potential complication.
INGESTION:
1.Ipecac syrup should be considered for ingestion of pure hexane exceeding 2-3 mL/kg. Extreme caution must be taken to avoid aspiration since small amounts of n-hexane intratracheally, produce a severe chemical pneumonitis

BIOLOGICAL EXPOSURE INDEX - BEI
BEIs represent the levels of determinants which are most likely to be observed in specimens collected in a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
2,5-hexanedione in urine	5 mg/gm creatinine	End of shift	NS
n-Hexane in end-exhaled air			SQ

NS: Non-specific determinant; Metabolite observed following exposure to other materials.
SQ: Semi-quantitative determinant; Interpretation may be ambiguous - should be used as a screening test or confirmatory test.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: -22 °C
Autoignition Temperature: 225 °C
LEL: 1.1% v/v
UEL: 7.5% v/v
Extinguishing Media: Dry chemical powder. Foam.
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). May emit clouds of acrid smoke.
Fire Incompatibility: Avoid reaction with oxidizing agents.
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: Pollutant - clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or 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 products 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.
Avoid concurrent exposure to materials containing Methyl Ethyl Ketone MEK

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.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment

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

Hands/Feet: Polyethylene gloves. Wear chemical protective gloves, eg. PVC.
Wear safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >500 to <1100 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 1100 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:

PE/EVAL/PE	A
PVA	A
SARANEX-23 2-PLY	A
VITON	A
VITON/CHLOROBUTYL	A
TEFLON	B
NITRILE	B
NEOPRENE	C
NEOPRENE/NATURAL	C
NITRILE+PVC	C
PVC	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 highly flammable liquid with typical paraffinic odor; floats on water. Mixes with most other organic solvents, chloroform, ether, alcohol. A very volatile liquid, it readily forms explosive vapor /air mixes.

Physical State: Liquid
Vapor Pressure (kPa): 13.33
Vapor Density (Air=1): 2.97
Formula Weight: 86.17
Specific Gravity (H_2O=1, at 4 °C): 0.6603 at 20 °C
Water Solubility: 0.002% by weight
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point Range: 68.89 °C (156 °F)
Freezing/Melting Point Range: -100 °C (-148 °F) to -95 °C (-139 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization: Presence of heat source and ignition source. 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}: 28710 mg/kg
Inhalation (human) TC_{Lo}: 190 ppm/8W
Inhalation (rat) LD_{50}: 48000 ppm/4h

IRRITATION

Eye (rabbit): 10 mg - mild

See NIOSH, *RTECS* MN9275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Photolysis, hydrolysis or bioconcentration are not expected to be an important environmental fate processes. Biodegradation may occur in soil and water; however, volatilization and adsorption are expected to be far more important fate processes. A K_{oc} range of 1250 to 4100 indicates a low to slight mobility class in soil. In aquatic systems it may partition from the water column to organic matter contained in sediments and suspended materials. A Henry's Law constant of 1.81 atm-cu m/mole at 25 °C suggests rapid volatilization from environmental waters. The volatilization half-lives from a model river and a model pond, the latter considers the effect of adsorption, have been estimated to be 2.7 hr and 6.8 days, respectively. It is expected to exist entirely in the vapor-phase in ambient air. Reactions with photochemically produced hydroxyl radicals in the atmosphere have been shown to be important (average estimated half-life of 2.9 days). Data also suggests that nighttime reactions with nitrate radicals may contribute to atmospheric transformation, especially in urban environments.
Ecotoxicity: No data found.
Henry's Law Constant: calculated at 1.81
BCF: estimated at 2.24 to 2.89
Biochemical Oxygen Demand (BOD): theoretical 0%, 7 days
Octanol/Water Partition Coefficient: log K_{ow} = 4.11
Soil Sorption Partition Coefficient: K_{oc} = estimated at 1250 to 4100

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: HEXANES
Hazard Class: 3.1
ID No.: 1208
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information: METHYLPENTANES

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
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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Issue Date: 2000-07

Nitric Acid
MSDS 7
NIT1080

Section 1 - Chemical Product and Company Identification 54.1

Material Name: Nitric Acid **CAS Number:** 7697-37-2
Chemical Formula: HNO_3
Structural Chemical Formula: HNO_3
Synonyms: ACIDE NITRIQUE; ACIDO NITRICO; AQUA FORTIS; AZOTIC ACID; AZOTOWY KWAS; ENGRAVER'S ACID; ENGRAVERS ACID; HYDROGEN NITRATE; KYSELINA DUSICNE; NITAL; NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH >70% NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH NOT >70% NITRICACID; NITROUS FUMES; NITRYL HYDROXIDE; RED FUMING NITRIC ACID (RFNA); SALPETERSAURE; SALPETERZUUROPLOSSINGEN; WHITE FUMING NITRIC ACID (WFNA)
General Use: Manufacture of organic and inorganic nitrates and nitro compounds for fertilizers, dye intermediates and many organic chemicals.
Used for etching and cleaning metals.
Operators should be trained in procedures for safe use of this material.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
nitric acid	7697-37-2	>95

OSHA PEL
TWA: 2 ppm; 5 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 2 ppm; 5 mg/m^3; STEL: 4 ppm; 10 mg/m^3.

ACGIH TLV
TWA: 2 ppm; 5.2 mg/m^3; STEL: 4 ppm; 10 mg/m^3.

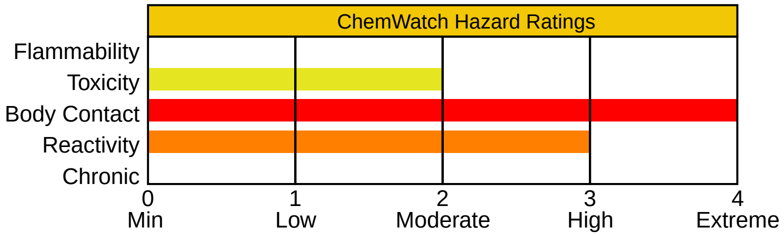
NIOSH REL
TWA: 2 ppm; 5 mg/m^3. STEL: 4 ppm; 10 mg/m^3.

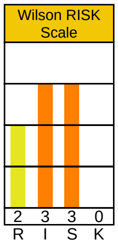
IDLH Level
25 ppm.

DFG (Germany) MAK
TWA: 2 ppm; 5 mg/m^3.

Section 3 - Hazards Identification

HMIS
3 Health
0 Flammability
0 Reactivity





Fire Diamond

ANSI Signal Word

Danger!

Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear to yellow fuming liquid; acrid, suffocating odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Also causes: heavy exposures: lung damage. Chronic: tooth erosion, bronchitis. Strong oxidizer capable of igniting combustibles.

Potential Health Effects

Primary Entry Routes: inhalation, ingestion, skin contact, eye contact
Target Organs: eyes, skin, respiratory system, teeth

Acute Effects

Inhalation: The vapor is extremely discomforting and corrosive to the upper respiratory tract and lungs and the material presents a hazard from a single acute exposure or from repeated exposures over long periods.
Inhalation hazard is increased at higher temperatures.
Reactions may occur following a single acute exposure or may only appear after repeated exposures.
Reactions may not occur on exposure but response may be delayed with symptoms only appearing many hours later.
The material may produce respiratory tract irritation which produces an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system. Unlike most organs the lung can respond to a chemical insult or agent by first trying to remove or neutralize the irritant and then repairing the damage. The repair process, which initially developed to protect mammalian lungs from foreign matter and antigens, may however, cause further damage the lungs when activated by hazardous chemicals. The result is often the impairment of gas exchange, the primary function of the lungs.
Inhalation of nitric acid mist or fumes at 2 to 25 ppm over an 8 hour period may cause pulmonary irritation and symptoms of lung damage.
Only several minutes of exposure to concentrated atmosphere i.e. 200 ppm may cause severe pulmonary damage and even fatality. Death may be delayed for several days.
Exposure to nitric acid fumes (with concurrent inhalation of nitrogen dioxide and nitric oxide) may elicit prompt irritation of the upper respiratory tract leading to coughing, gagging, chest pain, dyspnea, cyanosis if concentrations are sufficiently high and duration of exposure sufficiently long, pulmonary edema.

Eye: The liquid is extremely corrosive to the eyes and contact may cause rapid tissue destruction and is capable of causing severe damage with loss of sight.
The vapor 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.
The material may produce moderate eye irritation leading to inflammation.
Repeated or prolonged exposure to irritants may produce conjunctivitis.
Eye contact with concentrated acid may give no pain, whilst diluted solution causes intense pain and both can cause permanent eye damage or blindness. Burns may result in shrinkage of the eyeball, symblepharon (adhesions between tarsal and bulbar conjunctivae), permanent corneal opacification, and visual impairment leading to blindness.

Skin: The liquid is extremely corrosive to the skin and contact may cause tissue destruction with severe burns.
Bare unprotected skin should not be exposed to this material.
The vapor is highly discomforting to the skin.
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 contact causes yellow discoloration of the skin, blisters and scars that may not heal. The skin may be stained bright-yellow or yellowish brown due to the formation of xanthoproteic acid. Dilute solutions may harden the epithelium without producing overt corrosion.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The material is extremely corrosive if swallowed and is capable of causing burns to mouth, throat, esophagus, with extreme discomfort, pain and may be fatal.
Even a small amount causes severe corrosion of the stomach, burning pain, vomiting and shock, possibly causing non-healing scarring of the gastrointestinal tract and stomach. Death may be delayed 12 hours to 14 days or to several months. Such late fatalities are attributed to a chemical lobular pneumonitis secondary to aspiration. Survivors show stricture of the gastric mucosa and subsequent pernicious anemia.

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

Chronic Effects: Prolonged or repeated overexposure to low concentrations of vapor may cause chronic bronchitis, corrosion of teeth, even chemical pneumonitis.

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.
Immediately transport to hospital or doctor. DO NOT delay.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.

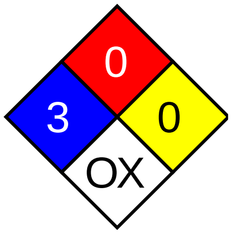
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor. DO NOT delay.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Immediately transport to hospital or doctor. DO NOT delay.

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

Note to Physicians: For acute or short-term repeated exposures to strong acids:
1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.
3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.
INGESTION:
1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.
2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
4.Charcoal has no place in acid management.
5.Some authors suggest the use of lavage within 1 hour of ingestion.
SKIN:
1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
2.Deep second-degree burns may benefit from topical silver sulfadiazine.
EYE:
1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.
2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.
3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Will not burn but increases intensity of fire.
Heating may cause expansion or decomposition leading to violent rupture of containers. Heat affected containers remain hazardous.
Contact with combustibles such as wood, paper, oil or finely divided metal may cause ignition, combustion or violent decomposition.
May emit irritating, poisonous or corrosive fumes.
Decomposes on heating and produces toxic fumes of nitrogen oxides (NO_x) and nitric acid.

Fire Incompatibility: Oxidizing agents as a class are not necessarily combustible themselves, but can increase the risk and intensity of fire in many other substances.
Reacts vigorously with water and alkali.
Avoid reaction with organic materials/compounds, powdered metals, reducing agents and hydrogen sulfide (H_2S) as ignition may result.
Reacts with metals producing flammable/explosive hydrogen gas.

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.
Extinguishers should be used only by trained personnel.
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.
If fire gets out of control withdraw personnel and warn against entry.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Dangerous levels of nitrogen oxides may form during spills of nitric acid.
Wear fully protective PVC clothing and breathing apparatus.
Clean up all spills immediately. No smoking, bare lights, ignition sources.
Avoid all contact with any organic matter including fuel, solvents, sawdust, paper or cloth and other incompatible materials, as ignition may result.
Avoid breathing dust or vapors and all contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with dry sand, earth, inert material or vermiculite. DO NOT use sawdust as fire may result.
Scoop up solid residues and seal in labeled drums for disposal.
Neutralize/decontaminate area.
Use soda ash or slaked lime to neutralize.
Large Spills: DO NOT touch the spill material. Restrict access to area.
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.
No smoking, flames or ignition sources. Increase ventilation.
Contain spill with sand, earth or other clean, inert materials.
NEVER use organic absorbents such as sawdust, paper, cloth; as fire may result. Avoid any contamination by organic matter.
Use spark-free and explosion-proof equipment.
Collect any recoverable product into labeled containers for possible recycling. DO NOT mix fresh with recovered material.
Collect residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains. Decontaminate equipment and launder all protective clothing before storage and reuse.
If contamination of drains or waterways occurs advise emergency services.
DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Do not allow clothing wet with material to stay in contact with skin.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
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.
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: Stainless steel drum. Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

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: Bare unprotected skin should not be exposed to this material. Impervious, gauntlet length gloves i.e., butyl rubber gloves or Neoprene rubber gloves or wear chemical protective gloves, e.g. PVC.
Wear safety footwear or safety gumboots, e.g. Rubber.

Respiratory Protection:
Exposure Range >2 to <25 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 25 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

Other: Operators should be trained in procedures for safe use of this material.
Acid-resistant overalls or Rubber apron or PVC apron.
Ensure there is ready access to an emergency shower.
Ensure that there is ready access to eye wash unit.
Ensure that there is ready access to breathing apparatus.

Glove Selection Index:

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to slightly yellow liquid. Sharp strong odor.
CAUTION: exothermic dilution hazard.
HIGHLY CORROSIVE. Corrosive to most metals. Powerful oxidizing agent.
Darkens to brownish color on aging and exposure to light.

Physical State: Liquid
Vapor Pressure (kPa): 8.26
Vapor Density (Air=1): 1.5
Formula Weight: 63.02
Specific Gravity (H_2O=1, at 4 °C): 1.3-1.42
Water Solubility: Soluble in all proportions

pH: < 1
pH (1% Solution): 1
Boiling Point Range: 83 °C (181 °F) at 760 mm Hg
Freezing/Melting Point Range: -42 °C (-43.6 °F)
Volatile Component (% Vol): 100 (nominal)
Decomposition Temperature (°C): Not applicable

Section 10 - Stability and Reactivity

Stability/Polymerization: Presence of heat source and direct sunlight. Storage in unsealed containers. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from reducing agents, finely divided combustible materials, combustible materials, sawdust, metals and powdered metals.
Avoid contamination of water, foodstuffs, feed or seed.
Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.

Section 11 - Toxicological Information

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

TOXICITY	IRRITATION
Oral (human) LD_{Lo}: 430 mg/kg	Nil reported
Inhalation (rat) LC_{50}: 2500 ppm/1 hr	
Unreported (man) LD_{Lo}: 110 mg/kg	

See NIOSH, *RTECS* QU 5775000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: LC_{50} Starfish 100-300 mg/l/48 hr /Aerated water conditions; LC_{50} Shore crab 180 mg/l/48 hr /Static, aerated water conditions; LC_{50} Cockle 330-1000 mg/l/48 hr /Aerated water conditions

BCF: no food chain concentration potential

Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Special hazards may exist - specialist advice may be required.
Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Treat and neutralize at an approved treatment plant.
Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.
Puncture containers to prevent reuse and bury at an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: NITRIC ACID
Hazard Class: 8
ID No.: 2031
Packing Group: I
Label: Corrosive[8],Oxid.Agent

Additional Shipping Information:

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 1000 lb
- **SARA EHS 40 CFR 355:** Listed 1,000 lb
- **TSCA:** Listed

Section 16 - Other Information

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

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1,4-Dichlorobenzene
DIC2450

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification

Material Name: 1,4-Dichlorobenzene **CAS Number:** 106-46-7
Chemical Formula: $C_6H_4Cl_2$
Structural Chemical Formula: $C_6H_4Cl_2$
EINECS Number: 203-400-5
ACX Number: X1001577-1
Synonyms: 1,4-Dichlorobenzene; 1,4-DICHLOROBENZENE; BENZENE,1,4-DICHLORO-; BENZENE,P-DICHLORO-; P-CHLOROPHENYL CHLORIDE; PARA CRYSTALS; P-DCB; 1,4-DICHLOORBENZEEN; P-DICHLOORBENZEEN; 1,4-DICHLOR-BENZOL; P-DICHLORBENZOL; DI-CHLORICIDE; P-DICHLOROBENZENE; PARA-DICHLOROBENZENE; DICHLOROBENZENE,PARA,SOLID; P-DICHLOROBENZOL; PARA-DICHLOROBENZOL; DICHLOROCIDE; 1,4-DICLOROBENZENE; P-DICLOROBENZENE; EPA PESTICIDE CHEMICAL CODE 061501; EVOLA; GLOBOL; PARACIDE; PARADI; PARADICHLORBENZOL; PARADICHLOROBENZENE; PARADICHLOROBENZOL; PARADOW; PARAMOTH; PARANUGGETS; PARAZENE; PDB; PDCB; PERSIA-PERAZOL; SANTOCHLOR
General Use: As an insecticidal fumigant, moth repellant for fabric and fur, germicide. Deodorant toilet blocks, urinal disinfectant. As a space odorant. In dyes, intermediates, pharmacy, agriculture (fumigating soil); In the manufacture of 2,5-dichloroaniline.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,4-dichlorobenzene	106-46-7	>97

OSHA PEL
TWA: 75 ppm; 450 mg/m^3.

NIOSH REL

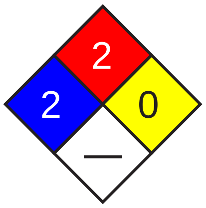
DFG (Germany) MAK
Skin.

OSHA PEL Vacated 1989 Limits
TWA: 75 ppm; 450 mg/m^3; STEL: 110 ppm; 675 mg/m^3.

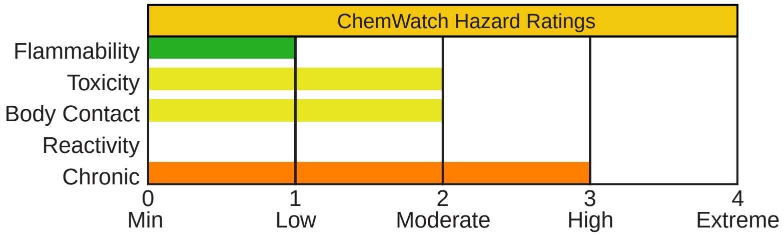
IDLH Level
150 ppm.

ACGIH TLV
TWA: 10 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
2	Flammability
0	Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Volatile, white crystals; mothball-like odor. Severely irritating. Other Acute Effects: hemolytic anemia, jaundice, methemglobinemia. Chronic Effects: lung granulomatosis, liver abnormalities, kidney damage, anemia, cataracts. Possible cancer hazard. Combustible.

Potential Health Effects

Target Organs: liver, respiratory system, eyes, kidneys, skin
Primary Entry Routes: inhalation, skin contact

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract if inhaled and the material may present a hazard from repeated exposures over long periods. The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

The physiological response to p-DCB is primarily injury to the liver and secondarily to the kidneys. Central nervous system depression will occur at concentrations that are extremely objectionable to the eyes and nose.

Individuals exposed to higher concentrations may show weakness, dizziness and weight loss. Vomiting may occur. Acute hemolytic anemia with methemoglobinemia has been reported.

Prolonged inhalation exposure may cause dizziness, headache nausea, vomiting, central nervous system depression and damage to liver and kidneys.

Rabbits exposed 8 hours/day for a total of 62 exposures in 83 days at 770-800 ppm exhibited tremors, weakness, and death along with edema of the cornea and opacity of the lens.

Eye: The material is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.

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

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

The vapor from heated material is highly discomforting to the eyes.

Vapors from heated material may cause mild corneal damage.

Solid particles in the eye are reported to be very painful. At workplace concentrations ranging from 50-170 ppm periodic medical examination found no evidence of adverse effects in workers with particular reference to ocular lesions including cataracts. Painful irritation of eyes and nose has been recorded at 80-160 ppm.

Skin: The material is moderately discomforting to the skin and it is absorbed by skin.

Toxic effects may result from skin absorption. Absorption by skin may readily exceed vapor inhalation exposure. Symptoms for skin absorption are the same as for inhalation. Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.

Skin contact may result in irritation, burning sensation, skin defatting and possible dermatitis. Skin contact resulted in dermatitis when workers handled cakes of the pure chemical. Prolonged occlusive contact will produce a burning sensation.

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

The material is discomforting and toxic if swallowed.

Large doses have caused tremor in exposed animals; insects exhibit symptoms resembling DDT poisoning.

Hepatic porphyria was produced in rats following seven consecutive doses of 770 mg p-DCB/kg. Slight to moderate corneal opacity was noted in rabbits following 3 weeks of daily dosing with 5000 mg/kg. Rats receiving a daily dose of 500 mg/kg for 20 days showed cloudy swelling and necrosis in the central areas of the liver lobules and swelling of the renal tubular epithelium. 100 mg/kg daily doses did not reproduce this finding. Pale and mottled kidneys were seen in rats given oral doses of 70 to 428 mg/kg/day for 28 days. Rats given 1200 mg/kg for 13 weeks showed degeneration and necrosis of hepatocytes, hypoplasia of the bone marrow, lymphoid depletion of the spleen and thymus, and epithelial necrosis of the nasal turbinates and small intestinal mucosa. At doses of 300 mg/kg male rats showed kidney damage characterized by degeneration or necrosis of the renal cortical tubular epithelial cells. Female rats did not show these lesions even at doses of 1500 mg/kg.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: In individuals exposed chronically to p-DCB, liver effects including jaundice, cirrhosis, and possible death may occur. Chronic exposure may also produce weakness, headache, rhinitis, twitching of the facial muscles. A woman who consumed 4 to 5 moth ball pellets daily for 2.5 years developed unsteady gait, tremors of the hand and general mental sluggishness which disappeared 4 months after exposure ceased. Eight workers manufacturing p-DCB based mothproofing agents for 1 to 7 months developed neural disorders including intensified muscle reflexes, mild clonus of the ankle and tremors of the fingers. They reported loss of appetite and hemopoietic changes.

Rats treated for 2 years with gastric intubation showed kidney lesion and in the male, hyperplasia of the thyroid at dose rates of 150 mg/kg.

Mice treated with 300 mg/kg in a similar 2 year gavage study showed liver changes characterized by hepatocellular degeneration. Thyroid follicular cell hyperplasia was increased in male but not female mice. Nephropathy consisting primarily of degeneration of the cortical tubular epithelium was seen and was more pronounced in males.

Rats, guinea pigs, rabbits, mice and monkeys exposed by inhalation 7 hours/day, 5 days/week for 140 exposures at 800 ppm exhibited tremor, weight loss and liver changes, including swelling and central necrosis in female rats, and swelling of the kidney epithelium.

An increase in liver tumors (e.g. renal tubular cell adenocarcinomas) was seen in male rats treated by gastric intubation doses of 150 mg/kg for 2 years. No evidence of carcinogenicity was seen in female rats. An increase incidence of hepatocellular carcinomas and adenomas was seen in mice treated with gavage doses of 300 mg/kg/day for 2 years. A positive dose-trend for adrenal gland pheochromocytomas in male mice was also reported.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

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

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

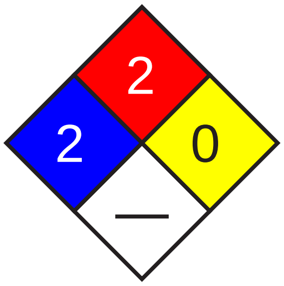
Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.
Avoid giving milk or oils.

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

Note to Physicians: Treat symptomatically.
EYES - Stain for evidence of corneal injury.
SKIN - Treat as for dermatitis.
RESPIRATION - Administer oxygen if available. The use of bronchodilators, expectorants and antitussives may help.
There is no antidote for systemic effects.
Readily absorbed after oral administration to rats and found in all organs with accumulation in adipose tissues. 90% of the dose is excreted within 48 hours. Two metabolites, 2,5-dichlorophenylmethylsulfone and 2,5-dichlorophenylsulfoxide are detected in the blood (though not the compound itself). Slow release from the adipose tissues is probably responsible for the persistence of these metabolites. 2,5-dichlorophenol is detected in plasma, urine, liver, kidneys and fatty tissues - in humans this metabolite is a useful monitor of exposure. An occupational exposure for 1 week to 7.4 ppm p-DCB produced an increase of p-DCB in the urine as a direct measurement.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: 65.556 °C Closed Cup
Autoignition Temperature: > 482 °C
LEL: 2.5% v/v
UEL: 16% v/v

Extinguishing Media: Water spray or fog; foam.
Dry chemical powder.
Alcohol stable foam.
Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Combustible. Slight fire hazard when exposed to heat or flame.
Heat may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit acrid smoke. May emit poisonous fumes.
Decomposes on heating and produces toxic fumes of hydrogen chloride, chlorine, carbon monoxide (CO), phosgene and carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result. Avoid contact with aluminum, powdered metals.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid contact with skin and eyes.
Control personal contact by using protective equipment.
Use dry clean-up procedures and avoid generating dust.

Place in a suitable labeled container for waste disposal.

Large Spills: Clear area of personnel and move upwind. Slippery when spilled.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Collect solid residues and seal in labeled drums for disposal.
Wash area with detergent and water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

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

Section 7 - Handling and Storage

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

Recommended Storage Methods: Glass container; Metal can. Steel drum.
DO NOT use aluminum or galvanized containers.
Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

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

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:
Exposure Range >75 to <150 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 150 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)

Other: Overalls. Eyewash unit.

Glove Selection Index:

NEOPRENE	Satisfactory; may degrade after 4 hours continuous immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Volatile, white crystals with penetrating, aromatic odor. Sublimes (evaporates) at room temperature. Soluble in alcohol, acetone aromatics.

Physical State: Divided solid
Vapor Pressure (kPa): 1.33 at 54.8 °C
Vapor Density (Air=1): 5.08
Formula Weight: 147.0
Specific Gravity (H_2O=1, at 4 °C): 1.46
Evaporation Rate: Slow
pH (1% Solution): Not applicable.
Boiling Point: 174 °C (345 °F) at 760 mm Hg

Freezing/Melting Point: 53.1 °C (127.58 °F)
Decomposition Temperature (°C): >55
Volatile Component (% Vol): 100
Water Solubility: 65.3 mg/L at 25 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers. DO NOT use aluminum or galvanized containers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 2000-3000 mg/kg
Oral (human) LD_{Lo}: 857 mg/kg
Oral (human) TD_{Lo}: 300 mg/kg
Oral (rat) LD_{50}: 500 mg/kg
Dermal (rabbit) LD_{50}: >2000 mg/kg
Intraperitoneal (rat) LD_{50}: 2562 mg/kg
Oral (mouse) LD_{50}: 2950 mg/kg
Intraperitoneal (mouse) LD_{50}: 2000 mg/kg
Oral (rabbit) LD_{50}: 2830 mg/kg
Dermal (rabbit) LD_{50}: >2000 mg/kg
Eye effects, respiratory tract changes, diarrhea, specific developmental effects (cardiovascular system) recorded.

