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# Final Work Plan for Remedial Design Investigations for Designing Phase III ISS Application of the Draft IRM Work Plan for *In-situ* Stabilization/Solidification to Control NAPL Seeps at the East Station Former MGP Site, Rochester, New York

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**MSVCA Index #B8-0535-98-07**
**Site # V00358-8**

Prepared for:

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**April 2007**

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# APPENDICES

# 1.0 INTRODUCTION

This work plan for remedial design investigations (RDI) provides details for the proposed sampling and analysis work using direct push technology and test pits to support the development of the remedial design for ISS IRM implementation at the East Station former MGP Site. This work plan is a supplement to the work plan entitled *Draft IRM Work Plan for In-situ Solidification/Stabilization (ISS) to Control NAPL Seeps at the Former East Station MGP Site, Rochester, New York,* dated October, 2003 (ISS IRM Work Plan). The remaining portion of this section provides an overview of the ISS IRM Work Plan.

Rochester Gas and Electric Corporation (RG&E) owns property at 86 Smith Street in Rochester, New York that was formerly operated as a manufactured gas plant (MGP) referred to as the former East Station MGP. RG&E initiated and completed three site investigations (SI) between 1992 and 1999. A focused feasibility study (FFS) was subsequently performed in 2001. RG&E selected to pursue an Interim Remedial Measure (IRM) to be performed to mitigate NAPL seeps at the riverbank as one of the priority actions for implementation at the East Station site under a multi-site voluntary cleanup agreement executed with NYSDEC in April 2003. RG&E submitted to NYSDEC in October 2003 the draft IRM work plan for ISS to control NAPL seeps at the East Station former MGP site. NYSDEC approved the implementation of Phase I of the ISS IRM Work Plan to carry out Remedial Design Investigation (RDI) to determine the suitability of the physical and chemical conditions of the site for implementing the ISS technology. The field work and the laboratory analyses of the samples were completed in December 2003 and early January 2004. The report on IRM Phase I RDI entitled *Report on IRM Phase I Remedial Design Investigation to Mitigate NAPL Seeps at the East Station MGP Site, Rochester, New York* (ISS IRM Phase I RDI Report) was submitted to NYSDEC on February 3, 2004. On July 1, 2005, NYSDEC approved commencement of Phase II of the proposed ISS IRM Work Plan to carry out laboratory treatability tests in order to develop the optimum grout mixture for the ISS process to be implemented at the East Station former MGP site. The Final Work Plan for Phase II (Ish Inc., September 2005) was submitted to NYSDEC on September 2, 2005. In 2005 and 2006, laboratory treatability tests were completed and final reports were submitted to NYSDEC in November 2006. In October 2006, NYSDEC approved the Phase II reports and development of a work plan for remedial design for Phase III to implement the ISS. NYSDEC has provided verbal comments on the Draft Phase III work plan that was submitted in early March 2007.

As a result of NYSDEC's comments, RG&E has prepared this Remedial Design Investigation (RDI) work plan that will support the development of the engineering design and construction plans for implementation of the ISS IRM at the East Station former MGP site. RG&E has retained Ish Inc. to prepare and implement work plans for Phases I through IV of the ISS IRM Work Plan. Construction contractors will be separately selected and retained by RG&E for the ISS IRM work utilizing the NYSDEC approved design and construction plans.

To recapitulate, the ISS IRM Work Plan consists of four phases:

- **Phase I** is a Remedial Design Investigation (RDI) to determine if physical characteristics of the target ISS area are suitable for proceeding with the next phases of the IRM effort. The components of this RDI phase involved soil boring/rock coring, test pitting, and collecting soil samples for chemical characterization and for treatability testing. (**This phase has been completed.**)
- **Phase II** (to be implemented if the results from the Phase I RDI indicate the physical characteristics of the East Station site are suitable for the ISS technology) consists of designing and carrying out laboratory treatability tests to establish the optimum mixture for the ISS process and to develop the performance measures for stabilized material. **(This phase has been completed.)**
- **Phase III** will consist of preparing the engineering design and construction specifications for ISS application to the East Station site if the results of the treatability testing yield a suitable mixture that will meet the desired criteria. The design package will be utilized to prepare the bid documents to select the construction contractor(s). However, RG&E has determined and NYSDEC has concurred, that there is a need to conduct remedial design investigation (RDI) before the engineering design and construction details can be developed for implementation of the ISS IRM. **(This work plan is for the RDI work. RG&E expects to submit for NYSDEC approval the Phase III design and Phase IV implementation work plans together after the RDI field work has been completed.)**
- **Phase IV** will consist of selecting the construction contractor and then carrying out the *in-situ* stabilization/solidification construction work and documentation of the ISS IRM completion. **(RG&E expects to submit Phase III design and**

**Phase IV implementation work plans together for future NYSDEC approval and then implementation.)**

## 1.1 Objectives

The specific objective of this Phase III RDI work plan is:

- To develop a work plan for remedial design investigations to support the development of design of the ISS application at the East Station former MGP site.

# 2.0 FOCUSED REMEDIAL DESIGN INVESTIGATION

## 2.1 Purpose

The purpose of these remedial design field investigations is to delineate the nature and extent of elevated cyanide concentrations in soils along the Genesee River at the former East Station MGP site, in the general area of the upcoming application of ISS technology to control NAPL seeps. In addition, these field investigations include test pitting (supplemented by soil borings as needed) activities in the area of the former light oil plant to determine the locations and presence of subsurface structures in that area. Both of these goals will aid in the final remedial design development and in implementation of the ISS IRM. The field investigation will also include careful examination to assess the distribution of NAPL in the subsurface soils above the bedrock to further decide on the extent of the ISS remediation. Soil samples will be collected and analyzed to characterize the excavated material for off-site disposal.

## 2.2 Existing Data

From previous work performed at the site by Atlantic Environmental in 1992 and META Environmental, Inc. in 1998, it is known that purifier materials and elevated cyanide concentrations are present in the overburden soil and groundwater at the site, particularly the northwestern portion of the site along the Genesee River. These previous data are summarized on Figure 2-1, which graphically depicts total cyanide concentrations in soil and groundwater on a map of the site.

## 2.3 Scope of Field Activities

### 2.3.1 Cyanide Area

A field program utilizing a combination of direct push soil borings and test pits is planned to delineate the nature and extent of elevated levels of cyanide in the overburden soils. Figure 2-2 shows the proposed sampling locations, which were placed using a grid sampling approach. A total of 15 direct push borings (DP-01 through DP-15) are shown on the figure, along with excavation of two test pits (TP2007-1 and TP2007-2). However, up to approximately 5 additional soil borings may be installed to be determined during the field program, through consultation between the field crew, NYSDEC and RG&E project managers. Table 2-1 shows the list of the proposed soil borings.

**Table 2-1**

**List of Proposed Soil Borings and Test Pit Installation for the Cyanide Delineation**

| **Proposed Soil Borings** | |
|---|---|
| DP-01 | To delineate cyanide containing soils |
| DP-02 | To delineate cyanide containing soils |
| DP-03 | To delineate cyanide containing soils |
| DP-04 | To delineate cyanide containing soils |
| DP-05 | To delineate cyanide containing soils |
| DP-06 | To delineate cyanide containing soils |
| DP-07 | To delineate cyanide containing soils |
| DP-08 | To delineate cyanide containing soils |
| DP-09 | To delineate cyanide containing soils |
| DP-10 | To delineate cyanide containing soils |
| DP-11 | To delineate cyanide containing soils |
| DP-12 | To delineate cyanide containing soils |
| DP-13 | To delineate cyanide containing soils |
| DP-14 | To delineate cyanide containing soils |
| DP-15 | To delineate cyanide containing soils |
| **Proposed Test Pits** | |
| TP2007-1 | To investigate the fill material near the former holders |
| TP-2007-2 | To investigate the fill material near the former holders |

The direct push borings will be installed using standard Ish Inc. protocols, including careful geologic logging of site soils, PID screening for organic vapors, recorded visual or olfactory observations of impacts, and notation of purifier materials or NAPL. In addition, two samples will be collected as vertical composites from each boring and analyzed for total cyanide. The intervals for these samples will be based on field observations, but are anticipated to be from approximately ground surface to 10 feet below ground surface (bgs) and from 10 feet bgs to bedrock refusal. The dividing line between these samples may be adjusted deeper from the ground surface, if significant impacts are noted below 10 feet bgs. The lower interval will start approximately 1 foot below the last visual observation of impacts in the boring. Geoprobe sampling equipment with a four-foot macro core sampler will be used for the soil borings. Although Ish Inc. expects to complete the soil borings work with the Geoprobe equipment, we will be prepared to use augering equipment, if needed, to complete the soil borings for the RDI.

Once the total cyanide concentrations data have been obtained and the boring logs have been constructed, NYSDEC and RG&E will discuss and establish the goals for cleanup of the cyanide containing soils in the area of investigation in this phase of the ISS IRM.

Two test pits are planned near the former holders and within the suspected area of cyanide impacts not to exceed about 12 feet deep. The test pits will be used to obtain a cross sectional view of the overburden, as well as to evaluate the presence and the nature of subsurface debris associated with the former holders. Large subsurface debris will need to be considered during the implementation of the remediation. Similar to the soil borings, observations will be recorded for the test pits and a minimum of two composite samples will be collected from each test pit and analyzed for total cyanide.

During advancement of the borings and test pits, adequate number of samples will also be collected for waste characterization parameters to guide the handling and off-site disposal of the soils during the remediation. Details of the soil analysis for waste characterization to be completed will be determined through consultation with potential landfills prior to implementation.

### 2.3.2 Light Oil Plant Area

Approximately six test pits and four soil borings are planned for the area of the former light oil plant (Figure 2-3). These test pits and soil borings will be used to determine the nature of the subsurface structures and presence of NAPL in this area. The test pits will be used to evaluate the presence of foundations related to the former structures, the presence of underground storage tanks (USTs) in the area, and whether foundations consist of walls and/or slabs. The test pits will be used to trace the foundation of the structures that are discovered, so the locations shown on Figure 2-3 are to be used as a general guide. The soil borings will provide supplemental information regarding the presence of NAPL in the subsurface in the light oil plant area. The location and elevation of soil borings and test pits will be surveyed by a qualified surveyor immediately following completion of the field effort. Table 2-2 lists the soil borings and test pits planned for the RDI work.

**Table 2-2**
**List of Proposed Soil Borings and Test Pits for the Light Plant Area RDI**

| **Proposed Test Pits Installation** | |
|---|---|
| TP2007-3 | To evaluate the presence of foundations related to the former structures |
| TP2007-4 | To evaluate the presence of foundations related to the former structures |
| TP2007-5 | To evaluate the presence of foundations related to the former structures |
| TP2007-6 | To evaluate the presence of foundations related to the former structures |
| TP2007-7 | To evaluate the presence of foundations related to the former structures |
| TP2007-8 | To evaluate the presence of foundations related to the former structures |
| **Proposed Soil Borings** | |
| DP-16 | To obtain information on NAPL presence |
| DP-17 | To obtain information on NAPL presence |
| DP-18 | To obtain information on NAPL presence |
| DP-19 | To obtain information on NAPL presence |

### 2.3.3 Test Pits Trenching and Backfilling Methods

During the excavation of the test pits, visually unimpacted soils, such as surface soils, will be segregated from soils that may be impacted. The visually unimpacted soils will be used to cover the impacted soils/source materials when placed back in the test pit excavation. Contaminated soil will be excavated and placed onto a 6 mil poly sheet. Special care will be given to try to segregate the soils so as to replace impacted soils back into the test pit trench first. Test pits will be backfilled as soon as possible after completion. Following backfilling of the excavation, the four corners of each test pit, along with foundations will be staked for surveying by RG&E and placement on a site map.

### 2.3.4 Waste Handling

The waste materials that will be generated during the RDI field activities will be PPE, poly sheeting, soil cuttings from borings and wastewater from decontamination of reusable drilling and sampling equipment. Wastewater will be contained in Department of Transportation (DOT)-approved 55-gallon drums or a large polyethylene tank designed for wastewater containerization. Soil cuttings, poly sheeting and PPE will be contained in DOT-approved 55-gallon steel drums. Generated wastewater and soil cuttings will be characterized as necessary at the completion of the field activities to facilitate proper disposal by RG&E.

### 2.3.5 Sampling Equipment Decontamination

An area for the decontamination of field equipment will be set up on-site in close proximity to the investigation activities. This area will be designated by a section of high density polyethylene sheeting placed on the ground. Decontamination of field equipment will occur in this area.

Non-disposable field equipment used for the collection of soil, such as split-spoons, continuous cores, spatulas, spoons, trowels, and bowls will be decontaminated after each use by the following procedure:

- Knock, scrape, or wipe off excess soil;
- Pre-rinse with tap water;
- Wash with non-phosphate detergent and tap water;
- Rinse with tap water;
- Rinse with methanol, distilled water, nitric acid or acetone, as required; and
- Air dry on a designated clean surface.