Irritation
Eye (human): 80 ppm

See *RTECS* HT 7525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it can be moderately to tightly adsorbed. Leaching from hazardous waste disposal areas has occurred and the detection in various groundwaters indicates that leaching can occur. Volatilization from soil surfaces may be an important transport mechanism. It is possible it will be slowly biodegraded in soil under aerobic conditions. Chemical transformation by hydrolysis, oxidation or direct photolysis are not expected to occur in soil. If released to water, volatilization may be the dominant removal process. The volatilization half-life from a model river one meter deep flowing one meter/sec with a wind velocity of 3 m/sec is estimated to be 4.3 hours at 20 °C. Adsorption to sediment will be a major environmental fate process based upon extensive monitoring data in the Great Lakes area and K_{oc} values based upon monitoring samples. Analysis of Lake Ontario sediment cores has indicated presence and persistence since before 1940. Adsorption to sediment will attenuate volatilization. Aerobic biodegradation in water may be possible, however, anaerobic biodegradation is not expected to occur. For the most part, experimental BCF values reported in the literature are less than 1000 which suggests that significant bioconcentration will not occur; however, a BCF of 1800 was determined for guppies in one study. Aquatic hydrolysis, oxidation and direct photolysis are not expected to be important. If released to air it will exist predominantly in the vapor-phase and will react with photochemically produced hydroxyl radicals at an estimated half-life rate of 31 days in typical atmosphere. Direct photolysis in the troposphere is not expected to be important. The detection in rain-water suggests that atmospheric removal via wash-out is possible.
Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 4.0 ppm/14 days /Conditions of bioassay not specified; LC_{50} Lepomis macrochirus (bluegill sunfish) 4.54 mg/l/24 hr; 4.3 mg/l/48 hr; 4.25 mg/l/96 hr /Static bioassay; LC_{50} Sheepshead minnow 7.5-10 mg/l/24 hr; 7.17 mg/l/48 hr; 7.4 mg/l/96 hr /Static bioassay
Henry's Law Constant: 0.0015
BCF: increases with log p
Octanol/Water Partition Coefficient: log K_{ow} = 3.39
Soil Sorption Partition Coefficient: K_{oc} = 273

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U072 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

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

Material Safety Data Sheet Collection

Genium group inc.

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Issue Date: 2005-05

Phenol
PHE3200

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Phenol **CAS Number:** 108-95-2

Chemical Formula: C_6H_6O

Structural Chemical Formula: C_6H_5OH

EINECS Number: 203-632-7

ACX Number: X1001304-8

Synonyms: ACIDE CARBOLIQUE; BAKER'S P AND S LIQUID AND OINTMENT; BENZENOL; CARBOLIC ACID; CARBOLSAURE; FENOL; FENOLO; HYDROXYBENZENE; IZAL; MONOHYDROXYBENZENE; MONOPHENOL; OXYBENZENE; PHENIC ACID; PHENOL; PHENOL ALCOHOL; PHENOLE; PHENOL,MOLTEN; PHENYL ALCOHOL; PHENYL HYDRATE; PHENYL HYDROXIDE; PHENYLIC ACID; PHENYLIC ALCOHOL

General Use: Used as a general disinfectant, either in solution or mixed with slaked lime, etc., for toilets, stables, cesspools, floors, drains, etc.; for the manufacture of colorless or light-colored artificial resins.
Also used in many medicinal and industrial compounds and dyes; as a reagent in chemical analysis.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
phenol	108-95-2	>99

OSHA PEL
TWA: 5 ppm; 19 mg/m^3; skin.

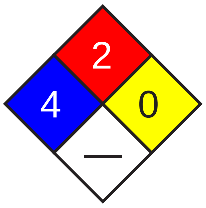
ACGIH TLV
TWA: 5 ppm; skin.

NIOSH REL
TWA: 5 ppm, 19 mg/m^3; Ceiling: 15.6 ppm; 60 mg/m^3, 15-minute; skin.

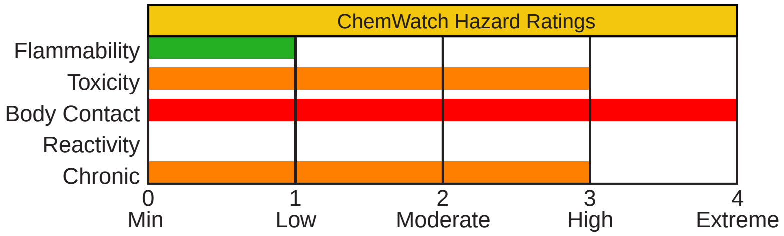
IDLH Level
250 ppm.

DFG (Germany) MAK
Skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
3 Health
2 Flammability
0 Reactivity

ANSI Signal Word

Danger!

Poison

Corrosive

☆☆☆☆☆ **Emergency Overview** ☆☆☆☆☆

White, crystalline solid; medicinal odor. Corrosive. Poison. Other Acute Effects: severe neurological effects (shock and coma), liver/kidney damage, absorbed through skin. Combustible.

Potential Health Effects

Target Organs: liver, kidneys, nervous system, skin

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

Acute Effects

Inhalation: The vapor is extremely discomforting to the upper respiratory tract, may cause severe mucous membrane damage and may be harmful if inhaled.
Pulmonary absorption may lead to systemic toxicity affecting the cardiovascular and central nervous system.
Inhalation of phenol and some of its derivatives may produce profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis, hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema with pneumonia. Respiratory failure and kidney damage may follow.
Inhalation of the vapor causes a sore throat, coughing, shortness of breath and labored breathing.

Systemic effects include paleness, weakness, headache, sweating, ringing of the ears, shock, cyanosis, excitement, dark colored urine, frothing of the nose and mouth.

Pulmonary inflammation and pneumonia, inflammation and necrosis of the myocardium, hepatic centro-lobular necrosis, renal proximal tube swelling and edema and globular degeneration and hind-limb paralysis was observed in guinea-pigs exposed 29 times for 7 hours/day, five days/week to concentrations ranging from 26 to 52 ppm.

Eye: The material is highly corrosive to the eyes and is capable of causing severe burns and capable of causing severe damage with loss of sight.

The vapor from heated material is highly discomforting to the eyes.

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

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

Some phenol derivatives may produce mild to severe eye irritation with redness, pain and blurred vision. Permanent eye injury may occur; recovery may also be complete or partial.

Skin: The solid/dust is corrosive to the skin, may cause blisters or burns or severe burns and is it is rapidly absorbed by the skin.

Toxic effects may result from skin absorption.

Phenol and some of its derivatives may produce mild to severe skin irritation on repeated or prolonged contact, producing second and third degree chemical burns. Rapid cutaneous absorption may lead to systemic toxicity affecting the cardiovascular and central nervous system.

Absorption through the skin may result in profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis (following the formation of methemoglobin), hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema followed by pneumonia. Respiratory failure and kidney damage may follow.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).

This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.

Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Contact with the skin causes a white, wrinkled discoloration followed by a severe burn or systemic poisoning if not promptly and properly removed.

Intense burning and pain from skin contact may be delayed. Extreme dangers are posed by percutaneous absorption.

In one case a 32 year old male who spilled a solution of phenol over his scalp, face, neck, shoulders and back, died 10 minutes later.

There was coagulation necrosis of the skin, left eye and acute dermatitis veneta with acute passive congestion of the lungs, liver, spleen, kidneys.

Skin absorption occurs at low vapor pressure, without apparent discomfort and proceeds with the same efficiency as absorption by inhalation.

Damage to the lungs has been described following percutaneous absorption.

Methemoglobinemia and hemolytic anemia are frequently documented.

Ingestion: The material is corrosive to the gastrointestinal tract, may cause severe mucous membrane damage and may be fatal if swallowed.

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

Ingestion of phenol causes blotches on the lips and in the mouth.

Some phenol derivatives may produce mild to severe damage within the gastrointestinal tract. Phenolic groups with ortho and para positions free from substitution are reactive; this is because the ortho and para positions on the aromatic ring are highly activated by the phenolic hydroxyl group and are therefore readily substituted.

Severe phenol ingestions cause hypotension, coma, ventricular dysrhythmias, seizures and white coagulative chemical burns.

Absorption may result in profuse perspiration, intense thirst, nausea, vomiting, diarrhea, cyanosis (following the formation of methemoglobin), hyperactivity, stupor, falling blood pressure, hypernea, abdominal pain, hemolysis, convulsions, coma and pulmonary edema followed by pneumonia.

Respiratory failure and kidney damage may follow. Phenol does not uncouple oxidative phosphorylation like dinitrophenol and pentachlorophenol and thus does not cause a heat exhaustion-like syndrome.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Prolonged exposure to some derivatives of phenol may produce dermatitis, anorexia, weight loss, weakness, muscle aches and pain, liver damage, dark urine, ochronosis, skin eruptions, diarrhea, nervous disorders with headache, salivation, fainting, increased skin and scleral pigmentation, vertigo and mental disorders. Liver and kidney damage may also ensue. Chronic phenol toxicity was first noted in medical personnel in the late 1800s when 5 and 10% phenol was used as a skin disinfectant. The term carbolic (phenol) marasmus was given to this syndrome.

Chronic phenol poisoning is very rarely reported, but symptoms include vomiting, difficulty in swallowing, diarrhea, lack of appetite, headache, fainting, dizziness, dark urine, mental disturbances, and possibly skin rash. Death due to liver and kidney damage may occur.

Repeated exposure of animals to phenol vapor at concentrations ranging from 26 to 52 ppm has produced respiratory, cardiovascular, hepatic, renal and neurologic toxicity.

Administration of phenol in the drinking water of mice (2500 ppm for 103 weeks) produced an increased incidence of leukemia and lymphomas.

Phenol has been studied in initiation/promotion protocols with a number of polycyclic hydrocarbons and has been shown to have promoting activity in the two-stage skin model.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

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

Skin Contact: If spilled on skin remove contaminated clothing, swab repeatedly with glycerin, PEG (polyethylene glycol), or PEG/ methylated spirit mixture or if necessary with methylated spirit alone.

Contamination of skin with phenol and some of its derivatives may produce rapid collapse and death. After skin contamination, keep patient under observation for at least 24-48 hours. Phenol-decontaminating fluid is more effective than water in removing phenol from the skin and retarding absorption; olive oil or vegetable oil may also be used; do not use mineral oil. Alcohols (methylated spirit, for example) may enhance absorption and their use alone may be ill-advised; some authorities, however, continue to advise the use of such treatment. Rapid water dilution of phenol burns may increase systemic absorption by decreasing the extent of the coagulum and thus allowing greater absorption.

Transport to hospital (or doctor).

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: * Provide preplacement and annual medical examinations for employees exposed to phenol.

Persons with a history of convulsive disorders or abnormalities of the skin, respiratory tract, liver or kidneys would be expected to be at increased risk from exposure. Examination of the liver, kidneys and respiratory tract should be stressed. A urinalysis should be performed including at a minimum, specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

For acute or short-term repeated exposures to phenols/ cresols:

1.Phenol is absorbed rapidly through lungs and skin. Massive skin contact may result in collapse and death.

2.Ingestion may result in ulceration of upper respiratory tract; perforation of esophagus and/or stomach, with attendant complications, may occur. Esophageal stricture may occur.

3.An initial excitory phase may present. Convulsions may appear as long as 18 hours after ingestion. Hypotension and ventricular tachycardia that require vasopressor and antiarrhythmic therapy, respectively, can occur.

4.Respiratory arrest, ventricular dysrhythmias, seizures and metabolic acidosis may complicate severe phenol exposures so the initial attention should be directed towards stabilization of breathing and circulation with ventilation, intubation, intravenous lines, fluids and cardiac monitoring as indicated.

5.Vegetable oils retard absorption; do NOT use paraffin oils or alcohols. Gastric lavage, with endotracheal intubation, should be repeated until phenol odor is no longer detectable; follow with vegetable oil. A saline cathartic should then be given. ALTERNATELY: Activated charcoal (1g/kg) may be given. A cathartic should be given after oral activated charcoal.

6.Severe poisoning may require slow intravenous injection of methylene blue to treat methemoglobinemia.

7.Renal failure may require hemodialysis.

8.Most absorbed phenol is biotransformed by the liver to ethereal and glucoronide sulfates and is eliminated almost completely after 24 hours

BIOLOGICAL EXPOSURE INDEX - BEI

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

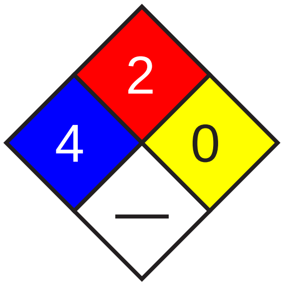
Determinant	Index	Sampling Time	Comments
Total phenol in blood	250 mg/gm creatinine	End of shift	B, NS

B: Background levels occur in specimens collected from subjects NOT exposed
NS: Non-specific determinant; also seen after exposure to other materials.

Section 5 - Fire-Fighting Measures

Flash Point: 79 °C Closed Cup
Autoignition Temperature: 715 °C
LEL: 1.7% v/v
UEL: 8.6% v/v
Extinguishing Media: Carbon dioxide; dry chemical powder.
Alcohol stable foam.
General Fire Hazards/Hazardous Combustion Products: Combustible. Moderate fire hazard when exposed to heat, flame or oxidizers.
Vapor may readily form an explosive mixture with air.
Decomposes on heating and produces toxic fumes of carbon monoxide (CO), carbon dioxide (CO_2).

See DOT ERG



Fire Diamond

Fire Incompatibility: Avoid reaction with strong oxidizing agents and halogens.
Reaction with calcium hypochlorite is exothermic and produces toxic fumes which may ignite. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium and zinc.
Do not heat phenol above 60 °C.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Use water delivered as a fine spray to control the fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: POLLUTANT -contain spillageEnvironmental hazard - contain spillage.
Wear protective clothing, impervious gloves and safety glasses.
Avoid breathing vapors and contact with skin and eyes.
Use dry clean-up procedures and avoid generating dust.
Place spilled material in clean, dry, sealable, labeled container.
Wash area down with large quantity of water and prevent runoff into drains.
Large Spills: POLLUTANT -contain spillageEnvironmental hazard - contain spillage.
Clear area of personnel and move upwind.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
If contamination of drains or waterways occurs, advise emergency services.
Shut off all possible sources of ignition and increase ventilation.
Stop leak if safe to do so.
Use dry clean-up procedures and avoid generating dust.
Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Use in a well-ventilated area.
Wear personal protective equipment when handling.
Avoid contact with incompatible materials.
Avoid smoking, bare lights or ignition sources.
Vapor may travel a considerable distance to source of ignition.
Avoid thermal shock.
Avoid physical damage to containers.
Handle and open container with care.

When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.

Recommended Storage Methods: Polylined drum. Stainless steel.
Steel drum.
Check that containers are clearly labeled.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Neoprene gloves; PVC gloves.
Rubber boots.

Respiratory Protection:
Exposure Range >5 to 50 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to <250 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range 250 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)

Other: Acid-resistant overalls.
PVC apron.
Hard hat with brim.
Ensure there is ready access to a safety shower.
Eyewash unit.

Glove Selection Index:

BUTYL	Best selection
BUTYL/NEOPRENE	Best selection
NATURAL+NEOPRENE	Best selection
NEOPRENE/NATURAL	Best selection
PE/EVAL/PE	Best selection
VITON	Best selection
VITON/NEOPRENE	Best selection
NEOPRENE	Best selection
TEFLON	Best selection
NATURAL RUBBER	Satisfactory; may degrade after 4 hours continuous immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
NAT+NEOPR+NITRILE	Poor to dangerous choice for other than short-term immersion
PVA	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: White, crystalline solid with a characteristic sharp medicinal, sweet, tangy odor, which is detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities, or if it is exposed to heat or light. Soluble in benzene. Very soluble in alcohol, chloroform, ether, glycerol, carbon disulfide, petrolatum, volatile and fixed oils, aqueous alkali hydroxides.

Physical State: Divided solid
Vapor Pressure (kPa): 101.33 at 181 °C
Vapor Density (Air=1): 3.24
Formula Weight: 94.11
Specific Gravity (H_2O=1, at 4 °C): 1.06 at 20 °C

Boiling Point: 181.8 °C (359 °F) at 760 mm Hg
Freezing/Melting Point: 40.9 °C (105.62 °F)
Volatile Component (% Vol): 100
Water Solubility: 1 g/15 ml water

Section 10 - Stability and Reactivity

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

Storage Incompatibilities: Segregate from strong oxidizers, halogens, calcium hypochlorite, and metals such as aluminum, lead, zinc, magnesium.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 317 mg/kg
Oral (human) LD_{Lo}: 140 mg/kg
Inhalation (rat) LC_{50}: 316 mg/m^3
Dermal (rabbit) LD_{50}: 850 mg/kg

Irritation

Skin (rabbit): 500 mg/24hr - SEVERE
Skin (rabbit): 500 mg open -SEVERE
Eye (rabbit): 5 mg - SEVERE
Eye (rabbit): 100 mg rinse - mild

See *RTECS* SJ 3325000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the environment, the primary removal mechanism is biodegradation which is generally rapid (days). Since it is a benchmark chemical for biodegradability studies, there is a large body of information on its degradation which concludes that it rapidly degrades in sewage, soil, fresh water and seawater. Acclimation of resident populations of microorganisms is rapid. Under anaerobic conditions degradation is slower and microbial adaptation periods longer. If released to soil, it will readily leach and biodegrade. The biodegradation in soil is generally rapid with half-lives of under 5 days even in subsurface soils. Biodegradation is sufficiently rapid that most groundwater is generally free of this pollutant. The exception would be in the cases of spills where high concentrations destroy degrading microbial populations. Biodegradation is also the primary removal process when released into water (half-lives are of the order of hours to days) although sensitized photolysis may also be important. In one study using estuarine water, the combination of biodegradation and photolysis resulted in a half-life in summer and winter of 39 and 94 hr, respectively. Since the pKa is 9.994, it will be partially dissociated at higher pHs in water and moist soils and its transport and reactivity may be pH-dependent. It does not bioconcentrate in aquatic organisms. In the atmosphere, it occurs as a vapor and reacts with photochemically-produced hydroxyl radicals resulting in a half-life of approximately 15 hours. During the nighttime, it reacts with nitrate radicals with a resulting half-life of 12 minutes. It has also been shown to be readily removed from the atmosphere by rain.

Ecotoxicity: LC_{50} Crangon crangon 5600 mg/l 3 min, 20 mg/l 1 hr, 80 mg/l 3 hr, 40 mg/l 6-24 hr, 30 mg/l 48-72 hr, 25 mg/l 96 hr in sea water at 15 °C /Conditions of bioassay not specified; LC_{50} Rainbow trout 5.6-11.3 mg/l/24 hr in a static bioassay; LC_{50} Ophicephalus punctatus 46.0 mg/l/48 hr in a static bioassay; TL_m Mercenaria mercenaria (hard clam) egg 5.263 $x10^4$ ppb/48 hr in a static bioassay; Algae: Microcystis aeruginosa inhibition of cell multiplication noted at 4.6 mg/l /Conditions of bioassay not specified; Protozoa: Vorticella campanula perturbation level 3 mg/l /Conditions of bioassay not specified ; Arthropoda: LD_0 Daphnia magna 16 mg/l /Conditions of bioassay not specified; Arthropoda: TL_m Daphnia magna (young) 17/7 mg/l 25-50 hr /Conditions of bioassay not specified ; TL_m Roach 15 mg/l/24 hr /Conditions of bioassay not specified

Henry's Law Constant: 3.33 $x10^{-7}$

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): 200%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 1.46

Soil Sorption Partition Coefficient: K_{oc} = 1 to 3

Section 13 - Disposal Considerations

Disposal: Follow applicable federal, state, and local regulations.
Incinerate contaminated waste at an approved site.
Phenol may be recovered by charcoal absorption, solvent extraction or steam stripping. A concentration of 1% by weight is required for economical recovery.
Recycle containers wherever possible, otherwise dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Phenol, solid
ID: UN1671
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: + - Override definitions
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*

Special Provisions: IB8, IP2, IP4, N78, T6, TP2
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U188 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Listed
RQ: 1000 lb
TPQ: 500/10000 lb
TSCA: Listed

Section 16 - Other Information

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

Phenanthrene
PHE1330

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 44/60

Material Name: Phenanthrene **CAS Number:** 85-01-8
Chemical Formula: $C_{14}H_{10}$
Structural Chemical Formula: $(C_6H_4CH)_2$
EINECS Number: 201-581-5
ACX Number: X1001897-8
Synonyms: COAL TAR PITCH VOLATILES: PHENANTHRENE; PHENANTHREN; PHENANTHRENE; PHENANTRIN
Derivation: A polynuclear aromatic hydrocarbon found as a component of coal tar pitch volatiles (products of bituminous coal distillation). Produced from toluene, bibenzil, 9-methyl fluorene or stilbene by passage through red hot tubes or by diene synthesis of 1-vinyl naphthalene and maleic anhydride.
General Use: Used in the manufacture of dyestuffs and explosives; in biological research or drug synthesis.

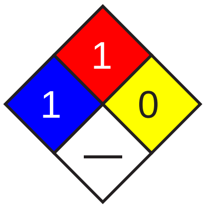
Section 2 - Composition / Information on Ingredients

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

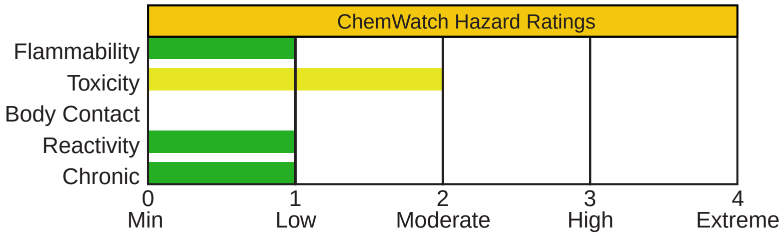
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond



HMIS
1 Health
1 Flammability
0 Reactivity

ANSI Signal Word
Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Shiny crystals; faint, aromatic odor. Acute Effects: skin photosensitization. Combustible. Reacts dangerously with oxidizers.

Potential Health Effects

Target Organs: Skin.
Primary Entry Routes: Skin contact.
Acute Effects
Inhalation: Effects not reported.
Eye: Effects not reported.
Skin: Can cause photosensitization of the skin.
Ingestion: Effects not reported.
Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: Skin disorders.
Chronic Effects: None reported.

Section 4 - First Aid Measures

See DOT ERG

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

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin Contact: *Quickly* remove contaminated clothing. Rinse exposed area with flooding amounts of water to remove loose material and then move quickly to a soap and water wash. For reddened or blistered skin, consult a physician.

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

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

Note to Physicians: Treatment is symptomatic and supportive.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 340 °F (171 °C), Open Cup

LEL: Not reported.

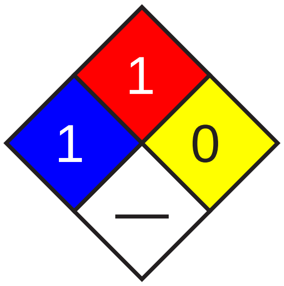
UEL: Not reported.

Flammability Classification: Class IIIB Combustible liquid

Extinguishing Media: Use dry chemical or carbon dioxide; water spray or foam may cause frothing.

General Fire Hazards/Hazardous Combustion Products: Carbon oxides (CO_x) and acrid smoke

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



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

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

Small Spills: To avoid dust generation, *do not* sweep! Carefully scoop up or vacuum (with appropriate filter). Damp mop residue.

Large Spills: Flush large spill to containment area for later disposal. Do not release into sewers or waterways. Mop up any residue.

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

Section 7 - Handling and Storage

Handling Precautions: Use nonsparking tools to open containers.
Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from heat, ignition sources, and strong oxidizers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all equipment used with and around phenanthrene. Provide general or local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin.

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

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

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, shiny crystals with a faint, aromatic odor.

Physical State: Solid

Vapor Pressure (kPa): 1 mm Hg at 244.76 °F (118.2 °C); 400 mm Hg at 586.4 (308 °C)

Formula Weight: 178.22

Density: 1.179 g/L at 77 °F (25 °C)

Refractive Index: 1.59427

Boiling Point: 644 °F (340 °C)

Freezing/Melting Point: 213 °F (101 °C)

Water Solubility: 1.6 mg/L at 59 °F (15 °C)

Other Solubilities: 1 g in: 2.4 mL toluene, 2.4 mL carbon tetrachloride, 2 mL benzene, 1 mL carbon disulfide, 25 mL absolute alcohol, 60 mL cold 95% alcohol, 10 mL boiling 95% alcohol and 3.3 mL anhydrous ether. Also soluble in glacial acetic acid, chloroform, and hot pyridine.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Phenanthrene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Phenanthrene dust generation and exposure to heat ignition sources, or oxidizers.

Storage Incompatibilities: Strong oxidizers.

Hazardous Decomposition Products: Thermal oxidative decomposition of phenanthrene can produce carbon oxide(s).

Section 11 - Toxicological Information

Acute Oral Effects:

Mouse, oral, LD_{50}: 700 mg/kg.

Other Effects:

Tumorgenicity, mouse, skin: 71 mg/kg produced tumors at site of application.
Genetic Effects - Rat, liver cell: 3 mmol/L caused DNA damage.
Human, lymphocyte: 100 µmol/L caused mutation.

See *RTECS* SF7175000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, some phenanthrene may biodegrade but the majority will bind to the soil without much leaching to groundwater. Volatilization is not expected to be significant. In water, it will adhere to particulates and sediment. Photolysis may occur near the surface producing toxic substances. Photolysis/photooxidation half-life = 8.4 hr. In the air, it will react with photochemically generated hydroxyl radicals (half-life = 1.67 days). Phenanthrene absorbs strongly to soil and sediment in water.

Ecotoxicity: *Neanhes arenaceodentata*, TL_m = 0.6 ppm/96 hr, sea water at 71.6 °F (22 °C)

Octanol/Water Partition Coefficient: $\log K_{ow} = 4.57$

Section 13 - Disposal Considerations

Disposal: For treatment of phenanthrene contaminated water, the particulate bound portion can be removed by sedimentation, flocculation, and filtration. Chlorination is not recommended as it has been shown to produce mutagenic substances. The dissolved portion requires oxidation for partial removal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

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

Naphthalene
NAP1620

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 50/60

Material Name: Naphthalene **CAS Number:** 91-20-3
Chemical Formula: $C_{10}H_8$
EINECS Number: 202-049-5
ACX Number: X1001294-7
Synonyms: ALBOCARBON; CAMPHOR TAR; DEZODORATOR; FAULDING NAPHTHALENE FLAKES; MIGHTY 150; MIGHTY RD1; MOTH BALLS; MOTH FLAKES; MOTHBALLS; NAFTALEN; NAPHTHALENE; NAPHTHALIN; NAPHTHALINE; NAPHTHENE; TAR CAMPHOR; WHITE TAR
Derivation: From coal tar; from petroleum fractions after various catalytic processing operations.
General Use: Used as a moth repellent, an antiseptic, toilet bowl deodorant, heat transfer agent, fungicide, smokeless powder, cutting fluid, lubricant, wood preservative; an intermediate for naphthol, phthalic anhydride, chlorinated naphthalenes, Tertralin, Decalin, naphthyl and naphthol derivatives, and dyes; in synthetic resins, synthetic tanning, textile chemicals, scintillation counters, and emulsion breakers.

Section 2 - Composition / Information on Ingredients

Name	**CAS**	**%**
Naphthalene	91-20-3	ca 100% wt.

Grade - By melting point, 165 °F (74 °C) min (crude) to greater than 174 °F (79 °C) (refined); scintillation 176-177 °F (80-81 °C)

OSHA PEL
TWA: 10 ppm; 50 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 10 ppm; 50 mg/m^3; STEL: 15 ppm; 75 mg/m^3.