Washed equipment will be wrapped in polyethylene sheeting or aluminum foil for storage or transportation from the designated decontamination area to the sampling location. At no time will washed equipment be placed directly on the ground. Decontamination wastewater will be collected and properly disposed.

### 2.3.6 Drill Rig and Backhoe Decontamination

Equipment used in intrusive work, including backhoe, drilling rig, augers and bits will be cleaned with high pressure hot water and scrubbed with a wire brush to remove dirt, grease, and oil before beginning field work and before leaving the project site upon completion of the last sampling activity.

A decontamination pad will be constructed of high density polyethylene sheeting on a prepared surface sloped to a sump. The sides of the pad will be bermed to contain decontamination water. Upon completion of field activities, the decontamination pad will be properly decommissioned by removing liquid from the sheeting, including the sump area, and allowing the area to dry. The sheeting will then be folded and placed in the waste container. The earthen material or wood timbers used to construct the containment berm will be inspected to ascertain if the material has come in contact with decontamination liquids during use. If they have, the materials will be disposed in the waste container for subsequent disposal at an appropriate facility. If the materials have not been in contact with decontamination liquids, they may be reused.

# 3.0 SITE MANAGEMENT PLANS

In order to ensure that RDI activities are performed in a safe manner that meets the project objectives, site-specific management plans were prepared for this work plan.

A project-specific Health and Safety Plan (HASP) has been prepared that contains site-specific information including emergency contacts, the route to the nearest hospital, and site-specific hazards (Appendix A). Based on previous experience at former MGP sites and existing site data, it is anticipated that the field activities will be performed with modified level D personal protection equipment.

In addition to a project-specific HASP, a Community Air Monitoring Plan (CAMP), consistent with NYSDOH guidelines, is included with this work plan (Appendix B). The CAMP describes the procedures and equipment that will be used to protect the on-site RG&E employees and the nearby community from fugitive chemical and particulate emissions during the RDI activities. Also, an Odor Management Plan (OMP) is included in Appendix C to protect the nearby community from fugitive odors during the RDI activities involving test pits and soil borings.

# 4.0 TARGET SCHEDULE AND PROJECT MANAGEMENT

## 4.1 Target Schedule for RDI

The following table provides a target schedule for conducting and completing the RDI program.

**Target Schedule for RDI Program**

| Task Description | Duration |
|---|---|
| Submit Work Plan for NYSDEC review and approval | End of March 2007 |
| Review and Approval of the RDI work Plan by NYSDEC | Third week of April 2007 |
| Mobilize and carry out field work consisting of soil borings and test pitting | Two weeks maximum duration for field work. (Start the field work approximately three weeks after NYSDEC approval of the work plan and subject to availability of drillers and test pit excavators) |
| Analytical results on soil samples from the laboratory | Three to four weeks |
| Data validation and summarizing the results including figures, maps, boring logs and test pit logs | Four to six weeks |
| RDI Draft report preparation and submission | Four weeks |
| Use the remedial design investigation data to finalize scope of the ISS IRM activities | Two weeks of deliberations and discussions with NYSDEC and RG&E |

## 4.2 Project Management

The Ish Inc. principal in charge (Dr. Ishwar P. Murarka) will be the primary point of contact with RG&E and NYSDEC, and will provide direction to the field project team for RDI work in conjunction with the RG&E on-site project manager. The Ish Inc. field team manager will coordinate the day-to-day field activities with the RG&E on-site project manager and the drilling/test pitting subcontractors. As presently envisioned, Severn Trent Laboratories, Inc. in Amherst, NY will conduct chemical analyses of the soil samples collected and submitted to the laboratory with the proper chain-of-custody.

# 5.0 FINAL ISS IRM DESIGN AND REPORTING

The findings of the RDI activities described in Section 2.0 will be presented in a RDI Report. Based on the results from the RDI program and concurrence with NYSDEC, the aerial extent of the ISS IRM activities will be finalized and incorporated into a Draft Phase III Remedial Design and the Phase IV construction plan. Ish Inc. team will prepare the Phase III design report that will provide information to be included in one or more bid documents for the ISS construction, NAPL collection trench construction and the soil excavation and backfilling work. The Phase III design and Phase IV ISS implementation report will contain engineering details and drawings, and details on the lay out of the site for the appropriate site preparation activities for the ISS IRM field work so that the soil removal/soil backfilling, ISS construction and NAPL collection trench installation are properly implemented. Site preparation activities may include construction of a gravel road, cutting down of trees near the river bank and providing for a site office trailer, electricity and communication hook-ups.

The Phase III Design and Phase IV ISS implementation report for IRM activities at the East Station site will provide the following information:

- Introductory information
- Site operations plan
- Unimpacted overburden material management
- Management of cyanide-impacted material
- ISS barrier design
- NAPL collection trench design
- Performance monitoring
- Site restoration plans
- Discussion of permits and approvals
- Site management plans
- Schedule considerations
- Project management plan
- Reporting requirements

# 6.0 REFERENCES

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Ish Inc., October 2003. Draft IRM Work Plan for *In-situ* Solidification/Stabilization (ISS) to Control NAPL Seeps at the Former East Station MGP Site, Rochester, NY.

Ish Inc., January 2004. Draft Report on IRM Phase I Remedial Design Investigation to Mitigate NAPL Seeps at the East Station MGP Site, Rochester, New York.