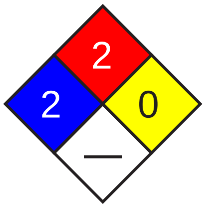
ACGIH TLV
TWA: 10 ppm; STEL: 15 ppm; skin.

NIOSH REL
TWA: 10 ppm, 50 mg/m^3; STEL: 15 ppm, 75 mg/m^3.

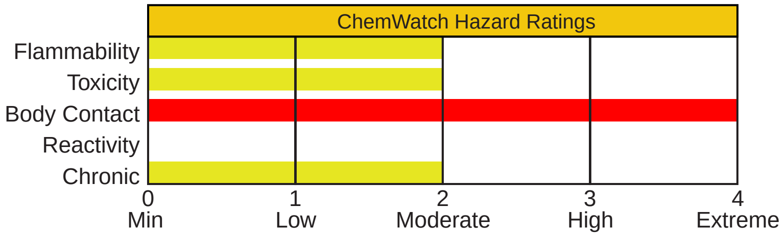
IDLH Level
250 ppm.

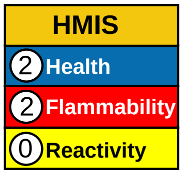
DFG (Germany) MAK
Skin.

Section 3 - Hazards Identification



Fire Diamond





HMIS	
2	Health
2	Flammability
0	Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White crystalline solid; "moth ball" or coal-tar odor. Irritating to eyes/skin/respiratory tract. Toxic by ingestion. Combustible solid. Dust may form explosive mixtures in air.

Potential Health Effects

Target Organs: Blood (red blood cell effects), eyes, skin, central nervous system (CNS), liver and kidneys
Primary Entry Routes: Inhalation, skin absorption, skin and/or eye contact
Acute Effects
Inhalation: Vapor inhalation causes headache, confusion, nausea, sometimes vomiting, loss of appetite, extensive sweating, dysuria (painful urination), hematuria (blood in the urine), and hemolysis (destruction of red blood cells).
Eye: Irritation, conjunctivitis, and corneal injury upon prolonged contact.
Skin: Irritation and hypersensitivity dermatitis.

Ingestion: Unlikely. However, ingestion causes irritation of the mouth and stomach, hemolytic anemia with hepatic and renal lesions and vesical congestion, kidney failure, hematuria, jaundice, depression of CNS, nausea, vomiting, abdominal pain, blue face, lips, or hands, rapid and difficult breathing, headache, confusion, excitement, malaise, fever, perspiration, urinary tract pain, dizziness, convulsions, coma, and death. Symptoms may appear 2 to 4 hours after exposure.

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

Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver and kidneys; individuals with a hereditary deficiency of the enzyme glucose-6-phosphate dehydrogenase in red blood cells are particularly susceptible to the hemolytic properties of naphthalene metabolites.

Chronic Effects: May cause optical neuritis, corneal injuries, cataracts, kidney damage. There are two reports of naphthalene crossing the placenta in humans.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed. Contact a physician immediately if symptoms of systemic poisoning are present.

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

Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area thoroughly with soap and water. For reddened or blistered skin, consult a physician. Contact a physician immediately if symptoms of systemic poisoning are present.

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

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

Note to Physicians: Obtain baseline CBC, electrolytes, liver and renal function rests, glucose-6-phosphatase dehydrogenase level, urinalysis, and benzidine dipstick to check for hemoglobinuria. Urinary metabolite, 1-naphthol or mercapturic acid, may help confirm the diagnosis.

Section 5 - Fire-Fighting Measures

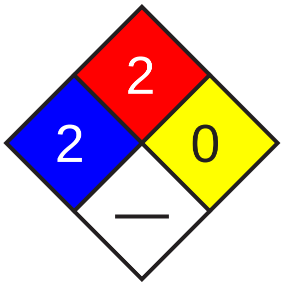
See DOT ERG

Flash Point: 174 °F (79 °C) OC; 190 °F (88 °C) CC
Autoignition Temperature: 979 °F (526 °C)
LEL: 0.9% v/v
UEL: 5.9% v/v
Flammability Classification: Combustible solid

Extinguishing Media: Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water or foam may cause frothing. Use water spray to keep fire-exposed containers cool.

General Fire Hazards/Hazardous Combustion Products: Toxic vapors including carbon monoxide. Volatile solid that gives off flammable vapors when heated. Dust may explode in air if an ignition source is provided.

Fire-Fighting Instructions: Move containers from the fire area if it can be done without risk. Otherwise cool fire-exposed containers until well after the fire is extinguished. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Wear full protective clothing. Structural clothing is permeable, remain clear of smoke, water fall out, and water run off.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Stop leak if you can do it without risk. Use spark-proof tools and explosion proof equipment. Cleanup personnel should wear personal protective equipment to protect against exposure.

Small Spills: Do not sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways.

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

Section 7 - Handling and Storage

Handling Precautions: To avoid vapor inhalation use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Avoid skin and eye contact. Wear personal protective clothing and equipment to prevent any contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material.

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

Recommended Storage Methods: Store in tightly closed, explosion-proof containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles (see Sec. 10). May be stored under nitrogen gas. Protect containers against physical damage. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor and dust dispersion into the work area. Ventilate at the site of chemical release. During the fractional distillation of naphthalene and in any operation entailing the heating or volatilization of naphthalene, enclosed apparatus should be employed. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with naphthalene. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the eyes, skin, liver, kidneys, CBC (RBC count, WBC count, differential count of a stained smear, hemoglobin, and hematocrit), and urinalysis including at a minimum specific gravity, albumin, glucose, and a microscopic examination on centrifuged sediment.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Teflon is recommended. *Do not* use butyl rubber, natural rubber, neoprene or polyvinyl chloride. Wear chemical dust-proof safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: White volatile flakes, cakes, cubes, spheres, or powder; strong coal-tar or moth ball odor.

Physical State: Crystalline solid

Odor Threshold: 0.084 ppm to 0.3 ppm

Vapor Pressure (kPa): 0.05 mm Hg at 68 °F (20 °C); 1.0 mm Hg at 127 °F (53 °C)

Formula Weight: 128.2

Density: 1.145 g/cm^3 at 68 °F (20 °C)

Boiling Point: 424 °F (218 °C)

Freezing/Melting Point: 176 °F (80.2 °C)

Water Solubility: Insoluble [31.7 mg/L at 68 °F (20 °C)]

Other Solubilities: Benzene, absolute alcohol; very soluble in ether, chloroform, carbon disulfide, hydronaphthalenes, fixed and volatile oils

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Naphthalene is stable at room temperature in closed containers under normal storage and handling conditions. It volatilizes at room temperature. Hazardous polymerization cannot occur. Exposure to heat and ignition sources, incompatibles.

Storage Incompatibilities: Include aluminum chloride, benzoyl chloride, chromic acid, chromium trioxide, oxidizers. Explosive reaction with dinitrogen pentaoxide. Melted naphthalene will attack some forms of plastics.

Hazardous Decomposition Products: Thermal oxidative decomposition of naphthalene can produce toxic fumes including carbon monoxide.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD$_{50}$: 490 mg/kg.
Mouse, oral, LD$_{50}$: 533 mg/kg.
Human (child), oral, LD$_{Lo}$: 100 mg/kg.

Acute Inhalation Effects:
Rat, inhalation, LC$_{50}$: >340 mg/m^3 produced lacrimation and somnolence.

Irritation Effects:
Rabbit, eye, standard Draize test: 100 mg produced mild irritation.
Rabbit, skin, open Draize test: 495 mg produced mild irritation.

Other Effects:
Rat, oral: 4500 mg/kg administered on gestational days 6-15 produced fetotoxicity and other developmental abnormalities.
Man, unreported, LD$_{Lo}$: 74 mg/kg.
Mouse, inhalation: 30 ppm/6 hr/2 yr administered intermittently produced toxic effects: tumorigenic - neoplastic by RTECS criteria; lungs, thorax, or respiration - tumors.
Hamster, ovary: 15 mg/L induced sister chromatid exchange.

See *RTECS* QJ0525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, naphthalene rapidly photodegrades with a half-life of 3-8 hr. Volatilization, photolysis, adsorption, and biodegradation are important loss mechanisms for naphthalene discharged into water. Depending on local conditions, the half-lives range from a couple of days to a few months. If released on land, it is adsorbed moderately to soil, undergoes biodegradation; but in some cases biodegradation may still occur if conditions are aerobic. Bioconcentration occurs to a moderate extent, but is a temporary problem since depuration and metabolism readily proceed in aquatic organisms.

Ecotoxicity: *Oncorhynchus gorbuscha* (pink salmon): 1.37 ppm/96 hr at 39 °F (4 °C). *Pimephales promelas* (fathead minnow): 7.76 mg/L/24 hr.

Octanol/Water Partition Coefficient: log K$_{ow}$ = 3.30

Section 13 - Disposal Considerations

Disposal: Consider rotary kiln or fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Naphthalene, crude *or* Naphthalene, refined
ID: UN1334
Hazard Class: 4.1 - Flammable solid
Packing Group: III - Minor Danger
Symbols:
Label Codes: 4.1 - Flammable Solid
Special Provisions: A1, IB8, IP3
Packaging: **Exceptions:** 151 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U165 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Section 1 - Chemical Product and Company Identification 44/60

Material Name: Methylene Chloride **CAS Number:** 75-09-2

Chemical Formula: CH_2Cl_2

EINECS Number: 200-838-9

ACX Number: X1000032-3

Synonyms: AEROTHENE MM; CHLORURE DE METHYLENE; DCM; DICHLOROMETHANE; METHANE DICHLORIDE; METHANE,DICHLORO-; METHYLENE BICHLORIDE; METHYLENE CHLORIDE; METHYLENE DICHLORIDE; METHYLENUM CHLORATUM; METYLENU CHLOREK; NARKOTIL; R 30; R30 (REFRIGERANT); SOLAESTHIN; SOLMETHINE

Derivation: Produced by chlorination of methane.

General Use: Used as a solvent for cellulose acetate, adhesives, food processing, and pharmaceuticals; in degreasing and cleaning fluids, paint and varnish removers, decaffeination of coffee, in propellant mixtures for aerosols; as a blowing agent in foams, dewaxing agent, component of fire extinguishing compound, chemical intermediate, low temperature heat-transfer medium, and as a fumigant. Formerly used as an anesthetic.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Methylene chloride	75-09-2	ca < 100% vol

Trace Impurities: Stabilizers may be added such as: amines, 4-cresol, hydroquinone, methanol, 2-methyl-2-ene, 1-naphthol, nitromethane + 1,4-dioxane, phenol, resorcinol, and thymol.

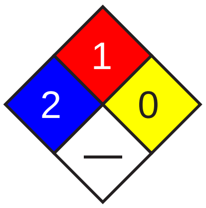
OSHA PEL
TWA: 25 ppm; STEL: 125 ppm.

NIOSH REL

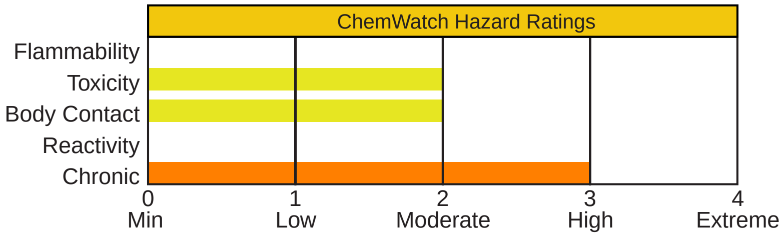
ACGIH TLV
TWA: 50 ppm.

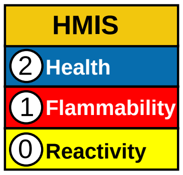
IDLH Level
2300 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Target Organs: Eyes, skin, central nervous system (CNS), cardiovascular system (CVS), blood.

Primary Entry Routes: Inhalation, skin and eye contact.

Acute Effects Methylene chloride will cross the placenta. The estimated lethal dose is 0.5 to 5 mL/kg. Although methylene chloride has a distinct sweetish odor, it is not recognized at levels low enough to protect from overexposure.

Inhalation: Symptoms include headache, giddiness, irritability, nausea, stupor, numbness and tingling of limbs, fatigue, anemia and polymorphonuclear leukocytosis, digestive disturbances, and neurasthenic disorders (emotional and psychic disorders characterized by easy fatigue, lack of motivation, feelings of inadequacy, and psychosomatic symptoms). Many symptoms are attributed to the metabolism of methylene chloride to carbon monoxide in the body. The carbon monoxide forms carboxyhemoglobin in the blood, which unlike hemoglobin, does not have the ability to carry oxygen. This lack of oxygen leads to CNS and CVS problems. However, CNS effects have been seen in persons without a significantly elevated blood carbon monoxide level.

Eye: Exposure to vapors produces irritation, tearing, and conjunctivitis. Direct contact with the liquid causes severe pain, but permanent damage does not occur.

Skin: Contact is irritating and can be painful (burns) if confined to skin (i.e. trapped under gloves or clothing). Methylene chloride can be absorbed through the skin to cause systemic effects.

Ingestion: Expected to cause gastrointestinal irritation, nausea, vomiting, and systemic effects.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Medical Conditions Aggravated by Long-Term Exposure: Skin and cardiovascular disorders.

Chronic Effects: Repeated skin contact can cause dermatitis. Liver disease has been reported. *Case Reports*: 1 yr exposure caused toxic encephalopathy (toxicity of the brain) with audio and visual delusions and hallucinations; 3 yr exposure to 300 to 1000 ppm caused memory loss, intellectual impairment, and balance disturbances.

Section 4 - First Aid Measures

See DOT ERG

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

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

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

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting with Ipecac syrup. If vomiting does not occur, the decision to perform gastric lavage should be made.

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

Note to Physicians: Lethal blood level = 280 mg/L. Biological monitoring: carbon monoxide in expired air (nonsmokers only). Recently, methylene chloride concentrations in urine have been found to correlate well to concentrations in air.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Methylene chloride does not have a flash point by standard tests. However, it does form flammable mixtures with air.

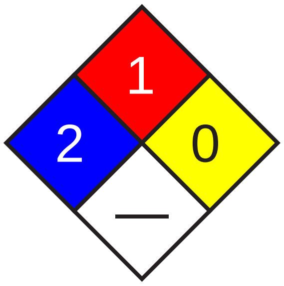
Autoignition Temperature: 1033 °F (556 °C)

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

UEL: 66.4% (in oxygen); UFL: 19% v/v

Extinguishing Media: For small fires, use dry chemical or carbon dioxide. For large fires, use water spray, fog, or regular foam.

General Fire Hazards/Hazardous Combustion Products: Hydrogen chloride, carbon monoxide and phosgene. Creates an explosion hazard if allowed to enter a confined space. Container may explode in heat of fire.



Fire Diamond

Fire-Fighting Instructions: Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel need to protect against inhalation and skin/eye contact.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material.

Large Spills: Dike far ahead of spill for later reclamation or disposal. Do not release into sewers or waterways. Damp mop any residue.

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

Section 7 - Handling and Storage

Handling Precautions: Do not use near ignition sources. Wear appropriate PPE. Do not use plastic or rubber hose for unloading trucks or tank cars unless the materials have been tested and approved for methylene chloride service.

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

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10). To minimize decomposition, all storage containers should be galvanized or lined with a phenolic coating. Indoor storage tanks should have vents piped outdoors to prevent vapors from escaping into work areas. Prevent moisture from entering tanks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Do not use closed circuit rebreathing systems employing soda lime or other carbon dioxide absorber because of formation of toxic compounds capable of producing cranial nerve paralysis. To prevent static sparks, electrically ground and bond all equipment used with and around methylene chloride. Provide general or local exhaust ventilation systems to maintain airborne levels below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on skin, liver, CNS, CVS, and blood. A complete blood count should be performed and carboxyhemoglobin levels should be determined periodically. Any level above 5% should prompt investigation of employee and workplace to determine the cause (smokers will already have an increased level of carboxyhemoglobin and are at increased risk). Use less hazardous solvents where possible.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyvinyl alcohol and Viton laminated with Neoprene are suitable materials for PPE. Natural rubber, synthetic rubbers, and polyvinyl chloride *do not* provide protection against methylene chloride. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

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

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless; volatile with a sweet odor.

Physical State: Liquid

Odor Threshold: 205 to 307 ppm

Vapor Pressure (kPa): 350 mm Hg at 68 °F (20 °C); 440 mm Hg at 77 °F (25 °C)

Bulk Density: 11.07 lb/gal at 68 °F (20 °C)

Formula Weight: 84.9

Specific Gravity (H_2O=1, at 4 °C): 1.33 at 15 °C

Refractive Index: 1.4244 at 68 °F (20 °C)

Boiling Point: 104 °F (40 °C)

Freezing/Melting Point: -142 °F (-97 °C)

Viscosity: 0.430 cP at 68 °F (20 °C)

Surface Tension: 0.5 to 2.3 g/L (*in oxygen*)

Ionization Potential (eV): 11.32 eV

Critical Temperature: 473 °F (245 °C)

Critical Pressure: 60.9 atm

Water Solubility: 2%

Other Solubilities: Soluble in alcohol, acetone, chloroform, carbon tetrachloride, ether, and dimethylformamide.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Methylene chloride is stable at room temperature in closed containers under normal storage and handling conditions. Tends to carbonize when vapor contacts steel or metal chlorides at high temperatures 572 to 842 °F (300 to 450 °C). Hazardous polymerization does not occur. Exposure to heat, ignition sources, and incompatibles.

Storage Incompatibilities: Include aluminum, lithium, sodium, aluminum bromide, azides, dimethyl sulfoxide + perchloric acid, N-methyl-N-nitrosourea + potassium hydroxide, sodium-potassium alloy, potassium *t*-butoxide, dinitrogen pentoxide, dinitrogen tetraoxide, nitric acid, and oxidizers. Methylene chloride will attack some forms of plastic, rubber, and coatings. Corrodes iron, some stainless steel, copper, and nickel.

Hazardous Decomposition Products: Hydrogen chloride, carbon monoxide and phosgene.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 1600 mg/kg.
Human, oral, LD_{Lo}: 357 mg/kg caused somnolence, paresthesia, and convulsions or effect on seizure threshold.
Acute Inhalation Effects:
Human, inhalation, TC_{Lo}: 500 ppm/8 hr caused euphoria.
Irritation Effects:
Rabbit, eye: 162 mg caused moderate irritation.
Rabbit, skin: 810 mg/24 hr caused severe irritation.
Other Effects:
Rat, oral: 1275 mg/kg caused DNA damage.
Rat, inhalation: 8400 ppm/6 hr/13 weeks (intermittently) caused changes in liver weight.
Rat, inhalation: 3500 ppm/2 yr (intermittently) caused endocrine tumors.
Mutagenicity - Human, fibroblast: 5000 ppm/1 hr (continuously) caused DNA inhibition.
Human, inhalation, TC_{Lo}: 500 ppm/1 yr (intermittently) caused altered sleep time, somnolence, and change in heart rate.

See *RTECS* PA8050000, for additional data.

Section 12 - Ecological Information

Environmental Fate: In air, methylene chloride degrades by reaction with photochemically-produced hydroxyl radicals (half-life = a few months) but does not undergo *direct* photolysis. Degradation products include carbon monoxide, carbon dioxide, and phosgene. In water, it is removed primarily by evaporation (est. half-life = 3 to 5.6 hr under moderate mixing conditions). Some may biodegrade but it is not expected to adsorb to sediment or bioconcentrate. If released to soil most methylene chloride will rapidly evaporate. Some may leach through soil. Methylene chloride will adsorb to peat moss but not to sand.
Ecotoxicity: *Pimephales promelas* (fathead minnow), LC_{50} = 193 mg/L/96 hr; *Lepomis macrochirus* (bluegill), LC_{50} = 230 mg/L/24 hr; *Poecilia reticulata* (guppies), LC_{50} = 294 ppm/14 days. Cytotoxic to plants.
Octanol/Water Partition Coefficient: log $K_{ow} = 1.25$

Section 13 - Disposal Considerations

Disposal: Pour on sand or earth at a safe distance/location from occupied areas and allow to evaporate (most is transformed to carbon monoxide). A good candidate for liquid injection, rotary kiln, or fluidized bed incineration. Investigate biodegradation: methylene chloride is reported to completely biodegrade under aerobic conditions with sewage seed or activated sludge between 6 hrs. and 7 days. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Dichloromethane
ID: UN1593
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, N36, T7, TP2
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U080 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

Methanol
MET1440

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification

Material Name: Methanol **CAS Number:** 67-56-1

Chemical Formula: CH_4O

Structural Chemical Formula: CH_3OH

EINECS Number: 200-659-6

ACX Number: X1001287-2

Synonyms: ALCOHOL,METHYL; ALCOOL METHYLIQUE; ALCOOL METILICO; CARBINOL; X-CIDE 402 INDUSTRIAL BACTERICIDE; COAT-B1400; COLONIAL SPIRIT; COLONIAL SPIRITS; COLUMBIAN SPIRIT; COLUMBIAN SPIRITS; EPA PESTICIDE CHEMICAL CODE 053801; EUREKA PRODUCTS CRIOSINE DISINFECTANT; EUREKA PRODUCTS,CRIOSINE; FREERS ELM ARRESTER; IDEAL CONCENTRATED WOOD PRESERVATIVE; METANOL; METANOLO; METHANOL; METHYL ALCOHOL; METHYL HYDRATE; METHYL HYDROXIDE; METHYLALKOHOL; METHYLOL; METYLOWY ALKOHOL; MONOHYDROXYMETHANE; PMC REJEX-IT F-40ME; PYROLIGNEOUS SPIRIT; PYROXYLIC SPIRIT; PYROXYLIC SPIRITS; SURFLO-B17; WILBUR-ELLIS SMUT-GUARD; WOOD ALCOHOL; WOOD NAPHTHA; WOOD SPIRIT

Derivation: Prepared by wood pyrolysis; non-catalytic oxidation of hydrocarbons; as a by-product in the fisher-tropsch synthesis; or by reduction of carbon monoxide.

General Use: Used as an industrial solvent; starting material for organic synthesis; antifreeze for windshield washer fluid; in fuel antifreezes; gasoline octane booster; fuel for stoves; extractant for oils; denaturing ethanol; softening agent; food additive; in paint, varnish removers, and embalming fluids; in the manufacture of photographic film, celluloid, textile soap, wood stains, coated fabrics, shatterproof glass, paper coating, waterproofing formulations, artificial leather, dyes.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Methanol	67-56-1	ca 100% vol

Trace Impurities: (Grade A): Acetone and aldehydes < 30 ppm, acetic acid < 30 ppm

OSHA PEL
TWA: 200 ppm; 260 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 200 ppm; 260 mg/m^3;
STEL: 250 ppm; 325 mg/m^3.

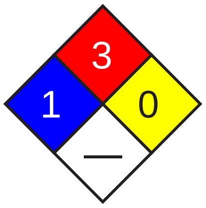
ACGIH TLV
TWA: 200 ppm; STEL: 250 ppm; skin.

NIOSH REL
TWA: 200 ppm, 260 mg/m^3;
STEL: 250 ppm, 325 mg/m^3; skin.

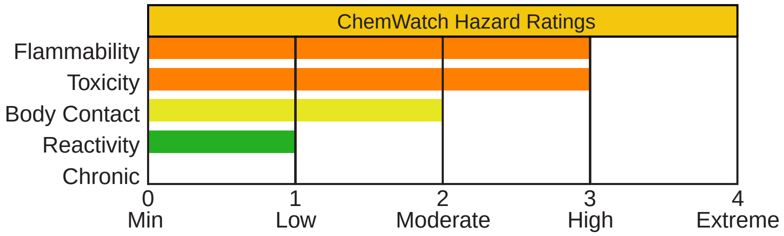
IDLH Level
6000 ppm.

DFG (Germany) MAK
TWA: 200 ppm; PEAK: 800 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; slight alcohol odor when pure or disagreeably pungent odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: headache, visual disturbance, blindness, respiratory failure. Chronic Effects: reproductive effects reported in animal testing. Flammable; moderate explosion hazard.

Potential Health Effects

Target Organs: Eyes, skin, central nervous system (CNS), gastrointestinal (GI) tract, respiratory system

Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption

Acute Effects

Inhalation: Irritation, breathing difficulty, headache, drowsiness, vertigo, light-headedness, nausea, vomiting, acidosis (decreased blood alkalinity), visual disturbance, and at high concentrations, CNS damage, convulsions, circulatory collapse, respiratory failure, coma and blindness can result from inhalation of methanol vapor. Concentration >= 200 ppm may cause headache; 50,000 ppm can cause death within 1-2 hrs.

Eye: Contact with liquid may result in irritation, inflamed lids, light sensitization, and superficial lesions.

Skin: Contact may cause irritation, dermatitis, swelling, scaling, and systemic effects.

Ingestion: GI irritation and systemic effects. Symptoms may be delayed 18-48 hours. Fatal dose - 2 to 8 ounces.

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

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

Chronic Effects: Exposure to methanol vapors has caused conjunctivitis, headache, giddiness, insomnia, GI disturbance, impaired vision. CNS damage is also likely. Methanol is slowly eliminated from the body; exposure is considered cumulative over the short term.

Section 4 - First Aid Measures

See DOT ERG

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

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

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

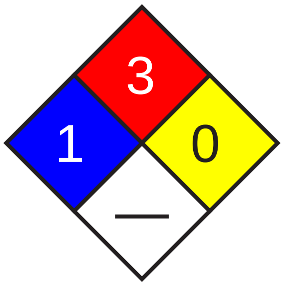
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.

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

Note to Physicians: Follow emesis with rehydration, correction of acidosis, and folate to enhance formate oxidation. Consider IV administration of ethanol (if blood methanol >20 mg/dL) to show metabolic oxidation of methanol. Assay formic acid in urine, blood pH and plasma bicarbonate.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: 54 °F (12 °C), Closed Cup

Burning Rate: 1.7 mm/min

Autoignition Temperature: 867 °F (464 °C)

LEL: 6.0% v/v

UEL: 36% v/v

Flammability Classification: OSHA Class IB Flammable Liquid.

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, fog or alcohol-resistant foam. A water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources.

General Fire Hazards/Hazardous Combustion Products: Heating methanol to decomposition can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes. Can form explosive mixtures in the air. The heavier-than-air vapors of methanol may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.

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

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Isolate spill area for at least 330-660 feet (100-200 m) in all directions. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Ground all equipment used when handling this product. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors.

Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Use clean non-sparking tools to collect absorbed material.

Large Spills: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Ground all equipment. Use non-sparking tools.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec. 2). Wear protective gloves, goggles, and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers.