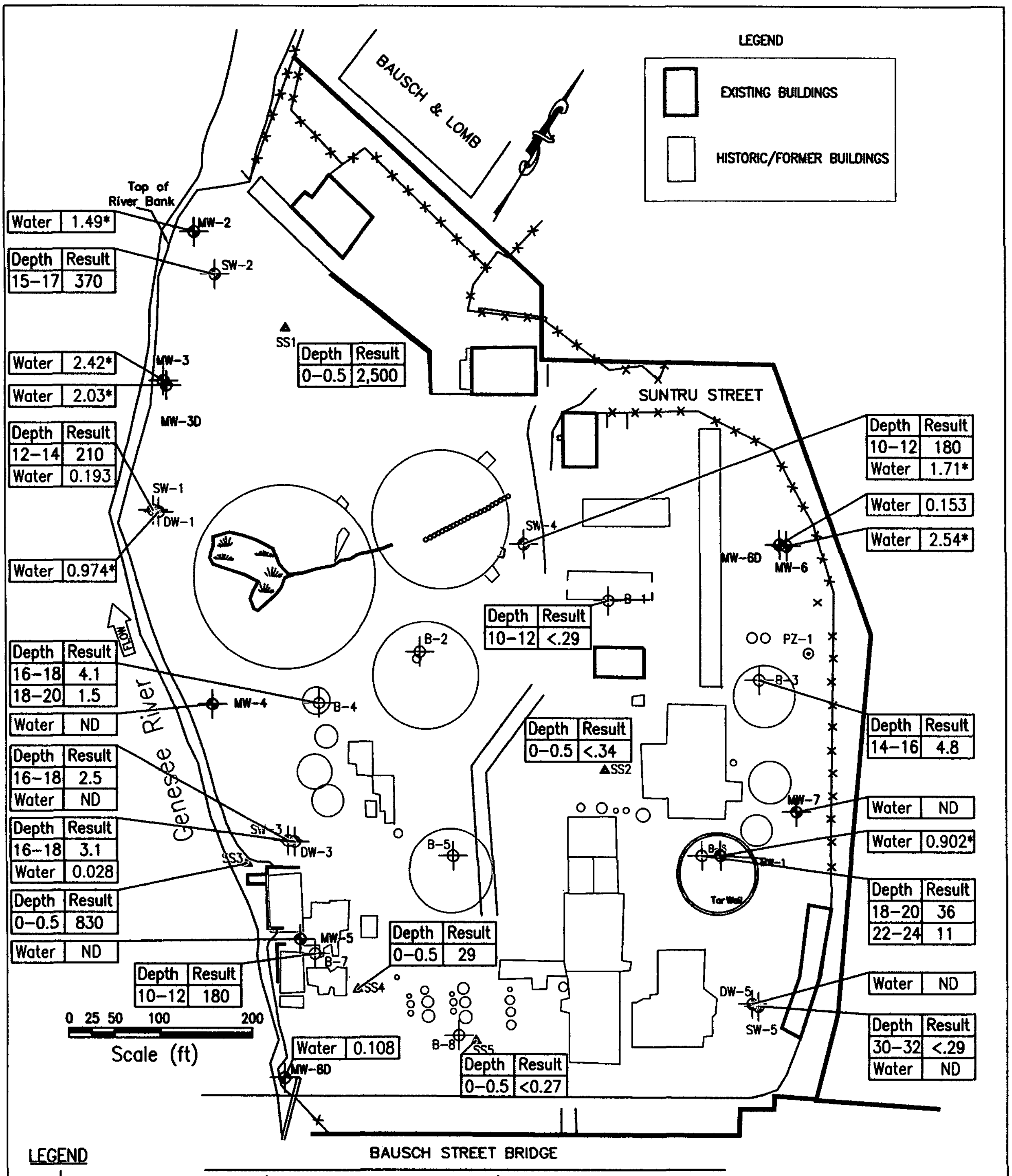
Ish Inc., September 2005. Final Work Plan for Phase II (Treatability Testing) of the Draft IRM Work Plan for *In-situ* SS to Control NAPL Seeps at the East Station Former MGP Site, Rochester, New York.

Ish Inc., November 2006. Final Report for Phase II (Treatability Testing) of the Draft IRM Work Plan for *In-situ* Stabilization/Solidification (ISS) at the RG&E East Station Former Manufactured Gas Plant Site, Rochester, New York.

Ish Inc., November 2006. Final Report for the Supplemental Testing in Phase II (Treatability Testing) of the Draft IRM Work Plan for *In-situ* Stabilization/Solidification (ISS) at the RG&E East Station Former Manufactured Gas Plant Site, Rochester, New York.

NYSDEC, 2002. Draft DER-10, Technical Guidance for Site Investigation and Remediation.

# FIGURES



LEGEND

- ⊕ Subsurface Soil Boring (Advanced by Atlantic Env. 1992)
- △ Surface Soil Boring (Advanced by Atlantic Env. 1992)
- ● Monitoring Well (Installed by META Env. 1998)
- ⊕ Monitoring Well (Installed by Atlantic Env. 1992)

Cyanide Results

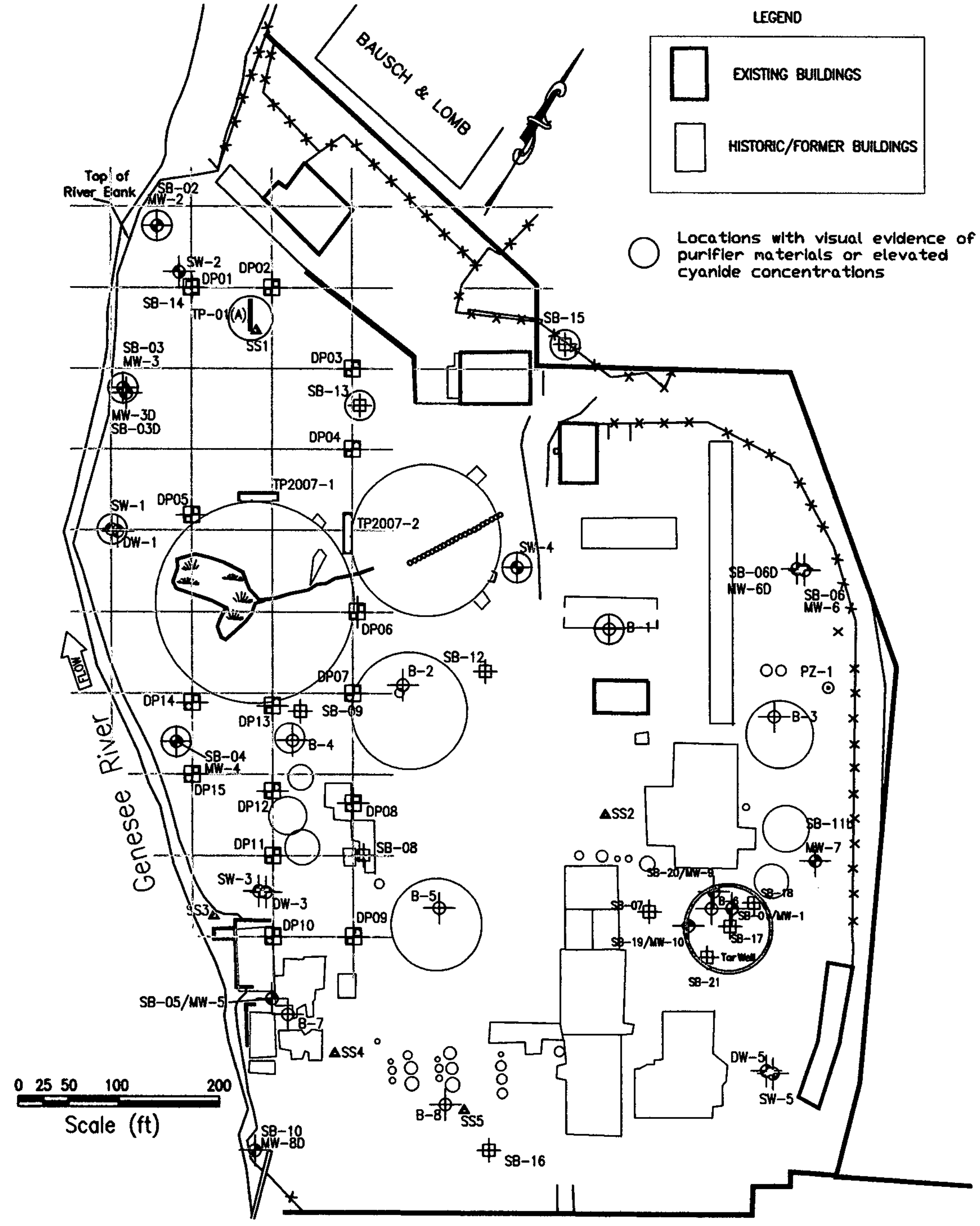
| Soil Depth | Result |
|---|---|
| in feet | mg/kg |
| Water | mg/L* |