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

Recommended Storage Methods: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations. Also 29 CFR 1910.106 for Class 1B Flammable Liquids.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Enclose operations and/or provide local explosion-proof exhaust ventilation at the site of chemical release. Where possible, transfer methanol from drums or other storage containers to process containers. Minimize sources of ignition in surrounding areas.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of butyl rubber, Teflon, Viton, Saranex, 4H, Responder, Trellchem HPS, or Tychem 10000 (Breakthrough Time (BT) >8 hr) to prevent skin contact. Natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl alcohol and CPF 3 may degrade after contact and are not recommended. Wear splash-proof chemical safety goggles, and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/ NIOSH-approved respirator. For concentrations <= 2000 ppm, use a supplied air respirator; <= 5000 ppm, supplied air (SA) respirator in continuous flow mode; <= 6000 ppm, SA respirator with tight-fitting face mask operated in continuous flow mode, or SCBA with full facepiece, or SA respirator with full facepiece; > IDLH/unknown/emergency, SCBA with full facepiece operated in pressure-demand or other positive-pressure mode, or SA respirator with full facepiece operated in pressure-demand or other positive-pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For escape, use an appropriate escape-type SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen- deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless; slight alcohol odor when pure, disagreeably pungent odor when crude.

Physical State: Liquid
Vapor Pressure (kPa): 127 mm Hg at 77 °F (25 °C)
Vapor Density (Air=1): 1.11
Bulk Density: 6.59 lbs/gal at 68 F (20 °C)

Formula Weight: 32.04
Density: 0.796 g/mL at 59 °F (15 °C)
Specific Gravity (H_2O=1, at 4 °C): 0.81 at 0 °C/4 °C
Refractive Index: 1.3292 at 68 °F (20 °C)

pH: Slightly acidic
Boiling Point: 148 °F (64.7 °C) at 760 mm Hg
Freezing/Melting Point: -144.04 °F (-97.8 °C)
Viscosity: 0.614 mPa sec
Surface Tension: 22.61 dynes/cm
Ionization Potential (eV): 10.84 eV
Water Solubility: Miscible
Other Solubilities: Ethanol, acetone, benzene, chloroform, DMSO, ether, ketones, most organic solvents.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Methanol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Vapor inhalation, oxidizers.

Storage Incompatibilities: Include beryllium dihydride, metals (potassium, magnesium), oxidants (barium perchlorate, bromine, chlorine, hydrogen peroxide, sodium hypochlorite, phosphorus trioxide), potassium tertbutoxide, carbon tetrachloride and metals, chloroform and heat, diethyl zinc, alkyl aluminum salts, acetyl bromide, chloroform and sodium hydroxide, cyanuric chloride, nitric acid, chromic anhydride, lead perchlorate.

Hazardous Decomposition Products: Thermal oxidative decomposition of methanol can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD$_{50}$: 5628 mg/kg.

Human, oral, LD$_{Lo}$: 428 mg/kg produced toxic effects: behavioral - headache; lungs, thorax, or respiration - other changes.

Human, oral, LD$_{Lo}$: 143 mg/kg produced optic nerve neuropathy, dyspnea, nausea or vomiting.

Acute Inhalation Effects:

Rat, inhalation, LC$_{50}$: 64000 ppm/4 hr.

Human, inhalation, TC$_{Lo}$: 300 ppm produced visual field changes, headache; lungs, thorax, or respiration - other changes.

Acute Skin Effects:

Rabbit, skin, LD$_{50}$: 15800 mg/kg.

Monkey, skin, LD$_{Lo}$: 393 mg/kg.

Irritation Effects:

Rabbit, standard Draize test: 100 mg/24 hr resulted in moderate irritation.

Rabbit, standard Draize test: 20 mg/24 hr resulted in moderate irritation.

Other Effects:

Rat, oral: 10 µmol/kg resulted in DNA damage.

Rat, inhalation: 50 mg/m^3/12 hr/13 weeks intermittently produced degenerative changes to brain and coverings; muscle contraction or spasticity.

Rat, inhalation: 2610 ppm/6 hr/4 weeks intermittently produced toxic effects: endocrine - changes in spleen weight.

Multiple Dose Toxicity Effects - Rat, oral: 12 g/kg/8 weeks intermittently produced toxic effects: behavioral - ataxia; behavioral - alteration of operant conditioning.

Human, lymphocyte: 300 mmol/L resulted in DNA inhibition.

Rat (female), oral: 7500 mg/kg, administered during gestational days 17-19 produced effects on newborn - behavioral.

Rat (female), oral: 35295 mg/kg administered during gestational days 1-15 produced effects on the fertility index; pre implantation mortality; and post-implantation mortality.

Rat (female), inhalation: 20000 ppm/7 hr, administered during gestational days 1-22 produced specific developmental abnormalities - musculoskeletal system; cardiovascular (circulatory) system; urogenital system.

Rat (male), oral: 200 ppm/20 hr, 78 weeks prior to mating produced paternal effects - testes, epididymis, sperm duct.

See *RTECS* PC1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Bioconcentration (BCF, estimated at 0.2) is not expected to be significant. Physical removal from air can occur via rainfall. Relatively rapid evaporation from dry surfaces is likely to occur. If released to the atmosphere, it degrades via reaction with photochemically produced hydroxyl radicals with an approximate half-life of 17.8 days. If released to water or soil, biodegradation is expected to occur. A low K_{oc} indicates little sorption and high mobility in the soil column.

Ecotoxicity: Trout, LC$_{50}$: 8,000 mg/L/48 hr; *Pimephales promelas* (fathead minnow) LC$_{50}$: 29.4 g/L/96 hr.

Henry's Law Constant: 4.55 x10^{-6} atm-m^3/mole at 77 °F (25 °C)

Octanol/Water Partition Coefficient: log K_{ow} = -0.77

Soil Sorption Partition Coefficient: K_{oc} = 0.44

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

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

Shipping Name and Description: Methanol
ID: UN1230
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols: + I
Label Codes: 3 - Flammable Liquid, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB2, T7, TP2
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:** 40

Shipping Name and Description: Methanol
ID: UN1230
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols: D - Domestic transportation
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T7, TP2
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U154 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

Section 1 - Chemical Product and Company Identification

Material Name: Methyl Ethyl Ketone **CAS Number:** 78-93-3
Chemical Formula: C_4H_8O
Structural Chemical Formula: $CH_3COCH_2CH_3$
EINECS Number: 201-159-0
ACX Number: X1001472-1
Synonyms: ACETONE,METHYL-; AETHYLMETHYLKETON; 2-BUTANONE; 3-BUTANONE; BUTANONE; BUTANONE 2; EPA PESTICIDE CHEMICAL CODE 044103; ETHYL METHYL CETONE; ETHYL METHYL KETONE; ETHYLMETHYLCETONE; ETHYLMETHYLKETON; KETONE,ETHYL METHYL; MEETCO; MEK; METHYL ACETONE; METHYL ETHYL KETONE; METILETILCETONA; METILETILCHETONE; METYLOETYLOKETON
General Use: As a solvent in lacquers, thinners, solvent cements, adhesives, glues, in paint removers, nail polish removers, nail polish and cleaning solvents.
In the manufacture of smokeless gunpowder and colorless synthetic resins.

Section 2 - Composition / Information on Ingredients

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

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

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

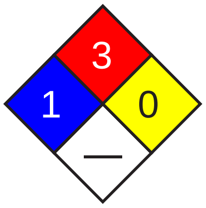
ACGIH TLV
TWA: 200 ppm; STEL: 300 ppm.

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

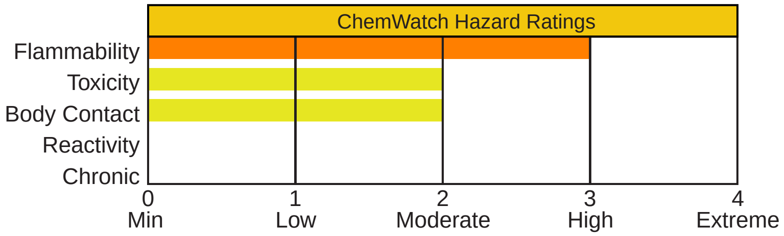
IDLH Level
3000 ppm.

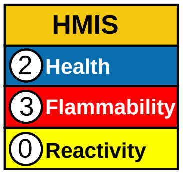
DFG (Germany) MAK
TWA: 200 ppm; PEAK: 200 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

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

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

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

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

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

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

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

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

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

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

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

Toxic effects may result from skin absorption.

The material may accentuate any pre-existing skin condition.

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

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

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

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

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

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

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

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

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

Combinations with chloroform show increase in toxicity.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

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

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

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

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

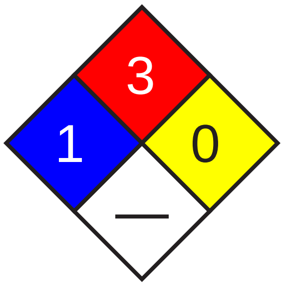
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: -9 °C Closed Cup
Autoignition Temperature: 404 °C
LEL: 1.4% v/v
UEL: 11.4% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

See DOT ERG



Fire Diamond

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

See DOT ERG

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

Section 7 - Handling and Storage

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

Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

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

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

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

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

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

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

Glove Selection Index:

BUTYL	Best selection
PE/EVAL/PE	Best selection
TEFLON	Best selection
PVA	Satisfactory; may degrade after 4 hours continuous immersion
BUTYL/NEOPRENE	Satisfactory; may degrade after 4 hours continuous immersion
SARANEX-23	Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL	Poor to dangerous choice for other than short-term immersion
HYPALON	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
NATURAL+NEOPRENE	Poor to dangerous choice for other than short-term immersion
VITON/NEOPRENE	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

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

Physical State: Liquid
Vapor Pressure (kPa): 9.5 at 20 °C
Vapor Density (Air=1): 2.4 at 20 °C
Formula Weight: 72.12
Specific Gravity (H_2O=1, at 4 °C): 0.81 at 20 °C
Evaporation Rate: 5.7 Fast (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 79.6 °C (175 °F)
Freezing/Melting Point: -86.3 °C (-123.34 °F)
Volatile Component (% Vol): 100
Water Solubility: 353 g/L water at 10 °C

Section 10 - Stability and Reactivity

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

Storage Incompatibilities: Avoid storage with oxidizers hypochlorites, e.g. pool chlorine, bleaches and. strong bases and chloroform.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD$_{50}$: 2737 mg/kg
Inhalation (human) TC$_{Lo}$: 100 ppm/5 m
Inhalation (rat) LD$_{50}$: 23500 mg/m^3/8 hr
Dermal (rabbit) LD$_{50}$: 6480 mg/kg

Irritation

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

See *RTECS* EL 6475000, for additional data.

Section 12 - Ecological Information

Environmental Fate: When discharged into water, it will be lost by evaporation (half-life 3-12 days) or be slowly biodegraded. When released to the atmosphere, it will photodegrade at a moderate rate (half-life 2.3 days or less). It would not be expected to bioconcentrate into aquatic organisms.

Ecotoxicity: LC$_{50}$ Pimephales promelas (fathead minnow) 3220 mg/l/96 hr (confidence limit 3130-3320 mg/l) /Conditions of bioassay not specified; Toxicity Threshold (Cell Multiplication Inhibition Test) Scenedesmus quadricauda (green algae) 4300 mg/l /Conditions of bioassay not specified; Toxicity Threshold (Cell Multiplication Inhibition Test) Entosiphon sulcatum (protoza) 190 mg/l /Conditions of bioassay not specified

Henry's Law Constant: 2.4 x10^{-5}

BCF: not significant

Biochemical Oxygen Demand (BOD): 214%, 5 days

Octanol/Water Partition Coefficient: log K$_{ow}$ = 0.26 to 0.29

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

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

ID: UN1193

Hazard Class: 3 - Flammable and combustible liquid

Packing Group: II - Medium Danger

Symbols:

Label Codes: 3 - Flammable Liquid

Special Provisions: IB2, T4, TP1

Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242

Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L

Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U159 Toxic Waste, Ignitable Waste

CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)

SARA 40 CFR 372.65: Listed

SARA EHS 40 CFR 355: Not listed

TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection

Genium group inc.

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

Issue Date: 2005-05

Fluorine
FLU3940

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Fluorine **CAS Number:** 7782-41-4

Chemical Formula: F_2

Structural Chemical Formula: F_2

EINECS Number: 231-954-8

ACX Number: X1003050-3

Synonyms: BIFLUORIDEN; FLUOR; FLUOR (DUTCH,FRENCH,GERMAN,POLISH); FLUORINE; FLUORINE-19; FLUORINE,COMPRESSED; FLUORO; FLUORURES ACIDE; FLUORURI ACIDI; SAEURE FLUORIDE

General Use: Used in the production of metallic and other fluorides, and fluorocarbons. Active constituents in toothpaste, fluoridating compounds in drinking water. Other uses include conversion of uranium tetrafluoride to uranium hexafluoride, and CFCs.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
fluorine	7782-41-4	>98

OSHA PEL
TWA: 0.1 ppm; 0.2 mg/m^3.

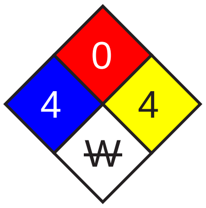
NIOSH REL
TWA: 0.1 ppm, 0.2 mg/m^3.

DFG (Germany) MAK
TWA: 0.1 ppm; PEAK: 0.2 ppm.

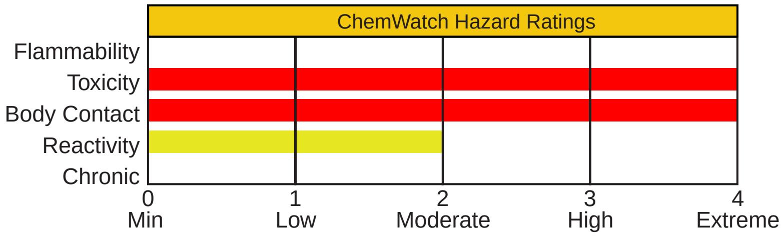
ACGIH TLV
TWA: 1 ppm; STEL: 2 ppm.

IDLH Level
25 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
4 Health
0 Flammability
4 Reactivity

ANSI Signal Word

Danger!

Poison

Corrosive

Compressed Gas

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Pale, yellow or greenish-yellow gas; pungent, sharp, irritating odor. Corrosive. Poison. Other Acute Effects: pulmonary edema, GI symptoms, frostbite. Chronic Effects: osteosclerosis. Water reactive. Strong oxidizer.

Potential Health Effects

Target Organs: respiratory system, eyes, skin

Primary Entry Routes: inhalation, skin contact, eye contact

Acute Effects

Inhalation: The gas is extremely discomforting to the upper respiratory tract, may cause severe mucous membrane damage and may be fatal if inhaled.

Acute effects of fluoride inhalation include irritation of nose and throat, coughing and chest discomfort.

A single acute over-exposure may even cause nose bleed.

Pre-existing respiratory conditions such as emphysema, bronchitis may be aggravated by exposure. Occupational asthma may result from exposure.

Symptoms of overexposure include coughing, choking, breathing difficulty, chest pain. Inhalation may cause lung congestion, bronchitis and loss of consciousness. Inhalation of fluorine gas at levels above 1 ppm produces irritation to the respiratory tract. Intolerable concentrations are in the range of 20 ppm. Exposure to higher concentrations causes choking, coughing, burning of the throat and severe irritation of the respiratory tract There is also possibility of pulmonary edema, general lung injury, bronchitis and death.

Mice exposed to sublethal concentrations showed pulmonary irritation and delayed development of focal necrosis in the liver and kidney. Evidence for a mild degree of tolerance was found by elevated 60-minute LC_{50} values in mice and for decreased lung and kidney weights in pre-exposed animals compared with previously unexposed controls.

Eye: The gas is highly discomforting to the eyes and is capable of causing severe damage with loss of sight.

The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The gas is highly discomforting to the skin, may cause severe burns and ulceration.

Solution of material in moisture on the skin or in perspiration may markedly increase skin corrosion and accelerate tissue destruction.

Bare unprotected skin should not be exposed to this material.

The skin is readily penetrated by the fluoride ion causing liquefaction necrosis of the soft tissues and decalcification and corrosion of bone.

Healing is delayed and necrotic changes may continue to occur and spread beneath a layer of tough coagulated skin.

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

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

Chronic Effects: Repeated exposure may cause decalcification of bones. Repeated over exposure can cause lung, liver and kidney damage.

Chronic fluoride intoxication, fluorosis, has been reported to cause digestive disturbances, nausea, vomiting, loss of appetite, diarrhea or constipation in more than 80% of a worker population exposed at an estimated concentration of 15-20 mg/m^3 of fluorine.

One study investigating workers who had been exposed to fluorine over a four-year period (0.3 to 1.4 ppm) reported the exposed group had a better health record than a group of unexposed employees. Criteria used in this study were illness, clinical visits, respiratory complaints and absences as a result of respiratory complaints.

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.

If victim is conscious, give six calcium gluconate or calcium carbonate tablets in water by mouth.

Transport to hospital or doctor, urgently.

See DOT ERG

Eye Contact: If this product or its vapors come in contact with the eyes, DO NOT DELAY: Immediately irrigate continuously by holding the eyes open and washing with fresh running water. Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by lifting the upper and lower lids. Irrigate for at least 15 minutes.

Transport to hospital or ophthalmologist without delay.

Skin Contact: If there is evidence of severe skin irritation or skin burns: Avoid further contact, strip off contaminated clothing, including footwear.

Wash affected parts continuously with copious amounts of running water for at least one minute. Transport to hospital or doctor, urgently.

Avoiding contamination of the hands, massage calcium gluconate gel into affected areas, pay particular attention to creases in skin. Continue gel application for at least 15 minutes after burning sensation ceases.

If pain recurs, repeat application of calcium gluconate gel or apply every 20 minutes. If no gel is available, continue washing for at least 15 minutes, using soap if available.

If patient is conscious, give six calcium gluconate or calcium carbonate tablets in water by mouth.

Ingestion: Contact a Poison Control Center. DO NOT induce vomiting. Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink. Transport to hospital or doctor without delay.

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

Note to Physicians: Following acute or short-term repeated exposure to hydrofluoric acid:

1.Subcutaneous injections of Calcium Gluconate may be necessary around the burned area. Continued application of Calcium Gluconate Gel or subcutaneous Calcium Gluconate should then continue for 3-4 days at a frequency of 4-6 times per day. If a "burning" sensation recurs, apply more frequently.

2.Systemic effects of extensive hydrofluoric acid burns include renal damage, hypocalcemia and consequent cardiac arrhythmias. Monitor hematological, respiratory, renal, cardiac and electrolyte status at least daily. Tests should include FBE, blood gases, chest X-ray, creatinine and electrolytes, urine output, Ca ions, Mg ions and phosphate ions. Continuous ECG monitoring may be required.

3.Where serum calcium is low, or clinical, or ECG signs of hypocalcemia develop, infusions of calcium gluconate, or if less serious, oral Sandocal, should be given. Hydrocortisone 500 mg in a four to six hourly infusion may help.

4.Antibiotics should not be given as a routine, but only when indicated.

5.Eye contact pain may be excruciating and 2-3 drops of 0.05% pentocaine hydrochloride may be instilled, followed by further irrigation

BIOLOGICAL EXPOSURE INDEX - BEI

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

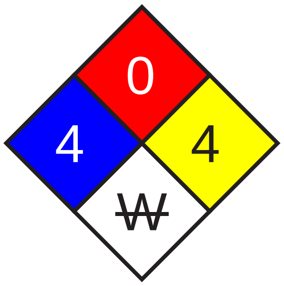
Determinant	Index	Sampling Time	Comments
Fluorides in Urine	3 mg/gm creatinine	Prior to shift	B,NS
	10 mg/gm creatinine	End of shift	B,NS

B: Background levels occur in specimens collected from subjects NOT exposed
NS: Non-specific determinant; also observed after exposure to other materials.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Dry chemical powder.
Bromochlorodifluoromethane (BCF) (where regulations permit).
DO NOT use water.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Will not burn but increases intensity of fire.
Heating may cause expansion or decomposition leading to violent rupture of containers.
Heat affected containers remain hazardous.
Contact with combustibles such as wood, paper, oil or finely divided metal may cause ignition, combustion or violent decomposition.
May emit irritating, poisonous or corrosive fumes.
Reacts vigorously with organic material, frequently causing fire.
Heating may cause expansion leading to violent rupture of cylinders.
Decomposes on heating and produces toxic fumes of fluorides.
Fire Incompatibility: Reacts violently with a wide range of substances.
Avoid contact with all organic materials including most plastics.
Avoid reaction with ammonia, hydrogen, water, metallic and non-metallic elements and their oxides.
Avoid reaction with metal salts particularly nitrates, halides, cyanides and carbonates.
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. May be washed to drain with large quantities of water. Consider evacuation.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Use fire fighting procedures suitable for surrounding area.
Cool fire-exposed containers with water spray from a protected location.
Do not approach containers suspected to be hot.
If safe to do so, stop flow of gas.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Clear area of personnel and move upwind.
Wear fully protective PVC clothing and breathing apparatus.
Avoid breathing vapors and contact with skin and eyes.
Apply leak detection solution to suspected sites in lines and equipment.
Stop leak if safe to do so.
Do not exert excessive pressure on valve; do not attempt to operate damaged valve.
Remove leaking cylinders to a safe place if possible. Release pressure under safe, controlled conditions by opening the valve.
Large Spills: Clear area of personnel and move upwind.
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.
Use extreme caution to avoid a violent reaction.
Stop leak if safe to do so.

Water spray or fog may be used to disperse vapor.
Do not exert excessive pressure on valve; do not attempt to operate damaged valve.
Remove leaking cylinders to a safe place if possible. Release pressure under safe, controlled conditions by opening the valve.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

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

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Use only in completely enclosed system.
Avoid breathing vapors and contact with skin and eyes.
Wear personal protective equipment when handling.
Avoid all ignition sources.
Handle and open container with care.
Keep containers securely sealed when not in use.
DO NOT transfer gas from one cylinder to another.
When handling, DO NOT eat, drink or smoke.
Avoid physical damage to containers.
Transport containers on a trolley.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Cylinder fitted with valve protector cap.
Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Cylinder valve must be closed when not in use or when empty.
Cylinder must be properly secured either in use or in storage.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.
Vacuum insulated container.

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: Full face shield. Close fitting gas tight goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Impervious, gauntlet length gloves; PVC gloves.
Butyl rubber gloves.
Neoprene gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >0.1 to 5 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range >5 to <25 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 25 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Nonflammable, pale yellowish gas with pungent odor. Highly poisonous. Corrosive.

Physical State: Compressed gas
Vapor Pressure (kPa): >100 at 20 °C
Vapor Density (Air=1): 1.31 at 21 °C
Formula Weight: 37.99

Specific Gravity (H_2O=1, at 4 °C): 1.14 at -10 °C
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): Stongly acidic

Boiling Point: -188.13 °C (-307 °F)
Freezing/Melting Point: -219.61 °C (-363.298 °F)
Volatile Component (% Vol): 100 at 20 °C
Decomposition Temperature (°C): Not applicable
Water Solubility: Reacts

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of water.
Product is considered stable under normal handling conditions. Stable under normal storage conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with all organic materials including most plastics. Avoid storage with ammonia, hydrogen, water, metallic and non-metallic elements and their oxides. Avoid storage with metal salts, particularly nitrates, halides, cyanides and carbonates.

Section 11 - Toxicological Information

Toxicity
Inhalation (rat) LC_{50}: 185 ppm/1h

Irritation
Eye (human): 25 ppm/5m - mild

See *RTECS* LM 6475000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: Aquatic toxicity: 2.3 ppm/*/trout/TL_m/fresh water *Time period not specified
BCF: no food chain concentration potential
Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: The gas may be vented under controlled conditions through 3-10% potassium hydroxide solution before venting to the air.
Ensure damaged or non-returnable cylinders are gas free before disposal.
Recycle where ever possible, otherwise dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Fluorine, compressed
ID: UN1045
Hazard Class: 2.3 - Poisonous gas
Packing Group:
Symbols:
Label Codes: 2.3 - Poison Gas, 5.1 - Oxidizer, 8 - Corrosive
Special Provisions: 1
Packaging: **Exceptions:** None **Non-bulk:** 302 **Bulk:** None
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:** 40, 89, 90

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed P056
- **CERCLA 40 CFR 302.4:** Listed per RCRA Section 3001 10 lb (4.535 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 10 lb
  - **TPQ:** 500 lb
- **TSCA:** Listed

Section 16 - Other Information

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

Ethylene Dichloride
DIC4250

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 50/60

Material Name: Ethylene Dichloride **CAS Number:** 107-06-2

Chemical Formula: $C_2H_4Cl_2$

Structural Chemical Formula: ClH_2CCH_2Cl

EINECS Number: 203-458-1

ACX Number: X1000031-6

Synonyms: AETHYLENCHLORID; 1,2-BICHLOROETHANE; BICHLORURE D'ETHYLENE; BORER SOL; BROCIDE; CHLORURE D'ETHYLENE; CLORURO DI ETHENE; 1,2-DCE; DESTRUXOL BORER-SOL; 1,2-DICHLOORETHAAN; 1,2-DICHLOR-AETHAN; DICHLOREMULSION; 1,2-DICHLORETHANE; DI-CHLOR-MULSION; DICHLOR-MULSION; 1,2-DICHLOROETHANE; ALPHA,BETA-DICHLOROETHANE; BETA-DICHLOROETHANE; DICHLORO-1,2-ETHANE; SYM-DICHLOROETHANE; DICHLOROETHYLENE; 1,2-DICLOROETANO; DUTCH LIQUID; DUTCH OIL; EDC; ENT 1,656; ETHANE DICHLORIDE; ETHANE,1,2-DICHLORO-; ETHYLEENDICHLORIDE; ETHYLENE CHLORIDE; 1,2-ETHYLENE DICHLORIDE; ETHYLENE DICHLORIDE; FREON 150; GLYCOL DICHLORIDE; NU-G00511; RY DICHLORO-1,2-ETHANE

Derivation: Prepared from reaction of acetone and hydrochloric acid, or ethylene and chloride gas.

General Use: Used primarily as an intermediate in the manufacture of vinyl chloride; also used as a degreaser, as a scavenger in leaded gasoline, in paint removers, in wetting and penetrating agents, in ore floatation processes, as a fumigant, and as a solvent for fats, oils, waxes and gums.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Ethylene dichloride	107-06-2	ca 100% vol

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

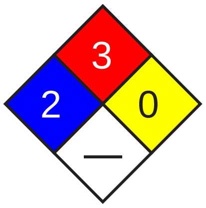
OSHA PEL Vacated 1989 Limits
TWA: 1 ppm; 4 mg/m^3; STEL: 2 ppm; 8 mg/m^3.

ACGIH TLV
TWA: 10 ppm.

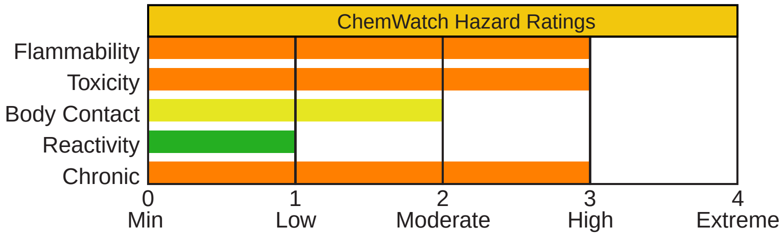
NIOSH REL
TWA: 1 ppm, 4 mg/m^3; STEL: 2 ppm, 8 mg/m^3.

IDLH Level
50 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

Target Organs: Liver, kidneys, heart, gastrointestinal tract, respiratory tract, skin, CNS, eyes; in animal testing, adrenal glands; cancer sites: forestomach, mammary gland, and circulatory system

Primary Entry Routes: Inhalation, skin and/or eye contact/absorption

Acute Effects Note: Nursing infants of mothers exposed to ethylene dichloride are at risk.

Inhalation: Inhalation may result in respiratory tract irritation, pulmonary edema, dizziness, vomiting, coma and delayed death.

Eye: At high concentrations vapors are irritating. Contact with liquid may cause pain, irritation, lacrimation, and, if not rapidly removed, permanent clouding of the cornea.

Skin: Skin contact with this defatting agent can cause drying and chapping. Prolonged contact with the skin, as when held tightly on skin with clothing, produces severe irritation, moderate edema, and necrosis. Absorption can result in acute systemic effects; only large doses produce serious poisoning.

Ingestion: CNS depression, gastrointestinal upset, mental confusion, dizziness, nausea, and vomiting may result from ingestion and may pose an aspiration hazard. Deaths have occurred from ingestion of 8-200 mL.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: Liver and kidney disease, cardiovascular and CNS disorders; conditions requiring the use of insulin or anti-coagulants may be aggravated by exposure to ethylene dichloride.

Chronic Effects: Long term exposure can result in hepatotoxicity (liver damage), nephrotoxiciy (kidney damage), weight loss, low blood pressure, jaundice, oliguria (reduced urine excretion), anemia, CNS depression, insomnia, nausea, vomiting, pulmonary congestion, and adrenal gland damage. Animal studies suggest that immunologic suppression may occur. Repeated skin contact may produce dermatitis with rough, red, dry, cracking skin.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.

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

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

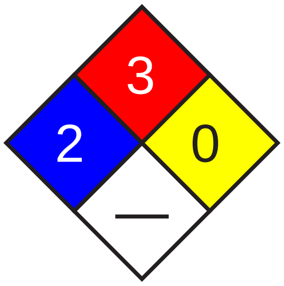
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Implement medical surveillance procedures for workers with potential for exposure. Monitor prothrombin time, serum glucose, electrolytes, liver function, and renal function in severe cases, and arterial blood gases and chest x-ray if respiratory tract irritation is present. Treat overexposure symptomatically and supportively.

Section 5 - Fire-Fighting Measures

Flash Point: 56 °F (13 °C) CC; 64°F (18 °C) OC
Autoignition Temperature: 775 °F (413 °C)
LEL: 6.2% v/v
UEL: 15.9% v/v
Flammability Classification: OSHA Class IB Flammable Liquid

See DOT ERG



Fire Diamond

Extinguishing Media: To extinguish fires involving this flammable liquid, use carbon dioxide, dry chemical, alcohol-resistant foam, water spray or fog. Water may be an ineffective extinguishing medium, but a water spray can be used to cool fire-exposed containers, and flush spills away from ignition sources.

General Fire Hazards/Hazardous Combustion Products: Include carbon oxides, acetylene, vinyl chloride, hydrogen chloride, and phosgene gas. In still air or confined spaces the heavier-than-air vapors of ethylene dichloride may travel along low-lying surfaces to distant ignition sources and flashback. Forms dense soot on burning. Vapors may form explosive mixtures with air.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Remove containers from fire hazard area if feasible. Otherwise, cool fire-exposed containers until well after the fire is extinguished. Structural protective clothing is permeable, remain clear of smoke, water fallout, and water runoff. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate area and deny entry. Remove sources of ignition, and provide maximum explosion-proof ventilation. Stay upwind and have cleanup personnel protect against inhalation and contact. Use appropriate foam to blanket release and suppress vapors.

Small Spills: Absorb ethylene dichloride with vermiculite, earth, sand or similar material.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways. Ground all tools. Use nonsparking equipment.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid inhalation of vapors, contact with skin and eyes. Use only with ventilation sufficient to maintain airborne concentrations at nonhazardous levels (see Sec. 2). Wear protective gloves, goggles, and clothing (see Sec. 2). Keep away from heat and ignition sources. Ground and bond containers during transfers to prevent static sparks.

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

Recommended Storage Methods: Store in tightly closed container in well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Ethylene dichloride is normally packaged under nitrogen gas.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where possible, transfer ethylene dichloride from drums or other storage containers to process containers in a closed system. Minimize ignition sources in surrounding low-lying areas where ethylene chloride vapors may collect. Electrically ground and bond all containers and equipment. Install Class I, Group D electrical equipment. Provide general or local explosion-proof exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Advise employees of potential health hazards associated with occupational exposure to ethylene dichloride. Consider preplacement and periodic medical exams with emphasis on the skin, eyes, respiratory tract, CNS, cardiovascular system, and liver and kidney function.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of Barricade^{TM}, Viton^{TM}, Teflon^{TM}, or Responder^{TM} (Breakthrough Time (BT) >8 hr), if possible, or alternatively, polyvinyl alcohol, 4H^{TM} (PE/EVAL) (BT >4 hr) to prevent prolonged or repeated skin contact. Butyl rubber, natural rubber, polyethylene, Neoprene, nitrile rubber, and polyvinyl chloride (BT < 1 hr) will rapidly degrade in the presence of ethylene dichloride, and are not recommended for protective clothing. Wear splash-proof chemical goggles and faceshield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. At concentrations above the NIOSH RELs, use any SCBA with full facepiece operated in pressure-demand or other positive-pressure mode, or any supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless with a sweet chloroform- like odor characteristic of chlorinated hydrocarbons.

Physical State: Liquid

Odor Threshold: Low: 4.3-5.7 ppm; high: 371 ppm

Vapor Pressure (kPa): 87 mm Hg at 77 °F (25 °C)

Formula Weight: 98.96

Specific Gravity (H_2O=1, at 4 °C): 1.26 at 69 °F (20 °C)

Refractive Index: 1.445 at 69 °F (20 °C)

Boiling Point: 182.3 °F (83.5 °C)
Freezing/Melting Point: -31.9 °F (-35.5 °C)
Viscosity: 0.84 cP at 68 °F (20 °C)
Surface Tension: 32.2 dynes/cm
Ionization Potential (eV): 11.05 eV
Water Solubility: 8.7 g/L at 68 °F (20 °C)
Other Solubilities: Alcohol, chloroform, ether, acetone, carbon tetrachloride

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Ethylene dichloride is stable at room temperature in closed containers under normal storage and handling conditions. However, over time, it slowly decomposes, becomes acidic and darkens in color. Hazardous polymerization cannot occur. Heat and incompatibles.

Storage Incompatibilities: Violent reactions can result from contact with liquid ammonia; nitrogen tetraoxide; chlorine; dimethylaminopropylamine; finely divided metals including aluminum, potassium, and magnesium; other alkalis, amines, strong oxidizers, strong acids, strong bases, and reducing agents. Ethylene dichloride can corrode steel, iron and other metals.

Hazardous Decomposition Products: Thermal oxidative decomposition of ethylene dichloride produces carbon oxides (CO_x), acetylene, vinyl chloride, hydrogen chloride (HCl), and phosgene gas.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 670 mg/kg.

Human, LD_{Lo}: 286 mg/kg produced toxic effects including ulceration or bleeding from stomach, nausea or vomiting, and fatty liver degeneration.

Human, TD_{Lo}: 428 mg/kg produced somnolence, cough, nausea or vomiting.

Human, TD_{Lo}: 892 mg/kg produced hypermotility, diarrhea, nausea or vomiting, and liver effects.

Acute Inhalation Effects:

Human, inhalation, TC_{Lo}: 4000 ppm/1 hr produced flaccid paralysis without anesthesia, coma, and nausea or vomiting.

Rat, inhalation, TC_{50}: 1000 ppm/7 hr produced coma, cyanosis, and body temperature decrease.

Acute Skin Effects:

Rabbit, skin, LD_{50}: 2800 mg/kg produced lacrimation, general anesthesia, and ataxia.

Irritation Effects:

Rabbit, ocular, 63 mg, 24 hr, caused severe irritation.

Other Effects:

Multiple Dose Toxicity Effects: Rat, inhalation, 1500 ppm/7 hr/5 days administered intermittently produced respiratory depression, changes in kidney, ureter or bladder tubules, and death.

Guinea pig, inhalation, 100 ppm/226 day, 7 hr/day, caused body weight loss, and increased liver weight.

Mouse, oral, 4.89 mg/kg/14 day, caused a 30% decrease in leukocyte number and suppressed humoral immune response.

Reproductive Effects: Rat, intrauterine, 1.5 ppm, day 7- term, resulted in increased rates of fetal heart defects.

Genetic Effects: Rat, oral, 150 mg/kg, resulted in DNA damage.

Tumorigenicity - Rat, inhalation, 5 ppm/7 hr/78 weeks, administered intermittently, resulted in production of tumors (skin and appendages) and leukemia.

Rat, oral, 47 mg/kg/day/78 weeks, caused increase in hemangiosarcomas of the circulatory system, squamous cell carcinomas of the forestomach, mammary gland adenocarcinomas and fibroadenomas.

See *RTECS* KI0525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Because of its moderately high vapor pressure, ethylene dichloride will readily evaporate from surface water (estimated half-life several hours to 10 days), as well as soil. It is not known to bioaccumulate. In the atmosphere, ethylene dichloride may be transported over long distances, and will degrade primarily by photo-oxidation (half-life: 1 month). In groundwater, this chemical does not readily degrade. Ethylene dichloride does not readily sorb and is highly mobile in the soil column.

Ecotoxicity: Stonefly (*Pteronarcys*), LC_{50}=100 mg/L/96 hr; rainbow trout (*Salmo gairdneri*), LC_{50}=225 mg/L/96 hr; bluegill (*Lepomis macrochirs*), LC_{50}=1430 mg/L/96 hr; fathead minnow (*Pimephales promelas*), LC_{50}=136 mg/L/96 hr.

Henry's Law Constant: 1.10×10^{-3} atm-m^3/mole

Octanol/Water Partition Coefficient: log K_{ow} = 1.48

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Ethylene dichloride
ID: UN1184
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB2, T7, TP1
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U077 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

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

Issue Date: 2005-05

Ethyl Bromide
ETH3100

Section 1 - Chemical Product and Company Identification 50/60

Material Name: Ethyl Bromide **CAS Number:** 74-96-4
Chemical Formula: C_2H_5Br
Structural Chemical Formula: CH_3CH_2Br
EINECS Number: 200-825-8
ACX Number: X1000047-4
Synonyms: BROMIC ETHER; BROMOETHANE; BROMURE D'ETHYLE; ETHANE,BROMO-; ETHYL BROMIDE; ETYLU BROMEK; HALON 2001; HYDROBROMIC ETHER; MONOBROMOETHANE
Derivation: By distillation from a mixture of hydrogen bromide (HBr), ethyl alcohol and sulfuric acid (H_2SO_4); by the reaction of ethylene with hydrogen bromide induced by g-radiation; or by the reaction of ethane with sulfur trioxide and potassium bromide at 572 to 617 °F (300 to 325 °C) with a 91% yield based on ethane.
General Use: Formerly used as a topical and inhalation anesthetic and refrigerant. Currently, the main commercial uses are as an ethylating agent and as a solvent in the chemical and pharmaceutical industries.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Ethyl bromide	74-96-4	98% vol (technical)

OSHA PEL
TWA: 200 ppm; 890 mg/m^3.

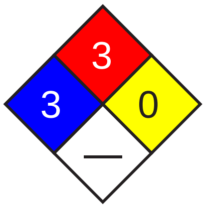
NIOSH REL

OSHA PEL Vacated 1989 Limits
TWA: 200 ppm; 890 mg/m^3;
STEL: 250 ppm; 1110 mg/m^3.

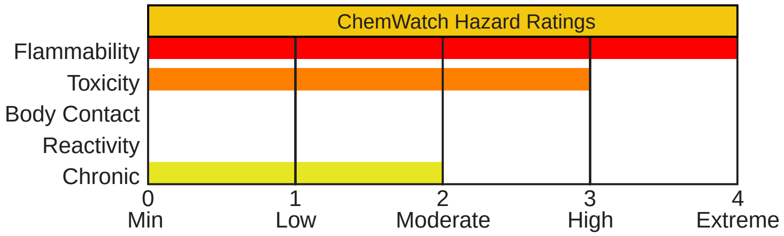
IDLH Level
2000 ppm.

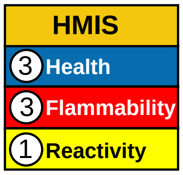
ACGIH TLV
TWA: 5 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





HMIS	
3	Health
3	Flammability
1	Reactivity

ANSI Signal Word

Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; ether-like odor; turns yellow on exposure to air/light. Irritating to eyes/skin/respiratory tract. Other Acute Effects: narcosis, affects cardiovascular system/liver/kidneys. Chronic Effects: animal carcinogen with mutagenic/tumorigenic effects. Highly flammable. Forms explosive concentrations with air. Reacts with water.

Potential Health Effects

Target Organs: Respiratory tract, central nervous system, cardiovascular system, eyes, skin, liver, kidneys
Primary Entry Routes: Inhalation, skin absorption, skin and/or eye contact
Acute Effects
Inhalation: Symptoms of exposure include irritated nose, throat, respiratory tract; nausea, dizziness, central nervous system depression, and difficulty breathing. Upon exposure to high concentrations, death may occur from respiratory or cardiac arrest or from delayed effects on the liver, kidney or heart.

Eye: Contact with liquid ethyl bromide may burn the eyes. Ocular complications reported were conjuctival hyperemia and occasional hemorrhages in conjunctiva.

Skin: Symptoms include dry, cracked, and chapped skin due to defatting action. In addition to being an irritant, ethyl bromide can be absorbed through skin and may lead to absorption of harmful amounts of the substance.

Ingestion: Symptoms include redness of face, dilation of pupils, rapid pulse, nausea, and vomiting. In severe cases, respiratory disorders, collapse, respiratory paralysis and even death occur.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: Ethyl bromide may aggravate existing liver and kidney diseases, and lung, cardiovascular, CNS, and skin (dermatitis) conditions.

Chronic Effects: Ingestion of excessive amounts of ethyl bromide may cause "bromism", a toxic syndrome characterized by behavioral changes, irritability, headache, confusion, slurred speech, nausea, vomiting, anorexia, weight loss, muscular weakness, and lethargy. Symptoms develop over 2 to 4 weeks or longer. Tumorigenic and mutagenic effects in animals have been reported. Bromides also cross the placenta and can be detected in the milk of nursing mothers. Prenatal exposure may cause growth retardation, craniofacial abnormalities and developmental delay.

Section 4 - First Aid Measures

See DOT ERG

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

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 20 minutes. Consult a physician or ophthalmologist immediately.

Skin Contact: *Quickly* remove and isolate contaminated clothing. Rinse with flooding amounts of water for at least 20 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: If ethyl bromide is swallowed, get medical attention immediately. 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. Consult a physician.

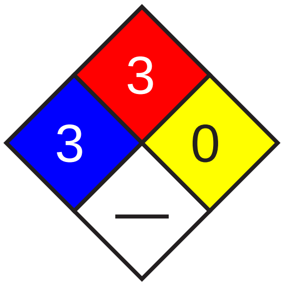
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically and supportively. Bromide is only slowly eliminated from the body; chloride is excreted preferentially.

Special Precautions/Procedures: Ensure that medical personnel are aware of possible exposure to ethyl bromide and take precautions to protect themselves. Effects of exposure to ethyl bromide may be delayed.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: <-4 °F (-20 °C)
Autoignition Temperature: 952 °F (511 °C)
LEL: 6.8% v/v
UEL: 8.0% v/v
Flammability Classification: OSHA Class IB flammable liquid

Extinguishing Media: Use dry chemical, CO_2, fog or alcohol-resistant foam. Water may be ineffective. It reacts with water or steam to produce toxic and corrosive fumes.

General Fire Hazards/Hazardous Combustion Products: Readily decomposes into volatile toxic products including bromine, hydrogen bromide, carbonyl bromide, carbon dioxide, and carbon monoxide. Ethyl bromide is highly flammable. It can be easily ignited by heat, sparks, or flames. Vapors may form explosive mixtures with air and may travel back to the ignition source and flashback. Vapors are heavier than air and will spread along the ground and collect in low or confined areas. Containers may explode when heated or involved in a fire.

Fire-Fighting Instructions: *Do not* extinguish fire unless flow can be stopped. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Move containers from fire area if it can be done without undue risk. Dike fire control water for later disposal. *Do not* scatter the material. *Do not* use straight streams. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. *Always* stay away from the ends of tanks. *Do not* release runoff from fire control methods to sewers or waterways. Fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Wear chemically protective clothing specifically recommended by the manufacturer. It may provide little or no thermal protection.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Isolate spill or leak area immediately for at least 100 to 200 meters (330 to 660 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering. Wear fully encapsulating, vapor protective clothing for spills and leaks with no fire. Eliminate all ignition sources. 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 undue risk.

See DOT ERG

Small Spills: Absorb ethyl bromide with earth, sand or other noncombustible material and carefully scoop up and then place in a suitable container for disposal. Use clean nonsparking tools to collect absorbed material.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. Prevent release into sewers or waterways, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. A water spray may reduce vapor but may not prevent ignition in closed spaces.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid skin and eye contact and vapor inhalation. Use with ventilation adequate to reduce airborne concentrations to nonhazardous levels (see Sec. 2). Wear personal clothing and equipment (see Sec. 8) to prevent contact. Ignition sources including tobacco products and open flames are prohibited where ethyl bromide is handled, used, or stored. Use only nonsparking, explosion-proof tools and equipment and fittings.

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

Recommended Storage Methods: Outdoor or detached storage is preferable. If stored outdoors, shield containers from direct exposure to sunlight and away from areas of acute fire hazard, high temperature processes, and readily oxidizable materials. Indoor storage should be a standard flammable liquid storage room in tightly closed containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in use, production, and storage areas. Where feasible, enclose operations to prevent vapor dispersion into the work area. Ventilate at site of chemical release. Construct industrial buildings (processing areas) of ceramic or similar material that does not absorb ethyl bromide. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the respiratory tract, skin, liver, and kidneys. Educate workers about the hazards associated with ethyl bromide. Train in work practices which minimize exposure.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Butyl rubber, natural rubber, and polyvinylchloride gloves are *not* recommended as degradation may occur. Wear protective splash-proof chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices and should *not* be worn when working with ethyl bromide. Appropriate eye protection must be worn instead of contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/ NIOSH-approved respirator. OSHA recommends a supplied-air respirator or any self-contained breathing apparatus (SCBA) with a full facepiece for exposures of 2000 ppm. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For escape, any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front or back mounted organic vapor canister or any appropriate escape-type, SCBA should be selected. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Immediately remove and isolate work clothing that becomes wet due to its flammability hazard. Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless with a sweet odor.

Physical State: Liquid [gas above 101 °F (38 °C)] **Odor Threshold:** 890 mg/m^3

Vapor Pressure (kPa): 375 mm Hg; 400 mm at 75 °F (21 °C); 467 mm at 77 °F (25 °C)
Bulk Density: 12-12.1 lb/gal
Formula Weight: 109
Specific Gravity (H_2O=1, at 4 °C): 1.46 at 68 °F (20 °C)
Refractive Index: 1.4242 at 68 °F (20 °C)
Boiling Point: 101 °F (38 °C)
Freezing/Melting Point: -182 °F (-119 °C)
Viscosity: 0.379 cP at 77 °F (25 °C)
Surface Tension: 24.15 dynes/cm
Ionization Potential (eV): 10.29 eV
Water Solubility: 0.9% by weight at 68 °F (20 °C)
Other Solubilities: Soluble in alcohol, ether, chloroform, and other organic solvents.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Ethyl bromide is stable at room temperature in closed containers under normal storage and handling conditions. Heat contributes to instability. Hazardous polymerization cannot occur. Incude heat and ignition sources, incompatibles, and confined areas.

Storage Incompatibilities: Ethyl bromide can react with sodium, potassium, calcium, powdered aluminum, zinc, and magnesium and oxidizers. It will attack some forms of plastics, rubber, and coatings. It reacts with water or steam to produce toxic and corrosive fumes.

Hazardous Decomposition Products: Thermal oxidative decomposition of ethyl bromide can produce bromine, hydrogen bromide, carbonyl bromide, carbon dioxide, and carbon monoxide.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 1350 mg/kg.

Acute Inhalation Effects:

Rat, inhalation, LC_{50}: 26980 ppm/1hr.

Mouse, inhalation, LC_{50}: 16230 ppm/1 hr produced toxic behavioral effects including somnolence and gastrointestinal effects of hypermotility and diarrhea.

Human Exposure: 6500 ppm for 5 minutes produced vertigo, slight headache, and mild eye irritation.

Rats and mice, inhalation: 400 ppm produced an increased incidence of conjunctivitis, pulmonary inflammation, nasal and alveolar epithelial hyperplasia, and decreased body weight.

Other Effects:

Rat, inhalation: 2 pph/6 hr/14 days administered intermittently resulted in death.

Rat, inhalation: 1600 ppm/6 hr/14 weeks administered intermittently produced changes in the spleen and death.

Hamster, cell type - ovary: 100 mg/L induced sister chromatid exchange.

Mouse, inhalation, dose: 1 pph/6 hr/14 days administered intermittently resulted in death.

Mouse, inhalation: 200 ppm/6 hr/2 yr administered intermittently produced uterine tumors. (Classified as an equivocal tumorigenic agent by RTECS criteria.).

Rat, inhalation: 100 ppm/6 hr/2 yr administered intermittently produced tumors of the brain and coverings. (Classified as an equivocal tumorigenic agent by RTECS criteria.)

See *RTECS* KH6475000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Ethyl bromide hydrolyzes in water and moist soils. Leaching in soil is likely. Ethyl bromide should evaporate readily from moist and dry terrestrial surfaces. Henry's Law constant (7.49 x 10^{-3} atm-m^3/mole) indicates that volatilization from environmental waters is very important. Biodegradation of ethyl bromide is expected to be an important fate process in both water and soil. It is expected to degrade relatively slowly in an average ambient atmosphere (half life 48 days est.) by reaction with photochemically-produced hydroxyl radicals. Using a 4 week closed bottle biodegradation study, with 100 mg/L ethyl bromide and 30 mg/L sludge, ethyl bromide had a theoretical BOD of 13 to 45%. Ethyl bromide may react with naturally-occurring nucleophiles in groundwater to form aliphatic sulfur-containing products. Based on estimated soil adsorption coefficients, K_{oc} values of 29 and 179, ethyl bromide has a moderate to high soil mobility. Adsorption to sediment is not expected to be important.

Ecotoxicity: Ethyl bromide can be released to the environment in effluents from manufacturing and use facilities, in leachates from landfills, and through its use as a refrigerant. It is not expected to bioconcentrate significantly in aquatic organisms.

Octanol/Water Partition Coefficient: log K_{ow} = 1.61 (measured)

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Prior to implementing land disposal of waste residue (including waste sludge) consult with environmental regulatory agencies for guidance on acceptable disposal practices. Sewers designed to preclude the formation of explosive concentrations of ethyl bromide vapors are permitted.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Ethyl bromide
ID: UN1891
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB2, T7, TP2, TP13
Packaging: **Exceptions:** None **Non-bulk:** 202 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:** 40, 85

Section 15 - Regulatory Information

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

Section 16 - Other Information

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

Dichlorodifluoromethane
DIC3900

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification

Material Name: Dichlorodifluoromethane **CAS Number:** 75-71-8
Chemical Formula: CCl_2F_2
Structural Chemical Formula: CF_2Cl_2
EINECS Number: 200-893-9
ACX Number: X1000002-5
Synonyms: ALGOFRENE TYPE 2; ARCTON 12; ARCTON 6; CFC-12; CFC 12; CHLOROFLUOROCARBON 12; DICHLORODIFLUOROMETHANE; DICLORODIFLUOMETANO; DIFLUORODICHLOROMETHANE; DWUCHLORODWUFLUOROMETAN; DYMEL 12; ELECTRO-CF 12; EPA PESTICIDE CHEMICAL CODE 000014; ESKIMON 12; F 12; FC 12; FCC 12; FKW 12; FLUOROCARBON-12; FLUOROCARBON 12; FORANE 12; FREON 12; FREON F-12; FRIGEN 12; GENETRON 12; HALON; HALON 122; ISCEON 122; ISOTRON 12; ISOTRON 2; KAISER CHEMICALS 12; LEDON 12; METHANE,DICHLORODIFLUORO-; PROPELLANT 12; R 12 (REFRIGERANT); R12; REFRIGERANT 12; REFRIGERANT R 12; UCON 12; UCON 12/HALOCARBON 12
General Use: Used as a refrigerant, blowing agent, aerosol propellant, solvent, degreasing agent and for therapeutic use. Transferred as a liquid in and out of refrigeration equipment by controlled pressure decanting through flexible pipework.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
dichlorodifluoromethane	75-71-8	100

OSHA PEL
TWA: 1000 ppm; 4950 mg/m^3.

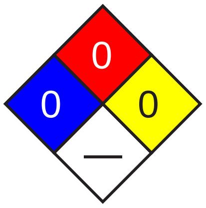
NIOSH REL
TWA: 1000 ppm, 4950 mg/m^3.

DFG (Germany) MAK
TWA: 1000 ppm; PEAK: 2000 ppm.

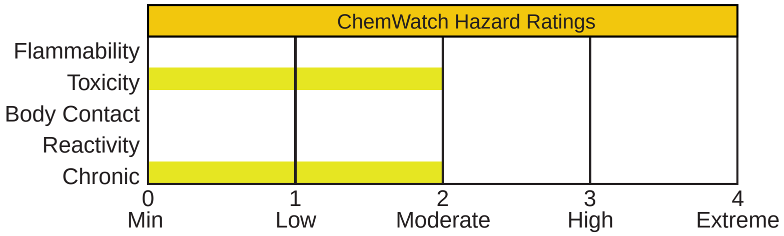
ACGIH TLV
TWA: 1000 ppm.

IDLH Level
15,000 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
1	Health
0	Flammability
0	Reactivity

ANSI Signal Word
Caution

Compressed Gas

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, practically odorless gas. Mildly irritating to eyes/skin/respiratory tract. Possible frostbite. Other Acute Effects: asphyxia, exhaustion, unconsciousness, convulsions, paresthesia, slurred speech, cardiac arrythmias. Chronic Effects: neurotoxic effects.

Potential Health Effects

Target Organs: cardiovascular system, central nervous system (CNS), peripheral nervous system
Primary Entry Routes: inhalation
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and lungs and may be harmful. Material is highly volatile and may quickly form concentrated atmosphere in confined or unventilated area. Vapor is heavier than air and may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure.

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

Exposure to high concentrations causes a reduction in the respiratory minute volume, bronchoconstriction and reduced compliance among various animal species.

Elimination from the body is rapid. Dogs exhaled within 1 hour all the fluorocarbon inhaled during a 6-20 minute exposure at 8000-12000 ppm.

Inhaled material appears rapidly in the blood, bile and cerebrospinal fluid and urine of anesthetised rabbits and dogs, Dichlorodifluoromethane has a very low acute inhalation toxicity and acts like a weak narcotic. Deaths occurred in rats but not guinea pigs after 2 hour exposures at 600,000 ppm. The cardiac sensitization potential is moderate.

Evidence of serious cardiac arrhythmia was found in dogs exposed to atmospheres of 50,000 ppm for 5 minutes and to intravenous adrenaline.