* Result exceeds NYSDEC Class GA Groundwater standard of 0.2 mg/L

All soil samples collected by Atlantic Environmental June 1992

Map based on site map from Site Investigation Report for East Station MGP Site, Atlantic Environmental Services, Inc., June 1993.

| Project: East Station; Rochester, NY | Client: RG&E | Ish Inc./META | |
|---|---|---|---|
| Figure 2-1<br>Summary of Cyanide Results in Soil and Groundwater | | | |
| Filename: CYANIDEINVEST | Drawn by: PJD | Approved by: IM | Date: 4/9/07 |



LEGEND

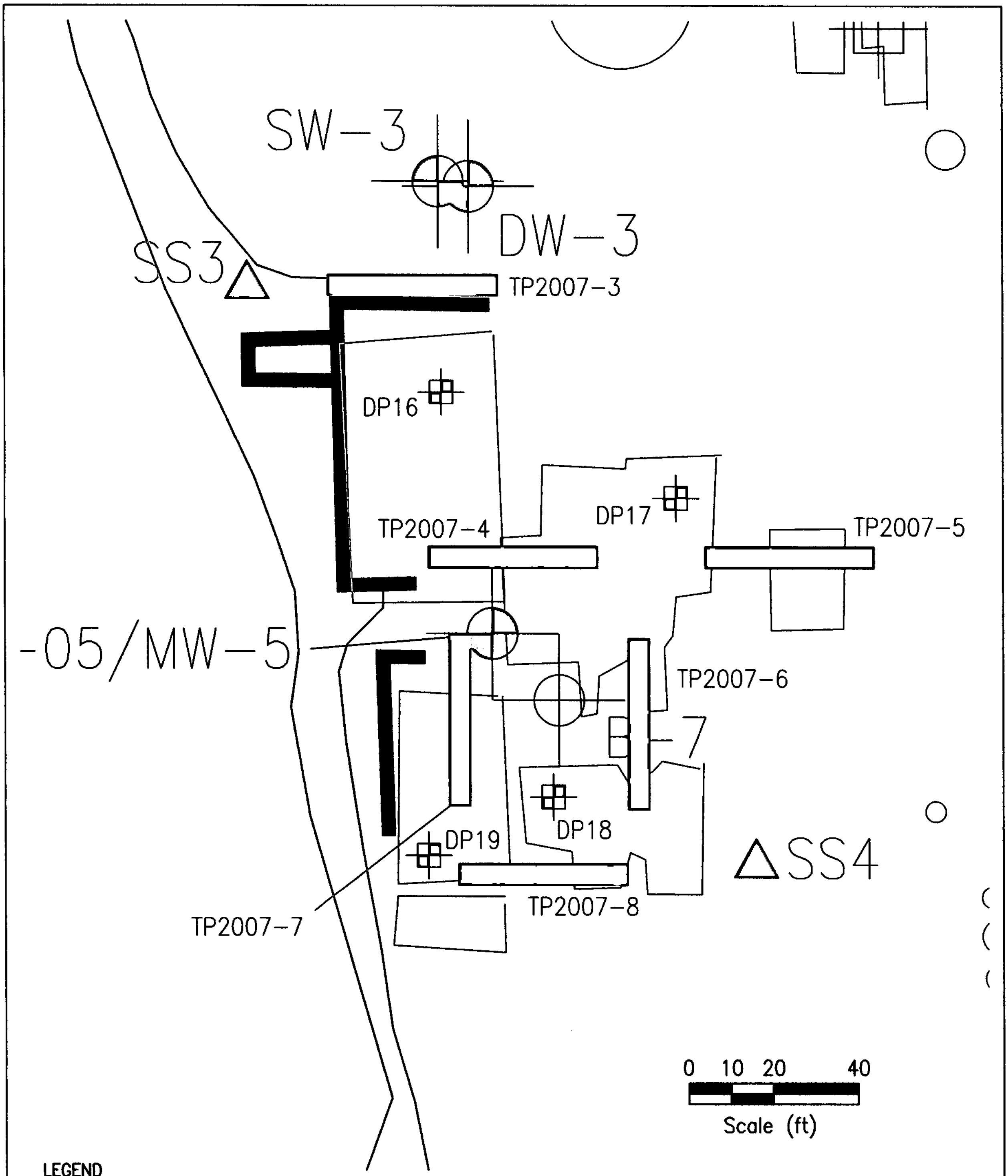
- ⊕ Subsurface Soil Boring (Advanced by Atlantic Env. 1992)
- ▲ Surface Soil Boring (Advanced by Atlantic Env. 1992)
- ⊕ Monitoring Well (Installed by Atlantic Env. 1992)
- ▭ Approximate Location of Test Pit (Excavated by Atlantic Env. 1992)
- ⊞ Surface Soil Boring (Advanced by META Env. 1998)
- ⊕ Monitoring Well (Installed by META Env. 1998)
- ⊞ Proposed Soil Boring
- ▭ Proposed Test Pit

Map based on site map from Site Investigation Report for East Station MGP Site, Atlantic Environmental Services, Inc., June 1993.

| Project: | Client: | |
|---|---|---|
| East Station; Rochester, NY | RG&E | Ish Inc./META |