Respiratory/circulation effects including bronchoconstriction and tachycardia were seen at concentrations of 50,000-1000,000 ppm.

Monkeys, guinea pigs and dogs exposed for 40 hours weekly over 10-12 weeks to 200,000 ppm showed generalized tremor and signs of mild narcosis as well as slight blood changes.

Exposure to high concentrations may produce cardiac arrhythmias or cardiac arrest due to sensitization of the heart to adrenalin or noradrenalin.

Deaths associated with exposures to fluorocarbons (specifically halogenated aliphatics) have occurred in occupational settings and in inhalation of bronchodilator drugs.

Bronchospasm consistently occurs in human subjects inhaling fluorocarbons.

At a measured concentration of 1700 ppm of one of the commercially available aerosols there is a biphasic change in ventilatory capacity, the first reduction occurring within a few minutes and the second delayed up to 30 minutes.

Most subjects developed bradycardia (reduced pulse rate). Sensitivity is increased by injection of adrenalin or cardiac ischemia/necrosis or pulmonary thrombosis/bronchitis. The cardiotoxic effects of the fluorocarbons originate from irritation of the respiratory tract which in turn reflexly influences the heart rate (even prior to absorption of the fluorocarbon) followed by direct depression of the heart after absorption.

Exposure to fluorocarbon thermal decomposition products may produce flu- like symptoms including chills, fever, weakness, muscular aches, headache, chest discomfort, sore throat and dry cough. Complete recovery usually occurs within 24 hours of exposure.

Eye: The vapor is discomforting to the eyes.

The liquid is capable of causing severe cold burns.

Skin: The liquid is capable of causing severe cold burns to the skin.

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

Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.

Ingestion: The liquid is harmful if swallowed and is capable of causing severe cold burns. Overexposure is unlikely in this form.

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

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

Chronic Effects: It is generally accepted that the fluorocarbons are less toxic than the corresponding halogenated aliphatic based on chlorine. Repeated inhalation exposure to the fluorocarbon FC-11 does not produce pathologic lesions of the liver and other visceral organs in experimental animals. There has been conjecture in non-scientific publications that fluorocarbons may cause leukemia, cancer, sterility and birth defects; these have not been verified by current research. The high incidence of cancer, spontaneous abortion, and congenital anomalies amongst hospital personnel, repeatedly exposed to fluorine-containing general anesthetics, has caused some scientists to call for a lowering of the fluorocarbon exposure standard to 5 ppm since some are mutagens.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

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

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.

Quickly remove all contaminated clothing, including footwear.

Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor.

In case of cold burns (frostbite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing

if possible and without rubbing.
Do not apply hot water or radiant heat. Apply a clean, dry dressing.
Transport to hospital or doctor.

Ingestion: 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.

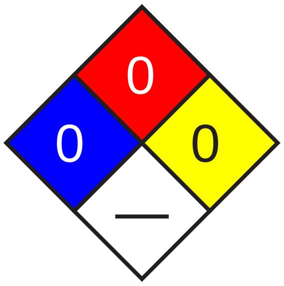
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: There is no restriction on the type of extinguisher which may be used.
General Fire Hazards/Hazardous Combustion Products: Nonflammable gas. Will not burn, but heat produces highly toxic fumes/vapors.
Heating may cause expansion or decomposition leading to violent rupture of containers.
If involved in fire emits toxic fumes of phosgene, chlorides, fluorides, carbon monoxide (CO) and carbon dioxide (CO_2).
Fire Incompatibility: Avoid reaction with alkali metals, magnesium and magnesium alloys, zinc, aluminum alloys (> 2% magnesium). Avoid contact with plastics such as acrylic polymers, polyethylene and polystyrene.
Fire-Fighting Instructions: Product is not combustible. No special firefighting procedures required.
Use fire fighting procedures suitable for surrounding area.
Wear full body protective clothing with breathing apparatus.
If safe to do so, remove containers from path of fire.
Do not approach cylinders suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.

See DOT ERG



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately.
No smoking, bare lights or ignition sources. Increase ventilation.
Avoid breathing vapors and contact with skin and eyes.
Large Spills: Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
Wear full body protective clothing with breathing apparatus.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Do not exert excessive pressure on valve; do not attempt to operate damaged valve.
Remove leaking cylinders to a safe place if possible. Release pressure under safe, controlled conditions by opening the valve.
Collect recoverable product into labeled containers for recycling.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Water spray or fog may be used to disperse vapor.
If contamination of drains or waterways occurs, advise emergency services.

See DOT ERG

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

Section 7 - Handling and Storage

Handling Precautions: Avoid breathing vapors and contact with skin and eyes.
Avoid physical damage to containers.
Wear personal protective equipment when handling.
When handling, DO NOT eat, drink or smoke.
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.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Wash hands with soap and water after handling.
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: Aerosol pack. Cylinder fitted with valve protector cap.
Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Cylinder valve must be closed when not in use or when empty.
Cylinder must be properly secured either in use or in storage.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.
Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: 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: Wear physical protective gloves, eg. leather.

Respiratory Protection:
Exposure Range >1000 to <15,000 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 15,000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: odor threshold unknown

Other: No special equipment needed when handling small quantities. Eyewash unit.
Ensure that there is ready access to breathing apparatus.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless liquefied gas or compressed gas with a faint sweetish odor. Dissolves many urethane components. Critical temperature: 111.8 °C. Critical pressure: 4125 kPa.

Physical State: Liquefied gas
Vapor Pressure (kPa): 652 at 25 °C
Vapor Density (Air=1): 4.2 at 25 °C
Formula Weight: 120.9
Specific Gravity (H_2O=1, at 4 °C): 1.3 at 25 °C
Evaporation Rate: 380 (BuAc=1)
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: -29.8 °C (-22 °F) at 760 mm Hg
Freezing/Melting Point: -158 °C (-252.4 °F)
Volatile Component (% Vol): 100
Decomposition Temperature (°C): > 260
Water Solubility: 0.28 g/L water at 25 °C at 1 atm

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Extremely high temperatures.
Product is considered stable under normal handling conditions. Stable under normal storage conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid reaction with alkali metals, magnesium and magnesium alloys, zinc, aluminum alloys (> 2% magnesium). Avoid contact with plastics such as methacrylate polymers, polyethylene and polystyrene.
Haloalkanes are highly reactive. Reaction with the lighter divalent metals may produce more reactive compounds analagous to Grignard reagents.
Prolonged contact with metal or other azides may produce explosive azides.

Section 11 - Toxicological Information

__Toxicity__
Inhalation (human) TC_{Lo}: 200000 ppm/30m
Inhalation (rat) LC_{50}: 800000 ppm/30m

__Irritation__
Nil Reported

See *RTECS* PA 8200000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on land, it will leach into the ground and volatilize from the soil surface. No degradative processes are known to occur in the soil. It is also stable in water and the only removal process will be volatilization. It can enter water bodies from the atmosphere and the in the surface water rapidly reaches equilibrium with the concentration in the air. Ocean currents also carry the chemical long distances and many kilometers below the surface. It is extremely stable in the troposphere and will disperse over the globe and diffuse slowly into the stratosphere where it will be lost by photolysis.
Ecotoxicity: No data found.
Henry's Law Constant: estimated at 0.225
BCF: possible under constant exposure
Biochemical Oxygen Demand (BOD): not pertinent
Octanol/Water Partition Coefficient: log $K_{ow} = 2.16$
Soil Sorption Partition Coefficient: $K_{oc} = 200$

Section 13 - Disposal Considerations

Disposal: Evaporate or incinerate residue at an approved site.
Follow applicable federal, state, and local regulations.
Ensure damaged or non-returnable cylinders are gas-free before disposal.
Return empty containers to supplier.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Dichlorodifluoromethane *or* Refrigerant gas R 12
ID: UN1028
Hazard Class: 2.2 - Non-flammable compressed gas
Packing Group:
Symbols:
Label Codes: 2.2 - Non-Flammable Gas
Special Provisions: T50
Packaging: **Exceptions:** 306 **Non-bulk:** 304 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** 75 kg **Cargo aircraft only:** 150 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U075 Toxic Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Chloromethane
MET2760

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Chloromethane **CAS Number:** 74-87-3
Chemical Formula: CH_3Cl
Structural Chemical Formula: H_3CCl
EINECS Number: 200-817-4
ACX Number: X1003175-5
Synonyms: ARTIC; CHLOOR-METHAAN; CHLOR-METHAN; CHLOROMETHANE; CHLORURE DE METHYLE; CLOROMETANO; CLORURO DI METILE; METHANE,CHLORO-; METHYL CHLORIDE; METHYLCHLORID; METYLU CHLOREK; MONOCHLOROMETHANE; R 40
General Use: Methylating agent in the production of silicones, butyl rubber, tetramethyl lead, methyl cellulose, methylene chloride, methyl mercaptan, plastics, pesticides, pharmaceuticals, dyes, perfumes, ethers, resins, quaternary drugs, methyl ethers and commercial Grignard reagents.
Blowing agent for some polystyrene (e.g. Styrofoam) and polyurethane foams.
A potent narcotic which has been used as a local anesthetic.
Refrigerant, low temperature extraction solvent, herbicide, fluid for thermometric and thermostatic equipment.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
chloromethane	74-87-3	>98

OSHA PEL
TWA: 100 ppm; Ceiling 200 ppm; 300 ppm, 5-minute maximum peak in any 3 hours.

OSHA PEL Vacated 1989 Limits
TWA: 50 ppm; 105 mg/m^3; STEL: 100 ppm; 210 mg/m^3.

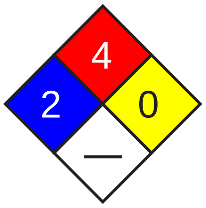
ACGIH TLV
TWA: 50 ppm; STEL: 100 ppm; skin.

NIOSH REL

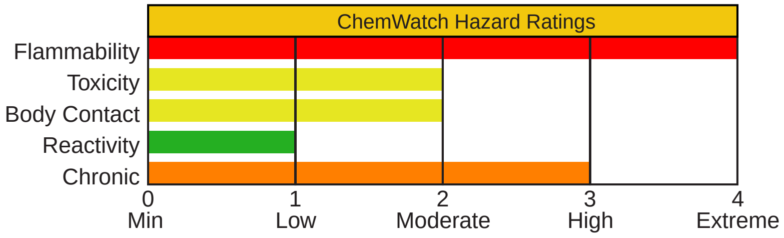
IDLH Level
2000 ppm.

DFG (Germany) MAK
TWA: 50 ppm; PEAK: 100 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
2	Health
4	Flammability
0	Reactivity

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless gas; sweet odor. Acute Effects: staggering gait, slurred speech, dizziness, blurred vision, liver/kidney damage, displaces available oxygen. Chronic Effects: CNS effects; damage may be permanent. Flammable.

Potential Health Effects

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

Chloromethane is not a typical halogenated aliphatic hydrocarbon. it produces only slight nervous system depression. The narcotic concentration for mice is 65000 ppm whilst that for chloroform is 440 ppm.

The brief prenarcotic phase involves inebriation with severe gastrointestinal symptoms (nausea, vomiting).

For lethal exposures the brain, lungs (pulmonary congestion and edema), kidneys and liver were reported to be markedly injured.

More than 30 deaths have been reported in the literature. The prenarcotic symptoms (headache, dizziness, confusion, marked sleepiness) and gastrointestinal disorders (nausea and vomiting) are followed by a symptom-free period of up to 2 days. Subsequent illness is characterized by neurotoxic symptoms. Personality changes originating in organic changes in the brain, tremor, tonic clonic spasms, hiccough and transient paralysis have all been observed. The eyes may also be affected. The symptoms (amblyopia, strabismus, double vision, accomodation disorders and ptosis) resemble those produced by methanol.

Apparent recovery from a seemingly minor exposure via inhalation may be followed by serious and prolonged after-effects within a few days or weeks.

These may be fatal.

Employees of a synthetic rubber plant exposed accidentally to chloromethane were disabled for 10-30 days. None suffered any permanent disability. Principal symptoms were blurred vision, dizziness and weakness. Other symptoms included gastrointestinal disturbance with prolonged vomiting, sleep disturbance, muscular incoordination, elevated body temperature and tachycardia.

When male rats inhaled 3500 ppm for 6 hours/day for 5 to 9 days, serum testosterone decreased as a result of central nervous system toxicity and degeneration of spermatic epithelium and the formation of epididymal granulomas.

Ataxia and renal damage (as evidenced by blood in the urine - hematuria) was evident, particularly in females, when mice were exposed to levels ranging from 500 to 2000 ppm chloromethane for 6 hours.

Degeneration and necrosis of proximal convoluted tubules and hepatic and cellular necrosis were found.

Exposures of 6 hours/day, 6 days/week at concentrations of 500 ppm were lethal to dogs in 4 weeks and to monkeys in 16 weeks. Signs of intoxication preceding death were convulsive seizures, periods of unconsciousness and neuromuscular disability. Repeated exposures at 300 ppm for 64 weeks did not produce adverse effects in either species.

Chloromethane is slowly excreted from the body and is metabolically converted to methanol.

Eye: The vapor is highly discomforting to the eyes, may be harmful following absorption, may cause chemical burns and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

Moderate human exposure to chloromethane has produced ocular symptoms such as mistiness, diplopia and difficulty in accommodation. These symptoms may persist for several weeks.

Skin: The liquid is discomforting to the skin.

Toxic effects may result from skin absorption.

Vaporizing liquid causes rapid cooling and contact may cause cold burns, frostbite.

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

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Chronic and sub-acute exposures in humans may result in CNS effects such as ataxia, staggering gait, weakness, tremor, vertigo, speech difficulties and blurred vision. Significant performance decrements were found in workers chronically exposed to concentrations of 7.4 to 70 ppm.

No changes in clinical electroencephalograph were noted.

Rats and mice, chronically exposed to concentrations of 50-1000 ppm for 6 hours/day, 5 days/week for 2 years, showed renal degenerative changes (cortical tubular epithelial hypertrophy and hyperplasia with and without karyomegaly) and hepatocellular degeneration. A statistically significant increase in both malignant and non-malignant renal tumors occurred in male mice exposed at 1000 ppm. Additionally, chronic inhalation of 1000 ppm induced functional limb muscle impairment and degeneration, impairment of the internal granular layer of the cerebellum and atrophy of the spleen in both male and female mice. In teratology studies no effects were seen in rats but fetal heart-valve malformations were found in mice.

The acute and chronic toxicity of chloromethane differs greatly amongst animal species. In a human population two types of individual may react in a different fashion to chloromethane exposure. The so-called "conjugators" and "non-conjugators" metabolize the substance at markedly different rates. The effect of this difference on the susceptibility of the individual to the toxic effects has yet to be clarified.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

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

water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: In case of cold burns (frost-bite): Bathe the affected area immediately in cold water for 10 to 15 minutes, immersing if possible and without rubbing.
Do not apply hot water or radiant heat. Apply a clean, dry dressing.
Transport to hospital or doctor.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Avoid giving milk or oils.
Avoid giving alcohol.

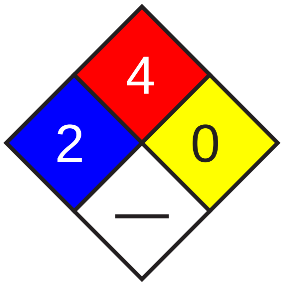
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.
Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

Section 5 - Fire-Fighting Measures

Flash Point: < 0 °C Open Cup
Autoignition Temperature: 634 °C
LEL: 8.1% v/v
UEL: 17.4% v/v
Extinguishing Media: Alcohol stable foam.
Bromochlorodifluoromethane (BCF) (where regulations permit).
Dry chemical powder.
Carbon dioxide.
Water spray or fog.

See DOT ERG



Fire Diamond

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

Fire Incompatibility: Reacts explosively with aluminum, magnesium, zinc or potassium, sodium or their alloys.

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

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Avoid breathing vapor and any contact with liquid or gas. Protective equipment including respirator should be used. Do NOT enter confined spaces where gas may have accumulated. Shut of all sources of possible ignition and increase ventilation. Clear area of personnel. Stop leak only if safe to so do. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve. Keep area clear of personnel until gas has dispersed.

Large Spills: ....Clear area of all unprotected personnel and move upwind.
Contact fire department and advise them of the location and nature of hazard.
May be violently or explosively reactive.
Wear full body clothing with breathing apparatus.
Prevent by any means available, spillage from entering drains and waterways.
Consider evacuation.
Shut off all possible sources of ignition and increase ventilation.
No smoking or bare lights within area.

Use extreme caution to prevent violent reaction.
Stop leak only if safe to so do.
Water spray or fog may be used to disperse vapor.
Do NOT enter confined space where gas may have collected.
Keep area clear until gas has dispersed.
Keep area clear of personnel until gas has dispersed.

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

Section 7 - Handling and Storage

Handling Precautions: Use good occupational work practices.
Avoid breathing vapors and contact with skin and eyes.
Avoid contact with incompatible materials.
Avoid smoking, bare lights or ignition sources.
Avoid sources of heat.
Avoid physical damage to containers.
Wear protective clothing and gloves when handling containers.
Use in a well-ventilated area.
Keep containers securely sealed when not in use.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Vapor may travel a considerable distance to source of ignition.
DO NOT transfer gas from one cylinder to another.
Ground all lines and equipment.
Vapor may ignite on pumping or pouring due to static electricity.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Cylinder fitted with valve protector cap.
Ensure the use of equipment rated for cylinder pressure.
Ensure the use of compatible materials of construction.
Cylinder valve must be closed when not in use or when empty.
Cylinder must be properly secured either in use or in storage.
WARNING: Suckback into cylinder may result in rupture.
Use back-flow preventive device in piping.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

Eyes: Close fitting gas tight goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVA gloves.

Respiratory Protection:
Exposure Range >100 to <2000 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 2000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properites

Other: Overalls. Eyewash unit.
Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless, gas, odorless or with slight sweetish ethereal odor. Soluble in alcohol, chloroform, benzene, carbon tetrachloride, glacial acetic acid.

Physical State: Liquefied gas
Vapor Pressure (kPa): 492 at 20 °C
Vapor Density (Air=1): 1.74
Formula Weight: 50.49
Specific Gravity (H_2O=1, at 4 °C): 0.92
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: -23.7 °C (-11 °F)
Freezing/Melting Point: -97 °C (-142.6 °F)
Volatile Component (% Vol): 100
Water Solubility: 303 ml/100ml at 20 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable under normal handling conditions.
Hydrolyzes with water, forming hydrochloric acid.
Stable under normal storage conditions. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.
In the presence of catalytic amounts of aluminum chloride, powdered aluminum and chloromethane interact to form pyrophoric trimethylaluminum.
Incompatible with galvanized iron.
Incompatible with natural rubber and many neoprene compounds. Polyvinyl alcohol remains unaffected.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 1800 mg/kg
Inhalation (human) LC_{Lo}: 20000 ppm/2h
Inhalation (rat) LC_{50}: 5300 mg/m^3/4h
Human cell mutagen. Reproductive effector in rats. Specific paternal effects affecting spermatogenesis, testes etc, fetotoxicity and fetolethality, specific developmental abnormalities of the musculoskeletal and cardiovascular systems recorded. Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Irritation
Nil reported

See *RTECS* PA 6300000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released into water, it will be rapidly lost by volatilization (half-life in a typical river 2.1 hr). It will also be rapidly lost from soil by volatilization although there is a potential for it to leach into groundwater where it may very slowly biodegrade and hydrolyze (half-life may exceed a year). Once in the atmosphere it will disperse and will be lost primarily by upward dispersion. Above the tropopause, reaction with hydroxyl radicals aid in the removal and above 30 km, photodissociation, diffusion and reaction with hydroxyl radicals make roughly equal contributions to its removal.
Ecotoxicity: LC_{50} Lepomis macrochirus 550 ppm/96 hr (static bioassay in fresh water at 23 °C, mild aeration applied after 24 hr); LC_{50} Menidia beryllina 270 ppm/96 hr (static bioassay in synthetic seawater at 23 °C, mild aeration applied after 24 hr); Toxicity Threshold (Cell Multiplication Inhibition Test) Pseudomonas putida (bacteria) 500 mg/l; Toxicity Threshold (Cell Multiplication Inhibition Test) Microcystis aeruginosa (algae) 550 mg/l
Henry's Law Constant: 8.82×10^{-2}
BCF: none likely
Biochemical Oxygen Demand (BOD): none
Octanol/Water Partition Coefficient: $\log K_{ow} = 0.91$

Section 13 - Disposal Considerations

Disposal: Follow applicable federal, state, and local regulations.
Evaporate or incinerate residue at an approved site.
Return empty containers to supplier.
Ensure damaged or non-returnable cylinders are gas-free before disposal.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Methyl chloride, *or* Refrigerant gas R 40
ID: UN1063
Hazard Class: 2.1 - Flammable gas
Packing Group:
Symbols:
Label Codes: 2.1 - Flammable Gas
Special Provisions: T50
Packaging: **Exceptions:** 306 **Non-bulk:** 304 **Bulk:** 314, 315
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** D **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U045 Toxic Waste, Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Chloroform **CAS Number:** 67-66-3

Chemical Formula: $CHCl_3$

Structural Chemical Formula: $CHCl_3$

EINECS Number: 200-663-8

ACX Number: X1000035-4

Synonyms: Chloroform; CHLOROFORM; CHLOROFORME; CLOROFORMIO; FORMYL TRICHLORIDE; FREON 20; METHANE TRICHLORIDE; METHANE,TRICHLORO-; METHENYL CHLORIDE; METHENYL TRICHLORIDE; METHYL TRICHLORIDE; R 20; R 20 (REFRIGERANT); TCM; TRICHLOORMETHAAN; TRICHLORMETHAN; TRICHLOROFORM; TRICHLOROMETHANE; TRICLOROMETANO

General Use: As a solvent for fats, oils, rubber, alkaloids, waxes, gutta-percha and resins; as a cleaning agent; in fire extinguishers to lower the freezing temperature of carbon tetrachloride; in the rubber industry; as a solvent in organic chemistry.

Medical use as anesthetic discontinued because ot toxicity.

Major use in modern industry is in the production of fluorocarbon-22, a refrigerant.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
chloroform	67-66-3	>98

OSHA PEL
Ceiling: 50 ppm, 240 mg/m^3.

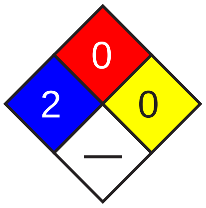
ACGIH TLV
TWA: 10 ppm.

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

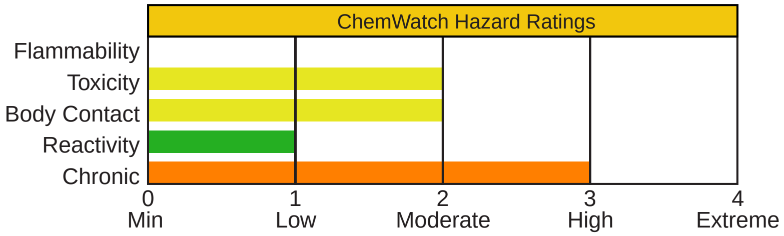
IDLH Level
500 ppm.

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

Section 3 - Hazards Identification



Fire Diamond



HMIS	
3	Health
0	Flammability
0	Reactivity

ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; ethereal odor. Irritating to eyes/skin/respiratory tract. Toxic. Other Acute Effects: dizziness, liver/kidney damage. Chronic Effects: CNS effects, possible cancer hazard, possible birth defects based on animal data.

Potential Health Effects

Target Organs: liver, kidneys, heart, eyes, skin

Primary Entry Routes: inhalation, ingestion, skin contact/absorption

Acute Effects

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

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

1000-2000 ppm may cause dizziness, headache, fatigue, salivation and nausea. 4000 ppm may cause vomiting, serious disorientation and a fainting feeling. 14000-16000 ppm may cause anesthesia and rapid loss of consciousness. More than 20000 ppm may cause respiratory failure, cardiac arrhythmias and death. Fatty changes and centrilobular necrosis of the liver and fatty degenerative changes of the kidney and heart may occur.

If death does not occur immediately from respiratory arrest or ventricular fibrillation, it may occur later from liver and kidney damage.

Toxic effects are increased by consumption of alcohol.

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

The material may produce moderate eye irritation leading to inflammation.

Repeated or prolonged exposure to irritants may produce conjunctivitis.

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

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

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

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

Other symptoms include burning of the mouth, throat, esophagus and stomach, diarrhea, abdominal and substernal pain, cold, clammy skin, cyanosis of the extremities and face, muscle cramps, mydriasis, hypotension, peripheral vasodilation, irregular respiration, respiratory failure, unconsciousness and liver damage.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class B, Justifiably suspected of having carcinogenic potential.

Chronic Effects: Repeated exposure to 77-237 ppm has caused lassitude, dullness, urinary frequency, and gastrointestinal disturbances. Other symptoms include dry mouth, thirst, malaise, anorexia, headache, depression, confusion, weakness, blurred vision, paresthesias, loss of sense of balance, memory loss, tremors, anemia, kidney damage, and fatty degeneration of the liver.

Repeated ingestion may cause liver and kidney damage.

Chloroform is not strongly teratogenic but is embryotoxic. Several epidemiological and ecological studies indicate that there is an association between cancer of the large intestine, rectum, and/or urinary bladder and the constituents of chlorinated water.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

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

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

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.

Note: DO NOT INDUCE VOMITING in an unconscious person.

Avoid giving milk or oils.

Avoid giving alcohol.

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

Note to Physicians: Treat symptomatically. Do not administer sympathomimetic drugs as they may cause ventricular arrhythmias.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable

LEL: Not applicable

UEL: Not applicable

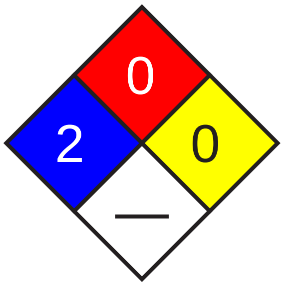
Extinguishing Media: There is no restriction on the type of extinguisher which may be used. Use fire fighting procedures suitable for surrounding area.

General Fire Hazards/Hazardous Combustion Products: Nonflammable liquid
Decomposes on heating and produces acrid and toxic fumes of phosgene, carbon dioxide (CO_2), carbon monoxide (CO), chlorine and hydrogen chloride.
Heating may cause expansion or decomposition leading to violent rupture of containers.

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

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Product is not combustible. No special firefighting procedures required.
Use fire fighting procedures suitable for surrounding area.
If safe to do so, remove containers from path of fire.
Cool fire-exposed containers with water spray from a protected location.

See DOT ERG



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Increase ventilation.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Place in suitable containers for disposal.
Allow small quantities to evaporate.

Large Spills: Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
Wear breathing apparatus plus protective gloves. Stop leak if safe to do so.
Absorb or cover spill with sand, earth, inert material or vermiculite.
Collect and seal in labeled drums for disposal.

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

See DOT ERG

Section 7 - Handling and Storage

Handling Precautions: Avoid breathing vapors and contact with skin and eyes. Avoid contact with strong alkalis.
Avoid sources of heat.
When handling, DO NOT eat, drink or smoke.
Use in a well-ventilated area.
Keep containers securely sealed when not in use.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Check that containers are clearly labeled.
Store in metal drums or safety cans.
Glass container.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

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

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:
Exposure Range >50 to <500 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

Note: poor warning properties

Other: Impervious protective clothingRubber apron.
Ensure there is ready access to a safety shower.

Glove Selection Index:

PE/EVAL/PE .... Best selection
PVA .... Best selection
TEFLON .... Best selection
VITON .... Satisfactory; may degrade after 4 hours continuous immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless, very volatile liquid with characteristic heavy, "sweetish" ethereal odor and sweet taste. Viscosity is 0.56 mPa sec at 20 °C. Mixes with alcohol, benzene, ether, petroleum ether, carbon tetrachloride, carbon disulfide, and oils.

Physical State: Liquid
Vapor Pressure (kPa): 21.2 at 20 °C
Vapor Density (Air=1): 4.13
Formula Weight: 119.37
Specific Gravity (H_2O=1, at 4 °C): 1.489 at 20 °C
pH: Not applicable

pH (1% Solution): Not applicable
Boiling Point: 61.67 °C (143 °F)
Freezing/Melting Point: -63.33 °C (-81.994 °F)
Volatile Component (% Vol): 100
Water Solubility: < 1 mg/mL at 19 °C

Section 10 - Stability and Reactivity

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

Storage Incompatibilities: Segregate from acetone, strong alkali, nitrogen tetroxide, fluorine, metals (Al, K, Li, Mg, Na, NaK alloy), potassium tert-butoxide, methanol, sodium methoxide, disilane, amd triisopropylphosphine.
Also reacts violently with (acetone + a base), (perchloric acid + phosphorous pentoxide), (KOH + methanol) and (NaOH + methanol).
Attacks, softens and may dissolve rubber, many plastics, paints and coatings.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 800 mg/kg
Oral (human) LD_{Lo}: 140 mg/kg
Unknown route (human) LD_{Lo}: 546 mg/kg
Inhalation (human) LC_{Lo}: 25000 ppm/5 m
Inhalation (rat) LC_{Lo}: 8000 ppm/4 h
Inhalation (human) TC_{Lo}: 10 mg/m^3/1 y
Inhalation (human) TC_{Lo}: 5000 mg/m^3/7 m

Irritation

Skin (rabbit): 10 mg/24 hr (open) - mild
Skin (rabbit): 500 mg/24 hr - mild
Eye (rabbit): 148 mg
Eye (rabbit): 20 mg/24 hr - moderate

See *RTECS* FS 9100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Releases to water and land will be primarily lost by evaporation and will end up in the atmosphere. Release to the atmosphere may be transported long distances and will photodegrade with a half-life of a few months. Spills and other releases on land will also leach into the groundwater where it will reside for long periods of time. Will not be expected to bioconcentrate into the food chain but contamination of food is likely due to its use as an extractant and its presence in drinking water.

Ecotoxicity: LC_{50} Micropterus salmoides (largemouth bass) 51 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Daphnia magna (cladoceran) 28,900 ug/l/48 hr in a static bioassay; LC_{50} Salmo gairdneri (rainbow trout) 2030 ug/l soft water, 1240 ug/l hard water (40% teratogenesis), 27 day flow-through tests (20 min after fertilization to 8 days after hatching)

Henry's Law Constant: 3.67 x10^{-3}
BCF: fish < 1
Biochemical Oxygen Demand (BOD): none
Octanol/Water Partition Coefficient: log K_{ow} = 1.97
Soil Sorption Partition Coefficient: K_{oc} = soils 34

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible.
Allow absorbed spillage to evaporate in an open top container, away from habitation.
Bury residue in an authorized landfill.
Return containers to drum reconditioner or recycler.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Chloroform
ID: UN1888
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, N36, T7, TP2
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U044 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 10 lb (4.535 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 10 lb
  - **TPQ:** 10000 lb
- **TSCA:** Listed

Section 16 - Other Information

Issue Date: 2005-05

Carbon Disulfide
CAR4990

Section 1 - Chemical Product and Company Identification

Material Name: Carbon Disulfide **CAS Number:** 75-15-0
Chemical Formula: CS_2
Structural Chemical Formula: S=C=S
EINECS Number: 200-843-6
ACX Number: X1001270-7
Synonyms: CARBON BISULFIDE; CARBON BISULPHIDE; CARBON DISULFIDE; CARBON DISULPHIDE; CARBON SULFIDE; CARBON SULPHIDE; CARBONE (SUFURE DE); CARBONE (SULFURE DE); CARBONIO (SOLFURO DI); DITHIOCARBONIC ANHYDRIDE; EPA PESTICIDE CHEMICAL CODE 016401; KOHLENDISULFID (SCHWEFELKOHLENSTOFF); KOOLSTOFDISULFIDE; SCHWEFELKOHLENSTOFF; SOLFURO DI CARBONIO; SULPHOCARBONIC ANHYDRIDE; SULPHURET OF CARBON; WEEVILTOX; WEGLA DWUSIARCZEK
General Use: Used in manufacture of rayon, carbon tetrachloride, xanthogenates, soil disinfectants, electronic vacuum tubes; solvent for phosphorus, sulfur, selenium, bromine, iodine, fats, resins, rubbers.
Also used as solvent in gas chromatography.

Section 2 - Composition / Information on Ingredients

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

OSHA PEL
TWA: 20 ppm; Ceiling: 30 ppm; 100 ppm, 30-minute maximum peak.

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

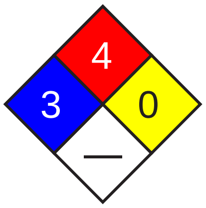
ACGIH TLV
TWA: 10 ppm; skin.

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

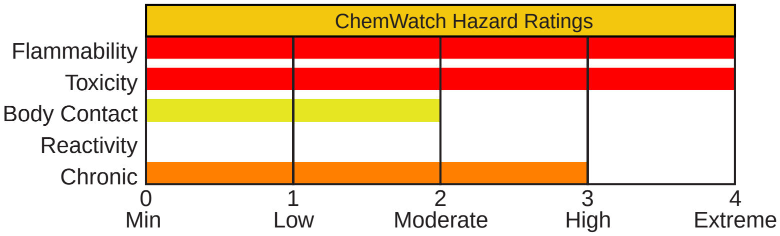
IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 5 ppm; PEAK: 10 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
③ Health
④ Flammability
⓪ Reactivity

ANSI Signal Word

Danger!

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

Potential Health Effects

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

Acute Effects

Inhalation: The vapor is highly discomforting to the upper respiratory tract and lungs and may be harmful if inhaled.

The material may accentuate any pre-existing skin condition.

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

Eye: The liquid is extremely discomforting to the eyes and is capable of causing pain and severe conjunctivitis.

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

Skin: The liquid is extremely discomforting to the skin and is capable of causing allergic skin reactions.

Toxic effects may result from skin absorption.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

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

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

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

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

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

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

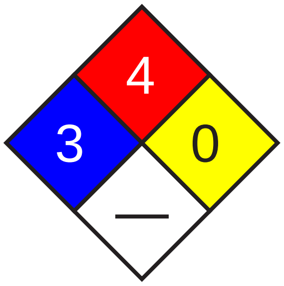
Determinant	Index	Sampling Time	Comments
2-thiothiazolidine 4-carboxylic acid	5 mg/gm creatinine.	End of shift	

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

Section 5 - Fire-Fighting Measures

Flash Point: 30 °C Closed Cup
Autoignition Temperature: 90 °C
LEL: 1.3% v/v
UEL: 50% v/v

See DOT ERG



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Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.
Note: Water may be ineffective except as a blanket. Foam is ineffective.

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

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

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Cool fire-exposed containers with water spray from a protected location.

Do not approach containers suspected to be hot.
Avoid spraying water onto liquid pools.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

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

Section 7 - Handling and Storage

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

Section 8 - Exposure Controls / Personal Protection

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

PVC boots.
Safety footwear.

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

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

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
VITON/CHLOROBUTYL	Best selection
VITON	Best selection
TEFLON-FEP	Best selection
NITRILE	Poor to dangerous choice for other than short-term immersion
CPE	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

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

Physical State: Liquid
Vapor Pressure (kPa): 40 at 20 °C
Vapor Density (Air=1): 2.67
Formula Weight: 76.14
Specific Gravity (H_2O=1, at 4 °C): 1.26 at 20 °C
pH: Not applicable

pH (1% Solution): Not applicable.
Boiling Point: 46.5 °C (116 °F) at 760 mm Hg
Freezing/Melting Point: -111.5 °C (-168.7 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.3% by weight

Section 10 - Stability and Reactivity

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

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

Section 11 - Toxicological Information

Toxicity

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

Irritation

Nil reported

See *RTECS* FF 6650000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on land, it will be primarily lost by volatilization. It may also readily leach into the ground where it may biodegrade. If released into water, it will be primarily lost due to volatilization (half-life 2.6 hr in a model river). Adsorption to sediment and bioconcentration in fish should not be significant. In the atmosphere it degrades by reacting with atomic oxygen and photochemically produced hydroxyl radicals (half-life 6-9 days). The soil may be a natural sink for the chemical by adsorbing and subsequently biodegrading it.

Ecotoxicity: TL_m Mosquitofish 162-135 mg/l/24-96 hr /Conditions of bioassay not specified

Henry's Law Constant: 1.44×10^{-2}

BCF: estimated at 7.9

Octanol/Water Partition Coefficient: $\log K_{ow} = 0.852$

Soil Sorption Partition Coefficient: K_{oc} = estimated at 63

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Carbon disulfide
ID: UN1131
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: I - Great Danger
Symbols:

Label Codes: 3 - Flammable Liquid, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: B16, T14, TP2, TP7, TP13
Packaging: **Exceptions:** None **Non-bulk:** 201 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:** 18, 40, 115

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed P022
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 100 lb
  - **TPQ:** 10000 lb
- **TSCA:** Listed

Section 16 - Other Information

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

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

Anthracene
ANT2000

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 44/60

Material Name: Anthracene **CAS Number:** 120-12-7

Chemical Formula: $C_{14}H_{10}$

Structural Chemical Formula: $(C_6H_4CH)_2$

EINECS Number: 204-371-1

ACX Number: X1001589-1

Synonyms: ANTHRACEN; ANTHRACENE; ANTHRACENE OIL; ANTHRACIN; COAL TAR PITCH VOLATILES:ANTHRACENE; GREEN OIL; P-NAPHTHALENE; PARANAPHTHALENE; PARANAPTHALENE; TETRA OLIVE N2G

Derivation: Occurs naturally in smoke (gasoline, coal, cigarette, etc.), charbroiled foods, and coal tar pitch volatiles. Obtained by distilling crude anthracene oil with alkali carbonate in iron retorts (phenanthrene is removed via carbon disulfide) *or* by salting out from crude anthracene oil and draining; the crude salts are then purified by pressing and the use of various solvents (phen-anthrene and carbazole are removed).

General Use: Used in chemical manufacture (phenanthrene, carbazole, anthraquinone), in calico printing; as a component of dyes, scintillation fluid, smoke screens; and in organic semi-conductor research.

Section 2 - Composition / Information on Ingredients

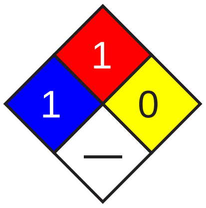
Name	CAS	%
Anthracene	120-12-7	ca 90 to 95% wt (commercial grade); 90 to 98% wt (technical grade)

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

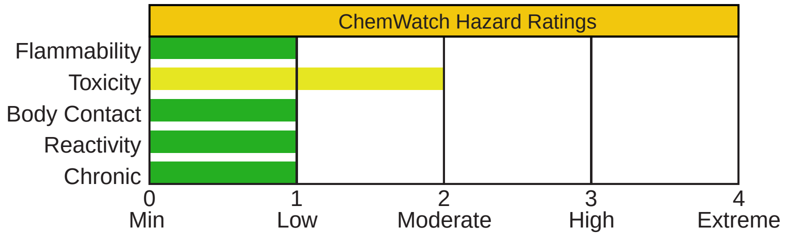
OSHA PEL **NIOSH REL**

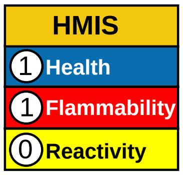
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Caution

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

Potential Health Effects

Target Organs: Eyes, skin, respiratory and digestive tracts.

Primary Entry Routes: Inhalation, skin/eye contact

Acute Effects

Inhalation: Symptoms include irritation of the respiratory tract, headache, nausea and vomiting, loss of appetite, slowed reactions, and adynamia (lack or loss of strength due to disease or other outside agent). Acute symptoms disappear within several days of last exposure.

Eye: Irritation of the conjunctiva with burning, itching and watering.

Skin: Irritation with burning, itching, and edema (fluid build-up). Volunteers with a 2% crude tar solution applied to the skin showed anthracene absorption via blood tests.

Ingestion: Gastrointestinal tract irritation.

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

Medical Conditions Aggravated by Long-Term Exposure: Dermatitis.

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

Section 4 - First Aid Measures

See DOT ERG

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

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

See DOT ERG

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

Autoignition Temperature: 1004 °F (540 °C)

LEL: 0.6% v/v

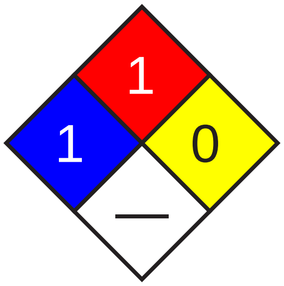
UEL: Not reported.

Flammability Classification: Combustible

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

General Fire Hazards/Hazardous Combustion Products: Include carbon oxide(s) and irritating, acrid smoke. May explode in air.

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



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

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

Small Spills: Carefully scoop up or vacuum (with appropriate filter) and place in suitable containers for disposal.

Large Spills: Use water to flush large spills to containment area for later disposal. Do not release into sewers or waterways. Damp mop any residue.

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

Section 7 - Handling and Storage

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

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond equipment used with and around anthracene. Enclosure of equipment and mechanization of processes will aid in exposure control. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin.

Personal Protective Clothing/Equipment: Limit work in sunlight as much as possible to prevent photosensitization. Photoprotective creams or pastes must be applied to bare skin regions. Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyvinyl chloride is a suitable material for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

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

Other: Separate contaminated work clothes from street clothes and place in closed containers until laundered. Remove anthracene from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless crystals with a violet fluorescence (pure), yellow crystals with a green fluorescence (due to tetracene and naphthacene).

Physical State: Solid
Vapor Pressure (kPa): 1mm Hg at 293 °F (145 °C)
Formula Weight: 178.22
Density: 1.25 g/cm^3 at 80.6 °F (27 °C)
Boiling Point: 644 °F (340 °C)
Freezing/Melting Point: 423 °F (217 °C)
Water Solubility: 1.29 mg/L at 77 °F/25 °C (*distilled water*), 0.6 mg/L at 77 °F/25 °C (*salt water*)
Other Solubilities: 1 g in 67 mL absolute alcohol, 70 mL methanol, 62 mL benzene, 85 mL chloroform, 200 mL ether, 31 mL carbon disulfide, 86 mL carbon tetrachloride, and 125 mL toluene. Also soluble in acetone.

Section 10 - Stability and Reactivity

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

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

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

Section 11 - Toxicological Information

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

See *RTECS* CA9350000, for additional data.

Section 12 - Ecological Information

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

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

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

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a) 5000 lb (2268 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

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

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
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Issue Date: 2005-05

Acetylene Dichloride
DIC4500

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Acetylene Dichloride **CAS Number:** 540-59-0
Chemical Formula: $C_2H_2Cl_2$
Structural Chemical Formula: ClCH=CHCl
EINECS Number: 208-750-2
ACX Number: X1002625-6
Synonyms: ACETYLENE DICHLORIDE; CIS-ACETYLENE DICHLORIDE; TRANS-ACETYLENE DICHLORIDE; 1,2-DCE; 1,2-DICHLOR-AETHEN; 1,2-DICHLOROETHENE; 1,2-DICHLOROETHYLENE; CIS-TRANS-1,2-DICHLOROETHYLENE; DICHLORO-1,2-ETHYLENE; SYM-DICHLOROETHYLENE; TRANS-DICHLOROETHYLENE; DIOFORM; ETHENE,1,2-DICHLORO-; ETHYLENE,1,2-DICHLORO-
General Use: Solvent for organic materials, dye extraction, perfumes, lacquers, thermoplastics and organic syntheses. The trans-isomer being a "universal solvent" is more widely used than either the cis-isomer or the mixture.

Section 2 - Composition / Information on Ingredients

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

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

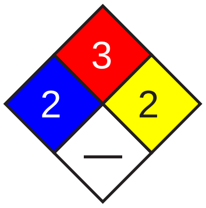
NIOSH REL
TWA: 200 ppm, 790 mg/m^3.

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

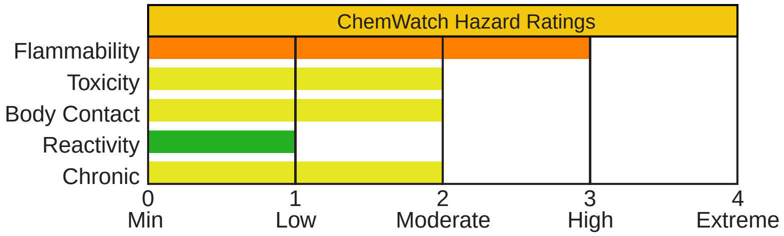
ACGIH TLV
TWA: 200 ppm.

IDLH Level
1000 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
③ Flammability
① Reactivity

ANSI Signal Word
Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

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

Inhalation: There is a single report of an industrial poisoning, a fatality caused by the inhalation of a vapor in a small enclosure.

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

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

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

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

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

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

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

Reversible corneal clouding has been described in exposures to acetylene dichloride

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

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

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

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

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

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

Section 4 - First Aid Measures

See
DOT
ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

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

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

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

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

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

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

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

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

Experience with this therapy is limited.

Section 5 - Fire-Fighting Measures

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

See
DOT
ERG

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

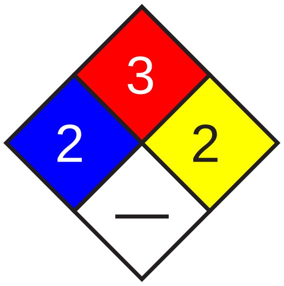
Water spray or fog - Large fires only.

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

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

Vapor forms an explosive mixture with air.

Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.



Fire Diamond

Heating may cause expansion/decomposition with violent rupture of containers.

On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include hydrogen chloride and phosgene.

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

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

Fight fire from a safe distance, with adequate cover.

If safe, switch off electrical equipment until vapor fire hazard removed.

Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protective location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.

Avoid breathing vapors and contact with skin and eyes.

Control personal contact by using protective equipment.

Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.

Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.

Use only spark-free shovels and explosion proof equipment.

Collect recoverable product into labeled containers for recycling.

Absorb remaining product with sand, earth or vermiculite.

Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.

Wear protective clothing when risk of exposure occurs.

Use in a well-ventilated area. Prevent concentration in hollows and sumps.

DO NOT enter confined spaces until atmosphere has been checked.

Avoid smoking, bare lights or ignition sources.

Avoid contact with incompatible materials.

When handling, DO NOT eat, drink or smoke.

Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.

Work clothes should be laundered separately.

Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Check that containers are clearly labeled.

Packaging as recommended by manufacturer.

DO NOT use aluminum or galvanized containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.

If risk of overexposure exists, wear NIOSH-approved respirator.

Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.

Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Butyl rubber gloves; Neoprene gloves.
Respiratory Protection:
Exposure Range >200 to <1000 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Barrier cream. Eyewash unit.
Glove Selection Index:
VITON .... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

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

Physical State: Liquid
Vapor Pressure (kPa): 36.66 at 20 °C
Vapor Density (Air=1): >1
Formula Weight: 96.94
Specific Gravity (H_2O=1, at 4 °C): 1.28
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 47.78 °C (118 °F)
Freezing/Melting Point: -50 °C (-58 °F)
Water Solubility: 0.4% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.
Acetylene dichloride in contact with solid caustic alkalies or their concentrated solutions will form chloracetylene which ignites in air.
Distillation of ethanol containing 0.25% of the halocarbon with aqueous sodium hydroxide gave a product which ignited in air.

Section 11 - Toxicological Information

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

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

See *RTECS* KV 9360000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released on soil, it should evaporate readily and leach in soil very slowly. Biodegradation should occur. If released into water, it will be lost mainly through volatilization (half life 3 hr in a model river). Biodegradation, adsorption to sediment, and bioconcentration to aquatic organisms should not be significant. In the atmosphere, cis- and trans- will be lost by reaction with photochemically produced hydroxyl radicals (half lives 8 and 3.6 days, respectively) and scavenged by rain. Because it is relatively long lived in the atmosphere, considerable dispersal from source area should occur.
Ecotoxicity: No data found.
Henry's Law Constant: 0.00408
BCF: calculated at 15
Octanol/Water Partition Coefficient: log K_{ow} = calculated at 1.86
Soil Sorption Partition Coefficient: K_{oc} = 36 to 49

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: 1,2-Dichloroethylene
ID: UN1150
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T7, TP2
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

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

Section 16 - Other Information

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

Issue Date: 2005-05

Acetone
ACE4750

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Acetone **CAS Number:** 67-64-1
Chemical Formula: C_3H_6O
Structural Chemical Formula: CH_3COCH_3
EINECS Number: 200-662-2
ACX Number: X1001253-6
Synonyms: ACETON; ACETONE; CHEVRON ACETONE; DIMETHYL KETONE; DIMETHYLFORMALDEHYDE; DIMETHYLKETAL; EPA PESTICIDE CHEMICAL CODE 004101; KETONE PROPANE; KETONE,DIMETHYL; BETA-KETOPROPANE; METHYL KETONE; 2-PROPANONE; PROPANONE; PYROACETIC ACID; PYROACETIC ETHER
General Use: Solvent for fats, oils, waxes, resins, rubber, plastics, lacquers.
Used in manufacture of methyl isobutyl ketone, mesityl oxide, acetic acid, diacetone alcohol, isoprene. Used in solvent extraction processes.
Solvent in the manufacture of explosives and rayon. Component of adhesives, glues, cleaning solvents, lacquer thinners, nail polish, paint removers.
Storing acetylene gas (takes up about 24 times its volume of the gas).
Purifying paraffin and biomedical hardening and dehydrating tissues.
Minor food additive, permitted in USA.

Section 2 - Composition / Information on Ingredients

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

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

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

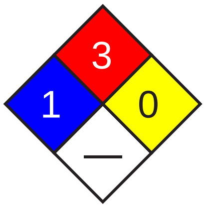
ACGIH TLV
TWA: 500 ppm; STEL: 750 ppm.

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

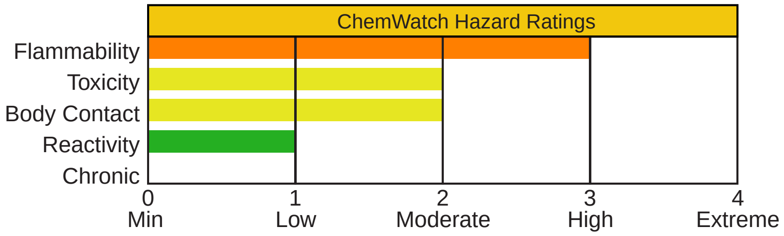
IDLH Level
2500 ppm (10% LEL).

DFG (Germany) MAK
TWA: 500 ppm; PEAK: 1000 ppm.

Section 3 - Hazards Identification



Fire Diamond



HMIS
① Health
③ Flammability
⓪ Reactivity

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

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

Potential Health Effects

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

Acute Effects

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

Inhalation hazard is increased at higher temperatures.

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

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

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

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

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

The vapor is discomforting to the eyes.

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

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

Toxic effects may result from skin absorption.

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

The material may accentuate any pre-existing skin condition.

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

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

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

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

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

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

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

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

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

Eye Contact: Immediately hold the eyes open and flush 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.

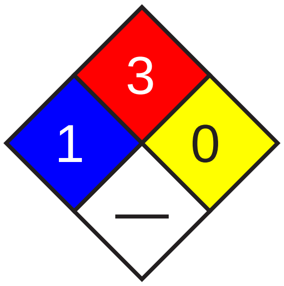
2.About 20% is expired by the lungs and the rest is metabolized.

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

See DOT ERG



Fire Diamond

Flash Point: -20 °C

Autoignition Temperature: 465 °C

LEL: 2.15% v/v

UEL: 13% v/v

Extinguishing Media: Water spray or fog; alcohol stable foam.

Dry chemical powder.

Bromochlorodifluoromethane (BCF) (where regulations permit).

Carbon dioxide.

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

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

Vapor forms an explosive mixture with air.

Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.

Heating may cause expansion/decomposition with violent rupture of containers.

On combustion, may emit toxic fumes of carbon monoxide (CO). Other combustion products include carbon dioxide (CO_2).

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

PLEASE NOTE: 10% of acetone in water has a flash point below 20 deg. C.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

Fight fire from a safe distance, with adequate cover.

If safe, switch off electrical equipment until vapor fire hazard removed.

Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protective location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.

Avoid breathing vapors and contact with skin and eyes.

Control personal contact by using protective equipment.

Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.

Contact fire department and tell them location and nature of hazard.

Avoid breathing vapors and contact with skin and eyes.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

Shut off all possible sources of ignition and increase ventilation.

Water spray or fog may be used to disperse vapor.

Stop leak if safe to do so. Contain spill with sand, earth or vermiculite.

Collect residues and place in flammable waste container.

Any electric cleaning equipment must be explosion proof.

Wash spill area with large quantities of water.

If contamination of drains or waterways occurs, advise emergency services.

After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.

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

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.

Wear protective clothing when risk of exposure occurs.

Use in a well-ventilated area. Prevent concentration in hollows and sumps.

DO NOT enter confined spaces until atmosphere has been checked.

Avoid smoking, bare lights, heat or ignition sources.

When handling, DO NOT eat, drink or smoke.

Vapor may ignite on pumping or pouring due to static electricity.

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

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

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

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

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

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

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

Glove Selection Index:

BUTYL/NEOPRENE	Best selection
PE/EVAL/PE	Best selection
PVDC/PE/PVDC	Best selection
BUTYL	Best selection
SARANEX-23 2-PLY	Satisfactory; may degrade after 4 hours continuous immersion
TEFLON	Satisfactory; may degrade after 4 hours continuous immersion
SARANEX-23	Poor to dangerous choice for other than short-term immersion
CPE	Poor to dangerous choice for other than short-term immersion
HYPALON	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
PVA	Poor to dangerous choice for other than short-term immersion
VITON/NEOPRENE	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NATURAL+NEOPRENE	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

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

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

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

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers, strong acids and strong alkalis.

Reacts violently with bromoform and chloroform in the presence of alkalies or in contact with alkaline surfaces.

Section 11 - Toxicological Information

Toxicity

Oral (man) TD$_{Lo}$: 2857 mg/kg
Oral (rat) LD$_{50}$: 5800 mg/kg
Inhalation (human) TC$_{Lo}$: 500 ppm
Inhalation (man) TC$_{Lo}$: 12000 ppm/4 hr
Inhalation (man) TC$_{Lo}$: 10 mg/m^3/6 hr
Inhalation (rat) LC$_{50}$: 50100 mg/m^3/8 hr
Dermal (rabbit) LD$_{50}$: 20000 mg/kg

Irritation

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

See *RTECS* AL 3150000, for additional data.