Figure 2-2
Proposed Cyanide Investigation
Direct Push Borings and Test Pits

| Filename: | Drawn by: | Approved by: | Date: |
|---|---|---|---|
| CYANIDEINVEST | PJD | IM | 4/9/07 |



LEGEND
- ⊕ Subsurface Soil Boring (Advanced by Atlantic Env. 1992)
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- ⊕ Monitoring Well (Installed by META Env. 1998)
- ⊞ Proposed Soil Boring
- ▬ Proposed Test Pit

Map based on site map from Site Investigation Report for East Station MGP Site, Atlantic Environmental Services, Inc., June 1993.

| Project: | Client: | |
|---|---|---|
| East Station; Rochester, NY | RG&E | Ish Inc./META |

Figure 2-3
Proposed Test Pits and Direct Push Borings for the Light Oil Plant Area

| Filename: | Drawn by: | Approved by: | Date: |
|---|---|---|---|
| CYANIDEINVEST | PJD | IM | 4/9/07 |

# APPENDIX A
# HEALTH AND SAFETY PLAN

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# HEALTH AND SAFETY PLAN (HASP) FOR INTERIM REMEDIAL MEASURE FOR THE EAST STATION FORMER MGP SITE ROCHESTER, NEW YORK

## SITE #: V00358-8
## INDEX #: B8-0535-98-07

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March 2007

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# 1
# INTRODUCTION

This Health and Safety Plan (HASP) addresses the health and safety practices that will be employed by site workers participating in the remedial design investigation and remedial construction program at the Rochester Gas & Electric Corporation (RG&E), East Station former manufactured gas plant (MGP) site (site) located in Rochester, New York. The HASP takes into account the specific hazards inherent to the East Station former MGP site and presents detailed procedures to be followed by Ish Inc. and any subcontractors it may retain in order to prevent or, if necessary, respond to potential health and/or safety concerns. Activities performed under this HASP will comply with OSHA regulations 29 CFR § 1910 and 1926, as amended. This HASP will be made available to any other contractor or subcontractor working on the site, in order to inform the party of any site characteristics or hazards. In addition, RG&E contractors and other subcontractors will be expected to develop and implement their own HASP that conforms to the procedures specified herein and appropriate regulations, to ensure the safety of their workers.

It is the responsibility of officers, supervisors, and other employees in charge of company operations to see that work is carried out in a safe manner, and in accordance with safe operating practices and the instructions set forth in this Plan. It is also the responsibility of each worker to conform to the safe work methods contained in this manual, as well as the RG&E Contractor Safety and Health Obligations (Attachment G).

As outlined in 29 CFR § 1910.120, a preliminary assessment of health and safety risks, based on a historical review of the characteristics of the East Station former MGP site was performed to aid in the selection of appropriate worker protection methods prior to site entry. The plan will be updated if any further hazards are identified during the remedial activities or any additional information is obtained concerning the materials at this site and their associated health and safety risks. For example, additional hazardous substance data sheets may need to be included as more data are gathered or appropriate engineering controls and personal protective equipment may be updated for the tasks to be performed.

Included in this HASP are five sections that cover the Medical Surveillance Program, Site Safety Plan, Personal Protection and Monitoring, Work Zones and Decontamination, Training, and Emergency Procedures. The Site Safety Plan is written in a format such that it can be separated from this HASP and posted at the site for general use.

Ish Inc. will designate an in-field Site Safety Supervisor prior to commencement of the field work at the East Station former MGP site. When mentioned in the following plan, Site Safety Supervisor refers to the Ish Inc. designee. If personnel changes are required to those designated at the time of the writing of this HASP, the changes will be identified during the on-site project kick-off meeting.

# 2
# MEDICAL SURVEILLANCE PROGRAM

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Workers handling or participating in hazardous waste operations can experience high levels of stress. Their daily tasks may expose them to toxic chemicals, safety hazards, biologic hazards, and physical hazards. They may develop heat stress while wearing personal protective equipment or working in extreme temperatures, or face life-threatening emergencies such as explosions and fires. Therefore, a medical program (29 CFR § 1910.120) is essential to assess and monitor workers' health and fitness both prior to employment and during the course of work, to provide emergency and other treatment as needed, and to keep accurate records for future reference. In addition, OSHA recommends a medical evaluation for workers required to wear a respirator (29 CFR § 1910.120).

Field personnel employed by the consultants and contractors to RG&E must undergo medical surveillance in accordance with their corporate health and safety programs. Prior to entry on site, personnel working within the exclusion or work zone shall provide to the Site Safety Supervisor evidence of participation in a medical surveillance program, a fit test record, and current certification of training in accordance with the requirements of 29 CFR § 1910.120. It is the responsibility of each company working on the project to ensure that its employees have proper medical surveillance per OSHA regulations.

In the event that a member of the field team is exposed to some form of hazardous substance and/or shows symptoms of exposure, he/she must inform the Site Safety Supervisor. In addition, each member of the field team is required to maintain current personnel Medical Data Sheet (MDS), which will be held by the Site Safety Supervisor during site activities. The MDS will be filled out prior to the field activities and placed in a sealed envelope to maintain medical confidentially. The MDS will only be accessed in the case of an emergency to alert emergency officials of any pre-existing medical conditions.

# 3

# SITE SAFETY PLAN

The plan presented in this section covers field investigation and oversight of remedial action activities at the East Station former MGP site and establishes policies and procedures to protect workers and the public from the potential hazards posed by the activities at the site. In addition, the plan identifies measures to minimize accidents and injuries which have the potential to occur during normal daily activities or adverse weather conditions.

## 3.1 GENERAL INFORMATION

- Utility Name: Rochester Gas & Electric Corporation
- Site Name: East Station former MGP site
- Date Prepared: February 2007
- Plan Prepared by: Peter DeClercq
- Scheduled Period of Plan Use: March 2007 through June 2008

The site can be described as follows:

1. Location and Access: The East Station site covers approximately 13 acres and is located north of the business district in the city of Rochester, New York within the Genesee River Gorge. The Genesee River borders the western edge of the site, while Suntru Street forms the eastern boundary. The Bausch Street bridge forms the southern boundary of the site, while the property is bounded to the north and northeast by a property owned by Bausch and Lomb.
2. Site History/Status: In 1871, a coal carbonization MGP facility was constructed at the East Station site. Later, a carbureted water gas plant was added to the site between 1892 and 1900. The East Station gas manufacturing operations ceased in 1917, when a new

MGP was constructed (West Station) across the Genesee River from East Station. However, the gas produced at the West Station was purified at the East Station until gas manufacturing ceased in the early 1950s. In 1952, facilities at East Station were modified to handle natural gas. This modification included the construction of a catalytic reforming plant on the southern portion of the site. The catalyst pellets were composed of nickel-coated ceramic. In 1917, a light oil recovery plant was constructed at East Station to recover low molecular weight compounds for the production of TNT for World War I. Other byproducts from gas manufacturing were also recovered at the East Station including creosote, pitch, ammonium thiocyanate, and ammonium sulfate. After the war, the light oil plant recovered compounds used for the production of Bengas (a substitute auto fuel). A Bengas production plant was constructed and operated at East Station.

3. Facilities and Utilities on Site: Currently there are four buildings on the northern portion of the site; one storage building and a fenced high-pressure gas main in the central part of the site; and two unused surge tanks in the southern portion of the site. Most of the site is covered with mixed vegetation.

4. Buried Utilities: All underground utilities will be cleared by notifying Dig Safely New York (formerly UFPO) to mark the locations of underground utilities on-site.

5. Topography: The East Station site slopes slightly upwards towards the southwest with the average elevation reported as 415 feet above NGVD.

6. Surrounding Population: The East Station former MGP site is surrounded by a mixture of industrial, commercial, and residential land.

7. Perimeter Control: The site is actively used by RG&E for meetings and laboratory work. It is fenced on three sides with a locked gate. The Genesee River forms the fourth side of the site.

8. Emergency Response Capabilities: The site is easily accessible to emergency response groups. Strong Memorial Hospital has an emergency room and is located approximately 4.5 miles south of the site.

## 3.2 AUTHORIZED SITE PERSONNEL AND THEIR RESPONSIBILITIES

Responsibilities have been assigned to the personnel indicated in Table 3-1 (Note: One person may be responsible for more than one job function). Personnel arriving at or departing from the active remediation area of the site will log in and out with the record keeper. Activities on-site must be cleared through the project Site Manager or Project Director (if on-site).

The Site Manager or their designee will be on-site during field activities performed by the Ish Inc. team. A Field Team Leader/Site Manager will also be designated for site activities other than the remedial action oversight, as necessary.

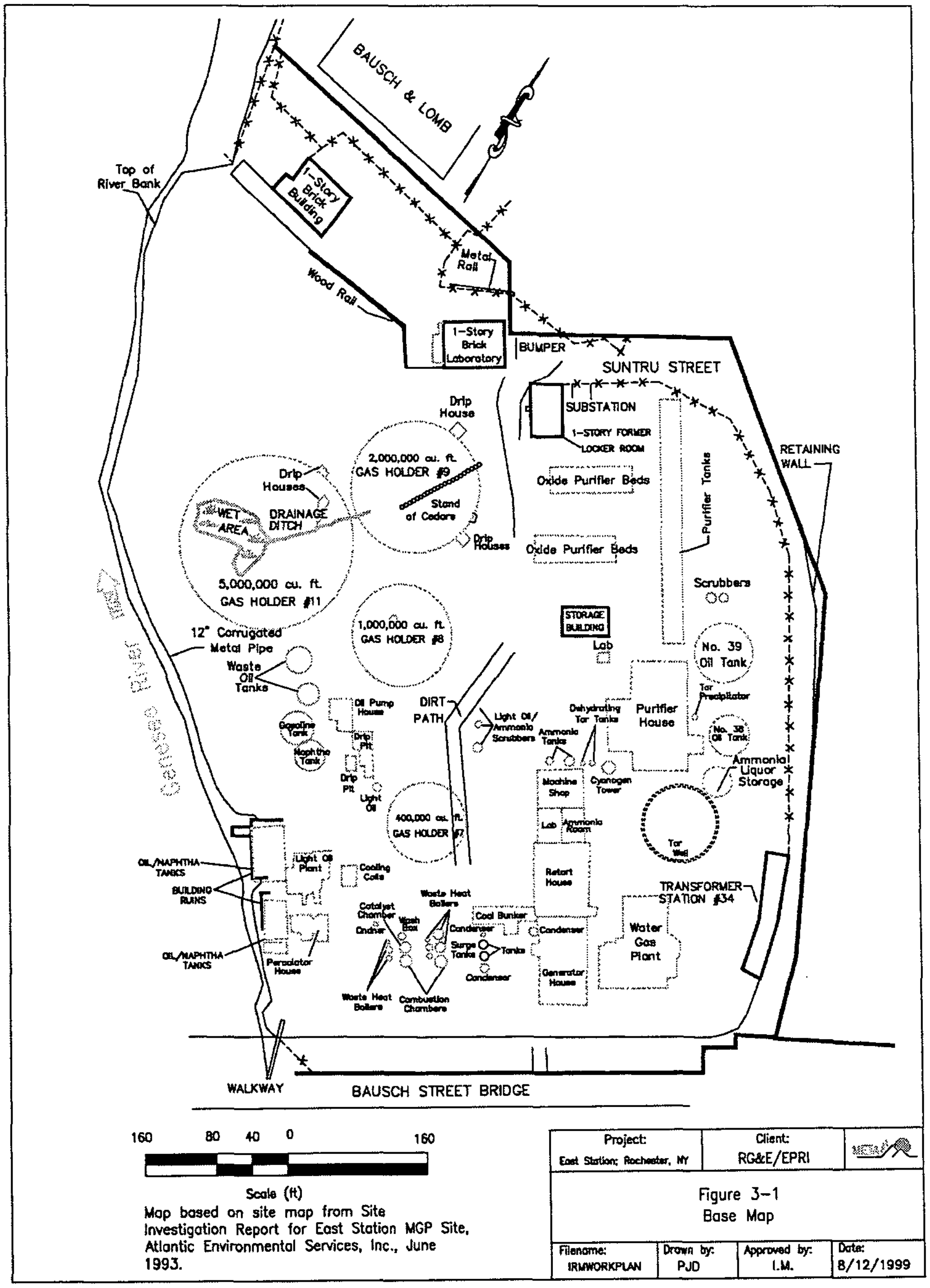
**Table 3-1**
**Authorized Site Personnel and Responsibilities**

| | |
|---|---|
| Principal in Charge/Project Director (Ish Inc.) | Dr. Ishwar Murarka |
| Field Team Leader/Site Manager | To be named |
| Site Safety Supervisor | To be named |
| Record Keeper | To be named |
| RG&E Project Manager | Mr. David Fingado and Mr. Daniel Kennedy |

## 3.3 CONTROL OF SITE ACCESS

The site is secured by a chain link fence. The site is an active laboratory and training center, so vehicles and personnel will be coming and going on the site during the field activities. The Field Team Leader will be responsible for controlling access to the work areas and contaminated zones on the site. Work zone boundaries will be clearly defined for the different areas and unauthorized personnel will not be permitted entry. Site workers will check in with the Site Safety Supervisor as necessary when they move on and off the work area. Good housekeeping at and around the job site shall be practiced to avoid tripping, falling, or other hazards. Equipment and materials which may have to be left on the job site shall be placed out of the way to eliminate hazards. Figure 3-1 shows the site base map. Work zones will be moved around the site as needed during the field activities.