Section 12 - Ecological Information

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

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

Henry's Law Constant: 3.97×10^{-5}

BCF: negligible

Biochemical Oxygen Demand (BOD): theoretical 122%, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = -0.24$

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Acetone
ID: UN1090
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

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

Section 16 - Other Information

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

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Pyrene **CAS Number:** 129-00-0
Chemical Formula: $C_{16}H_{10}$
EINECS Number: 204-927-3
ACX Number: X1001901-7
Synonyms: BENZO(DEF)PHENANTHRENE; BENZO(D,E,F)PHENANTHRENE; COAL TAR PITCH VOLATILES:PYRENE; PYREN; BETA-PYRENE; PYRENE; PYRENE
General Use: Laboratory reference standard.
Occurs in coal tar or in destructive hydrogenation of hard coals.

Section 2 - Composition / Information on Ingredients

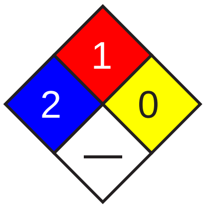
Name	CAS	%
pyrene	129-00-0	>98

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

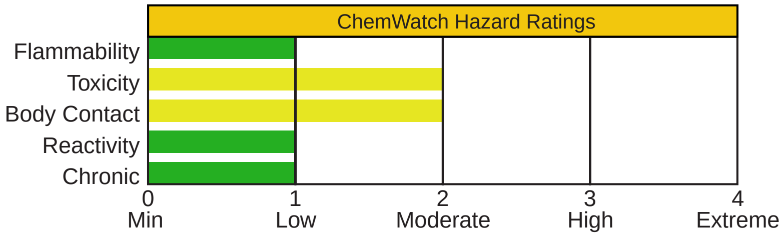
NIOSH REL
TWA: 0.1 mg/m^3, cyclohexane-extractable fraction; as particulate polycyclic aromatic hydrocarbon.

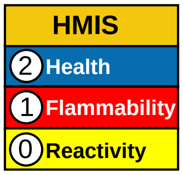
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless solid. Irritating to eyes/skin/respiratory tract. Also causes: conjunctival irritation, dermal irritation, ingestion may irritate and burn esophagus/gastrointestinal tract.

Potential Health Effects

Target Organs: skin, eyes, respiratory system
Primary Entry Routes: inhalation, ingestion, skin contact
Acute Effects
Inhalation: The dust may be discomforting to the upper respiratory tract and may be fatal if inhaled.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.
Animal inhalation studies have demonstrated hepatic, pulmonary and intragastric pathologic changes. The levels of neutrophil, leukocyte and erythrocytes decreased.
Eye: The dust may be discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
Skin: The material may be mildly discomforting to the skin.
Open cuts, abraded or irritated skin should not be exposed to this material.
Toxic effects may result from skin absorption.

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

Skin application resulted in hyperemia (blood engorgement), weight loss and hematopoietic (blood cell development) changes. Contact dermatitis was also evident.

Ingestion: The solid/dust is discomforting to the gastrointestinal tract and harmful if swallowed.

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

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

Chronic Effects: Chronic exposure to pyrene results increase in blood leukocytes (leukocytosis).

The so-called polycyclic aromatic hydrocarbons (PAHs) comprise a large family; some members occur in coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified, in animal studies, as amongst the most highly active carcinogens.

Rodent species are sensitive to some PAHs with skin application producing cancerous growths. Injection produces soft tissue tumors (sarcomas) in rats and mice.

Administration of PAHs to Rhesus monkey on the other hand has not yet proved successful in yielding tumors and there is inadequate date to support the proposition that individual PAHs produce cancer in humans. There are however a number of epidemiology and mortality studies that show increased incidence of cancer in humans exposed to mixtures of PAHs. Evidence exists of lung and genito-urinary cancer mortality amongst coke-oven workers and skin tumors in workers exposed to creosote. Exposures to other chemical mixtures containing PAHs such as cigarette smoke, coal tar, coal tar pitch and bitumens, have been associated with increased incidences of lung cancer in humans. Anthracene, the basic unit on which most PAHs are built, is not carcinogenic whereas benz[a]anthracene appears to have weak carcinogenicity. Additions of other benzene rings to select positions on the benz[a]anthracene skeleton results in agents with powerful carcinogenicity (e.g. dibenz[a,h]anthracene and benz[a]pyrene). Further substitution of methyl groups in position on the rings enhances carcinogenicity (7,12 dimethylbenz[a]anthracene is one of the most powerful PAH carcinogens known). Biotransformation to produce soluble metabolites suitable for excretion appears to transform some PAHs to reactive electrophiles (as epoxides) which bind to DNA. Initiation of carcinogenesis is thought to rely upon such interactions.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water.

Consider drinking water to remove dust from throat.

Lay patient down. Keep warm and rested.

Seek medical attention if irritation or discomfort persist.

See DOT ERG

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.

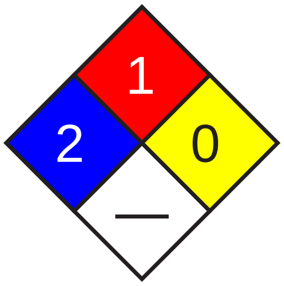
See DOT ERG

General Fire Hazards/Hazardous Combustion Products: Solid which exhibits difficult combustion or is difficult to ignite.

Avoid generating dust, particularly clouds of dust in a confined or unventilated space.

Dust may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion.

Dry dust can be charged electrostatically by turbulence, pneumatic transport, pouring, in exhaust ducts and during transport. Build-up of electrostatic charge may be prevented by bonding and grounding.



Fire Diamond

Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

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

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves for fire only. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear protective clothing, gloves, safety glasses and dust respirator.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up. Place in clean drum then flush area with water.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain or absorb spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

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

Section 7 - Handling and Storage

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

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

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

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

Personal Protective Clothing/Equipment:

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

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

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

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless crystalline solid when pure. Contamination by tetracene results in slight yellowing. Solid and solutions have slight blue fluorescence.

Physical State: Divided solid
Vapor Pressure (kPa): Negligible
Formula Weight: 202.24
Specific Gravity (H_2O=1, at 4 °C): 1.271
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 393 °C (739 °F) at 760 mm Hg
Freezing/Melting Point: 156 °C (312.8 °F)
Volatile Component (% Vol): Negligible
Water Solubility: 0.135 mg/L (+ or - 0005 mg/L) in water

Section 10 - Stability and Reactivity

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

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 2700 mg/kg
Inhalation (rat) LC_{50}: 170 mg/m^3
Oral (mouse) LD_{50}: 800 mg/kg
Intraperitoneal (mouse) LD_{50}: 514 mg/kg
Conjunctival irritation, excitement and muscle contraction recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

Irritation

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

See *RTECS* UR 2450000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Although environmental concentrations are highest near sources, its presence in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long distance transport. When released to air it may be subject to direct photolysis, although adsorption to particulates apparently can retard this process. Half-lives for reaction of vapor phase with atmospheric pollutants are: O3, 0.67 days, NO2, 14 days; estimated half-life for reaction with photochemically produced hydroxyl radicals is 1.12 days. If released to water, it will adsorb very strongly to sediments and particulate matter, bioconcentrate in aquatic organisms slightly to moderately, but will not hydrolyze. It may be subject to significant biodegradation, and direct photolysis may be important near the surface of waters. Evaporation may be important with a half-life of 4.8 to 39.2 days predicted for evaporation from a river 1 m deep, flowing at 1 m/sec with a wind velocity of 3 m/sec; half-life for evaporation from a model pond was 1176 days. Adsorption to sediments and particulates will limit evaporation. If released to soil it will be expected to adsorb very strongly to the soil and will not be expected to appreciably leach to the groundwater, although its presence in groundwater illustrates that it can be transported there. It will not be expected to hydrolyze or significantly evaporate from soils and surfaces. It may be subject to appreciable biodegradation in soils.
Ecotoxicity: TL_m (Median threshold limit) Mosquito fish 0.0026 mg/l/96 hr at 24-27 °C in a static bioassay
Henry's Law Constant: calculated at 5.42 $x10^{-5}$
BCF: rainbow trout 72
Octanol/Water Partition Coefficient: log K_{ow} = 4.88
Soil Sorption Partition Coefficient: K_{oc} = soils 57 to 764

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

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

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP2, IP4
Packaging: **Exceptions:** None **Non-bulk:** 212 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Toxic solids, organic, n.o.s.
ID: UN2811
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB8, IP3
Packaging: **Exceptions:** 153 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 307(a)
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 5000 lb
  - **TPQ:** 1000/10000 lb
- **TSCA:** Listed

Section 16 - Other Information

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

Attachment J

Chemical Hazard Information Table

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TABLE 3-1 (CONT'D)
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Benzene [71-43-2]	9.24	34-119	Inh Abs Ing Con	Irritated eyes, nose, and respiratory system; giddiness; headache; nausea; staggered gait; fatigue; anorexia, lassitude; dermatitis; bone marrow depression – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (0.5 ppm) NIC-0.1 skin 0.1 ppm	 2.5 ppm	PEL TLV REL	Ca (500 ppm)* *OSHA 29 CFR 1910.1028
Ethylbenzene [100-41-4]	8.76	0.09-0.6	Inh Ing Con	Irritated eyes, mucous membranes; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	800 ppm
Ethylene Dichloride [107-06-2	11.05	4.3-5.7 low 371 high	Inh Abs Ing Con	Irritated eyes, corneal opacity; central nervous system depressed; nausea, vomiting; dermatitis; liver, kidney and central nervous system damage, carcinogen	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	1 ppm 10 ppm 1 ppm		PEL TLV REL	Ca 50 ppm
Gasoline	?		Inh Abs Ing Con	Skin irritation, respiratory irritation; headache; dizziness; nausea, vomitting; weakness, loss of coodination, blurred vision, drowsiness, confusion, or disorientation; central nervous system effects; respiratory depression; tremors, convultions, loss of consciousness, coma, death – carcinogen HIGHLY FLAMMABLE	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	NA 300 ppm	NA 500	PEL TLV	
Hexane [591-78-6]	9.34	ND	Inh Abs Ing Con	Irritated eyes and nose; peripheral neuropathy; weakness, paresthesia; dermatitis; headache, drowsiness	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 5 ppm 1 ppm		PEL TLV REL	1,600 ppm
Chloroform [67-66-3]	11.42		Inh Abs Ing Con	Irritated eyes and skin; dizziness; mental dullness; nausea; confusion; headache; fatigue; anesthesia; enlarged liver; carcinogen	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	50 ppm 10 ppm 2 ppm (60 min)		PEL TLV REL	Ca 500 ppm
Coal-tar-pitch volatiles (benzene-soluble fraction) (polynuclear aromatic hydrocarbons [PAH]) [65996-93-2]	ND	ND	Ing Con	Eye sensitivity to light; eye and skin irritation, dermatitis, bronchitis; carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m^3 0.2 mg/m^3 0.1 mg/m^3		PEL TLV REL	Ca [80 mg/m^3]
Methyl Ethyl Ketone [78-93-3]	?	?	Inh Ing Con	Irritation to eyes, skin, nose, and throat; cough, dyspnea (difficulty breathing); pulmonary edema; blurred vision; blisters and scars skin; abdominal pain; vomiting; diarrhea; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	200 ppm 200 ppm 200 ppm	300 ppm 300 ppm 300 ppm	PEL TLV REL	3000 ppm
Toluene [108-88-3]	8.82	0.16-37	Inh Abs Ing Con	Fatigue, weakness; confusion, euphoria, dizziness; headache; dilated pupils, lacrimation; nervousness, muscular fatigue,	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm (skin) 100 ppm	150 ppm 150 ppm	PEL TLV REL	500 ppm

TABLE 3-1 (CONT'D)
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
				insomnia; paralysis; dermatitis					
Methanol [67-56-1]	10.84		Inh Abs Ing Con	Irritation of eyes, skin, and upper respiratory tract; headache; drowsiness; vertigo; light-headedness; nausea; vomiting; visual disturbance; optic nerve damage (blindness); dermatitis	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	200 ppm 200 ppm 200 ppm	250 ppm 250 ppm 250 ppm	PEL TLV REL	6000 ppm
Methylene Chloride [75-09-2]	11.32	205-307	Inh Abs Ing Con	Fatigue, weakness, sleepiness, lightheadedness, numbness, and tingling in the limb; nausea; irritated eyes and skin; carcinogen.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	25 ppm 50 ppm	125 ppm	PEL TLV	2300 ppm
Phenol [108-95-2]	?	?	Inh Abs Ing Con	Irritated eyes, nose and throat; anorexia, low weight; weakness, muscular ache and pains; dark urine; cyanosis; liver and kidney damage; skin burns; dermatitis; ochronosis; tremors, convulsions, twitching; carcinogen.	Eye: Irrigate immediately Skin: Swab with glycerin, PEG, transport to hospital Breath: Respiratory support Swallow: Immediate medical attention	5 ppm 5 ppm 5 ppm		PEL TLV REL	250 ppm
Xylene (o-, m-, and p-isomers) [1330-20-7; 95-47-6; 108-38-3; 106-42-3]	8.56 8.56 8.44	1.1-20	Inh Abs Ing Con	Dizziness, excitement, drowsiness, incoordination, staggering gait; irritated eyes, nose, throat; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	150 ppm 150 ppm 150 ppm	PEL TLV REL	900 ppm

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

References:

American Conference of Governmental Industrial Hygienists Guide to Occupational Exposure Values, 1991, compiled by the American Conference of Governmental Industrial Hygienists.
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Fazzuluri, F.A., Compilation of Odor and Taste Threshold Values Data, American Society for Testing and Materials, 1978.
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Micromedex Tomes Plus (R) System, 1992, Micromedex, Inc.
National Institute for Occupational Safety and health Pocket Guide to Chemicals, Pub. 1990, No. 90-117, National Institute for Occupational Safety and Health.
Odor Threshold for Chemicals with Established Occupational Health Standards, American industrial Hygiene Association, 1989.
Respirator Selection Guide, 3M Occupational Health and Safety Division, 1993.
Verschuseren, K., Handbook of Environmental Data on Organic Chemicals, Van Nostrand and Reinhold, 1977.
Warning Properties of Industrial Chemicals – Occupational Health Resource Center, Oregon Lung Association.
Workplace Environmental Exposure Levels, American Industrial Hygiene Association, 1992.

Attachment K

Incident/Near Miss Investigation Form

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Incident / Near-Miss Investigation Report

☐ OSHA Recordable	☐ First Aid Injury	☐ Fire	Date of Incident:
☐ Lost Workday Injury	☐ Vehicle Accident	☐ Spill / Leak	
☐ Restricted Duty Injury	☐ Equipment Damage	☐ Near Miss	Incident Number:

Every employee injury, accident, and near miss must be reported within 24 hours of the injury. If the incident results in hospitalization, an immediate report must be made by telephone to the Project Manager and the Health and Safety Officer.

Project Information

Project Name:	Project #
Location of Incident:	

Employee

Name:	Employee Number:
Employment Status: ☐ Regular ☐ Part Time	How long in present job?

Injury or Illness Information

Where did the incident / near miss occur? (number, street, city, state, zip):

Employee’s specific activity at the time of the incident / near miss:

Equipment, materials, or chemicals the employee was using when the incident / near miss occurred (e.g., the equipment employee struck against or that struck the employee; the vapor inhaled or material swallowed; what the employee was lifting, pulling, etc.):

Describe the specific injury or illness (e.g., cut, strain, fracture, etc.):

Body part(s) affected (e.g., back, left wrist, right eye, etc.):

Name and address of treatment provider (e.g., physician or clinic):	Phone No.:
If hospitalized, name and address of hospital:	Phone No.:
Date of injury or onset of illness: / /	Time of event or exposure: ☐ AM ☐ PM

Did employee miss at least one full shift’s work? ☐ No ☐ Yes, 1st date absent (MM/DD/YYYY) / /

Has employee returned to work? ☐ Regular work ☐ Restricted work ☐ No
☐ Yes, date returned (MM/DD/YYYY) / /

To whom reported:	Other workers injured / made ill in this event? ☐ Yes ☐ No

Description of Incident / Near Miss: (Describe what happened and how it happened.)

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Incident / Near-Miss Investigation Report

Motor Vehicle Accident (MVA)			Company Vehicle?	☐ Yes ☐ No				
Accident Location (street, city, state)								
Vehicle Towed?	☐ Yes ☐ No	Other Vehicle?	☐ Yes ☐ No	# Vehicles Towed:		# of Injuries:		

Spill

Material Spilled:	Quantity:	Source:
Agency Notifications:		
Cost of Incident $		

Third Party Incidents

Name of Owner:		Address:	Telephone:
Description of Damage:			
Witness Name:		Address:	Telephone:
Witness Name:		Address:	Telephone:

#	**Root Cause and Contributing Factors: Conclusion (Describe in Detail Why Incident / Near Miss Occurred)**
1	
2	
3	
4	
5	

Root Cause(s) Analysis (RCA):

1. Lack of skill or knowledge.
2. Lack of or inadequate operational procedures or work standards.
3. Inadequate communication of expectations regarding procedures or work standards.
4. Inadequate tools or equipment.
5. Correct way takes more time and / or requires more effort.
6. Short-cutting standard procedures is positively reinforced or tolerated.
7. Person thinks there is no personal benefit to always doing the job according to standards.
8. Uncontrollable.

#	RCA #	Solution(s): How to Prevent Incident / Near Miss From Reoccurring	Person Responsible	Due Date	Closure Date

Investigation Team Members

Name	Job Title	Date

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Incident / Near-Miss Investigation Report

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date
	Project Manager	
	Health and Safety Reviewer	

Attachment L

Loss Prevention Observation Form

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Loss Prevention Observation

BBL/BBLES

Observer Name	Observer Title	Project/Project Number

Date ________________ Time ____ ☐ AM ☐ PM	Project Type / Task Observed

Background Information

List Critical Work Procedures

List Issue/Items Requiring Corrective Action

Root Cause Analysis

1. Employee lacks the skill or knowledge to carry out duties
2. Procedures, work standards, or expectations were not communicated
3. Procedures or work standards were not developed or were inadequate
4. Equipment, systems, or tools were inadequate
5. Employee chose not to take the time or put forth the effort to do the job properly
6. Supervisor did not require the employee to follow the standard procedure
7. Employee doesn't see any advantage to doing the job to standard.
8. Uncontrollable.

Criterion #	RCA #	Corrective Action Identified	Responsible Individual	Due Date	Closure Date

Results of Corrective Action

Reviewed by	Date	Reviewed by	Date

Environmental Operations

	PRE-TASK PREPARATION	Correct	Questionable	Comments
1.	Health and Safety Plan / MSDSs on site			
2.	Employee familiar / trained on task			
3.	OSHA-required training/medical surveillance			
4.	Utility mark out / check performed			
5.	Traffic hazard addressed / work area marked			
6.	Walking / working surfaces free of hazards			
7.	Tailgate safety meeting performed			
8.	Impact on nearby residence/business evaluated			
9.	Communicates intentions to other personnel			
10.	Knowledge of emergency procedures			
11.	Distance between equipment and power lines			
12.	Personal protective equipment			
13.	Air monitoring equipment on site, calibrated			
14.	First aid kit / fire extinguisher on site			
15.	One person trained in first aid / CPR			
16.	Work zones established and marked			
	PERFORMING TASK			
17.	Employee trained in task to be performed			
18.	Correct body positioning			
19.	Proper lifting / pushing / pulling techniques			
20.	Keep hands / body away from pinch points			
21.	Walking / working surfaces kept clear of debris			
22.	Faces traffic as appropriate			
23.	Vehicles/ barricades to protect against traffic			
24.	Drill rig located properly, blocked / chocked			
25.	Drill rig moved only with derrick lowered			
26.	Excavator located on stable ground			
27.	Eye contact made with equipment operator			
28.	Spoil at least 2 feet back from edge of excavation			
29.	Excavation shored/sloped/benched			
30.	Excavation entry controlled			
31.	Equipment/tools used properly			
32.	Electrical equipment connected through GFCI			
33.	Power tools handled properly			
34.	Electrical cords inspected / in good condition			
35.	Follows lockout / tagout procedures			
36.	Air monitoring conducted/action levels understood			
37.	Equipment decontaminated properly			
38.	Personnel decon prior to eating/drinking/smoking			
39.	Decontamination effective			
	POST – TASK			
40.	Procedures / JSA adequate			
41.	Equipment / tools stored properly			
42.	Proper storage of soil / water / waste material			
43.	Work area secured			
44.	Other			

Attachment M

Lock-Out/Tag-Out Form

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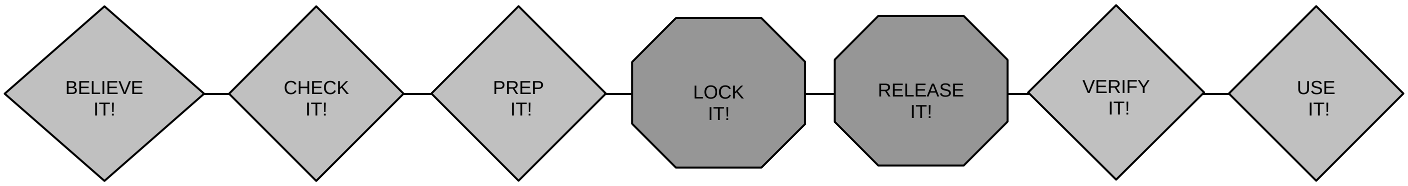
Lockout / Tagout Equipment-Specific Energy Control Procedure



Equipment Identification: ____________________

____

Hazardous Energy Source		Isolation Device			Verifying Lockout Means of Verification of Lockout
Type and Magnitude	**Function**	**Type**	**Location**	**I.D. No.**	
Electrical 120v					
Pneumatic					
Hydraulic					
Mechanical					
Potential					
Gravity					
Other					
Other					
Other					

Area:	**Date of Last Review:**	**Authorized by:**

Attachment N

Site Hot Work Form

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Site Hot Work Permit

Permit #:

Project:

ALL COPIES OF PERMIT MUST REMAIN AT JOB SITE UNTIL THE WORK IS COMPLETE

Location and Description of Hot Work:

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

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

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

Monitor's Name: ___________________________________

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

Air Monitor ____
Print Name

____
Signature Date Time

Attachment O

Air Monitoring Log

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Air Monitoring Log

Project:

Date:

Monitoring Instruments:

Air Monitor:

Activity:

Level of Protection:

Time	Location	Instrument Reading	Comments

Attachment P

Health and Safety Inspection Form

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Health and Safety Inspection Form

Project Name:	**Date:**			
Project Number:	**Location:**			
Prepared By:	**Project Manager:**			
Auditor:	**HSS On Site:**			
	YES	**NO**	**N/A**	**COMMENTS**
GENERAL				
Is the HASP on site?				
Is the HASP finalized and approved?				
Is the OSHA poster displayed?				
Are emergency telephone numbers posted?				
Is emergency eyewash immediately available?				
Is an emergency shower immediately available?				
Are emergency notification means available (radio, telephone)?				
Is a first-aid kit immediately available?				
Is the first-aid kit adequately stocked?				
Is there a proper sanitation facility on site?				
DOCUMENTATION AND RECORDKEEPING				
Are only personnel listed and approved in the HASP on site?				
Are all personnel properly trained? (Check company-issued wallet cards.)				
Is the daily field log kept by the Site Manager?				
Are levels of PPE recorded?				
Are contaminant levels recorded?				
Are site surveillance records kept by HSS?				
Is a copy of current fit test records on site?				
Are calibration records maintained for air monitoring equipment?				
Are accident / incident forms on site?				
Are field team review sheets signed?				
Are additional hospital route directions available?				
Is the visitors' logbook being accurately maintained?				
Are MSDSs available for all chemicals on site?				
Are HASP revisions recorded?				
Is the first-aid kit inspected weekly?				
Are daily safety meetings held?				
Are emergency procedures discussed during safety meetings?				

	YES	NO	N/A	COMMENTS
PERSONNEL AND EQUIPMENT DECONTAMINATION (continued)				
Are sample containers decontaminated?				
Are disposable items replaced as required?				
WORK PRACTICES				
Was proper collection and disposal of potentially contaminated PPE performed?				
Was proper collection and disposal of decontamination fluid performed?				
Is water available for decontamination?				
Is the buddy system used?				
Is equipment kept off drums and the ground?				
Is kneeling or sitting on drums or the ground prohibited?				
Do personnel avoid standing or walking through puddles or stained soil?				
Are work zones established?				
If night work is conducted, is there adequate illumination?				
Is smoking, eating, or drinking in the exclusion or CRZ prohibited?				
To the extent feasible, are contaminated materials handled remotely?				
Are contact lenses not allowed on site?				
Is entry into excavations not allowed unless properly shored or sloped?				
Is a competent person on site during excavation?				
Are all unusual situations on site listed in HASP?				
If not, when?				
Action taken?				
HASP revised?				
CONFINED SPACE ENTRY				
Are employees trained according to 1910.146 – Confined Space Entry?				
Are all confined spaces identified? If not, list:				
Is all appropriate equipment available and in good working order?				
Is equipment properly calibrated?				
Are confined space permits used?				
Are confined space permits completely and correctly filled out?				

*N/A = Not Applicable

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Health and Safety Inspection Form

	YES	NO	N/A	COMMENTS
EMERGENCY RESPONSES				
Is a vehicle available on site for transportation to the hospital?				
Are fire extinguishers on site and immediately available at designated work areas?				
Is at least one person trained in CPR and first aid on site at all times during work activities?				
Do all personnel know who is trained in CPR / first aid?				
PERSONAL PROTECTIVE EQUIPMENT (PPE)				
Is proper PPE being worn as specified in HASP?				
Level of PPE being worn.				
Is PPE adequate for work conditions?				
If not, give reason.				
Upgrade/downgrade to PPE level.				
Does any employee have facial hair that would interfere with respirator fit?				
If yes, willing to shave, as necessary?				
Fit-tested within the last year? (Documentation present)				
If Level B, is a back-up / emergency person suited up (except for air)?				
Does the HSS periodically inspect PPE and equipment?				
Is the PPE not in use properly stored?				
Is all equipment required in the HASP on site?				
Properly calibrated?				
In good condition?				
Used properly?				
Other equipment needed?				
List.				
Is monitoring equipment covered with plastic to minimize contamination?				
PERSONNEL AND EQUIPMENT DECONTAMINATION				
Is the decontamination area properly designated?				
Is appropriate cleaning fluid used for known or suspected contaminants?				
Are appropriate decontamination procedures used?				
Are decontamination personnel wearing proper PPE?				

Is the equipment decontaminated?				

Attachment Q

Daily Safety Meeting Log

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Safety Meeting Log

Project:	**Location:**
Date / Time:	**Activity:**

1. Work Summary

2. Physical / Chemical Hazards: Has JSA been reviewed/modified to address changing conditions?

3. Protective Equipment/Procedures

4. Emergency Procedures

Is there anyone with any medical conditions that they would like the team to know about? For example: Medic Alert, Allergic to bee stings, nitro for chest pains, etc.

Location of medical equipment: fire extinguishers, first aid kit, route to hospital, auto-injectors, etc.

5. Signatures of Attendees