# Figure 3-1
# Site Base Map



Map based on site map from Site Investigation Report for East Station MGP Site, Atlantic Environmental Services, Inc., June 1993.

## 3.4 HOURS OF ON-SITE ACTIVITIES

Remediation and oversight personnel are expected to be on the site at 07:00, with work commencing shortly thereafter. Work will generally continue through the sunlight hours of the day and will end prior to sunset. Should RG&E or the local community prefer alternative hours, the field team can accommodate, as needed. The Site Manager or a designee will remain on-site until after significant site work has been completed.

## 3.5 EXCAVATION AND STAKE-OUTS

Before any subsurface activity is to begin, a utility stake-out shall be requested at least two, but not more than ten, working days in advance. In addition to obtaining subsurface utility markings and clearance, the area will also be visually examined for overhead and other above grade utilities.

Excavations greater than five feet in depth, which workers may be required to enter, shall be sloped, shored, sheeted, braced, or otherwise supported in accordance with OSHA regulations subpart P of 29 CFR § 1926. In addition, these excavations will conform to OSHA regulations subpart P of 29 CFR § 1926 and be certified by a "competent person" and/or a site engineer. Excavated or other material shall be effectively stored and retained at least three feet or more from the edge of the excavation. **Under no circumstances, will excavations greater than 5 feet be entered without proper shoring during the work at the East Station site.**

When possible, trenches or excavations will be backfilled the same working day. When this is not possible, a competent person shall make daily inspections of excavations before work begins. If evidence of possible cave-ins or slides is apparent, work in the excavation shall cease until the necessary precautions have been taken to safeguard the employees. Trench observations will be made from a distance of several feet away from the narrow end wall of each trench. Special care will be taken to maintain a safe distance from the excavation so as not to collapse the open trench.

## 3.6 COMMUNICATION PROCEDURES

A cellular telephone will be available for use by Ish Inc. personnel and the on-site contractor's personnel for on-site emergency use.

## 3.7 CONFINED SPACE ENTRY

The field activity will not involve any confined space entry by Ish Inc. personnel as defined by 29 CFR § 1910.146.

## 3.8 FIELD OBJECTIVES

This plan is written specifically to cover remedial design investigation and remedial construction activities at the East Station former MGP site. The following tasks are planned for the field activities:

- pre-excavation characterization by soil borings and test pits,
- excavation and stockpiling of soils,
- excavation, loading and off-site disposal of soils
- demolition of subsurface structures and removal for off-site disposal
- collection of soil samples,
- backfilling and restoring of the excavated areas,
- construction of the ISS columns
- backfilling and reconstruction of surface topography,
- equipment decontamination, and
- trenching and construction of NAPL collection system.

Potentially contaminated media associated with these activities may include site groundwater, decontamination fluids, and soil.

## 3.9 EVALUATION OF POTENTIAL HAZARDS

### 3.9.1 Hazardous Chemical Waste

The waste types that may be encountered at the East Station former MGP site include free tars, oils, soil contaminated with organic chemicals, contaminated water, purifier waste (spent iron oxide impregnated wood chips), other mixed wastes produced as by-products of the MGP process and petroleum residuals from the former USTs. The primary hazards of each are identified in the Table 3-2.

### 3.9.2 Electrical/Physical Hazards

A main priority of the field team will be proper housekeeping to avoid trip and fall hazards. In addition, hand and power tools may be used for various tasks and can present a variety of hazards, both from flying objects and electrocution. Power sources will be equipped with a ground fault circuit interrupter (GFCI).

In addition, heavy equipment and trucks will be moving around the site and pedestrians and operators will need to be cognizant of maintaining eye contact to ensure awareness of each other's presence. A reflective vest should be worn by personnel to increase visibility.

In addition, overhead power lines are present at the site and care will be taken during field activities using heavy equipment so that proper clearance is maintained. Downed power lines are extremely hazardous and will be avoided. If electric shock results from contact with a downed power line, the power line must be turned off before a rescuer approaches anyone who may be in contact with the wire. If the victim is in a car with a power line fallen across it, tell them to stay in the car until the power can be shut off. The only exception to this rule is when fire threatens the car. In this case, tell the victim to jump out of the car without making contact with the car or wire.

If you approach a victim and you feel a tingling sensation in your legs and lower body, stop. This sensation signals you are on energized ground and that an electrical current is entering through one foot, passing through your lower body and leaving through your other foot. If this happens, raise a foot off the ground, turn around and hop to a safe place. Prevent bystanders from entering the danger area.

## Table 3-2
## Hazardous Chemical Waste Table

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Waste Form:** | **Tar/Creosote** | | | | | | | |
| | | Gas | X | Liquid | X | Soil (adsorbed) | | Sludge |
| **Characteristic** | | Corrosive | | Ignitable | | Radioactive | X | Volatile |
| | X | Toxic | | Reactive | X | Other: Carcinogenic | | |
| **Source** | | Drum | X | Pit (buried) | | Pond | | Lagoon |
| | | AST | | UST | X | Soils | X | Groundwater |
| | X | Debris | X | Other: Piping | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Waste Form:** | **Purifier Waste** | | | | | | | |
| | | Gas | | Liquid | X | Soil (adsorbed) | | Sludge |
| **Characteristic** | | Corrosive | | Ignitable | | Radioactive | | Volatile |
| | X | Toxic | X | Reactive | X | Other: | | |
| **Source** | | Drum | X | Pit (buried) | | Pond | | Lagoon |
| | | AST | | UST | X | Soils | | Groundwater |
| | X | Debris | | Other: | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Waste Form:** | **SVOCs** | | | | | | | |
| | | Gas | X | Liquid | X | Soil (adsorbed) | | Sludge |
| **Characteristic** | | Corrosive | | Ignitable | | Radioactive | X | Volatile |
| | X | Toxic | | Reactive | X | Other: Carcinogenic | | |
| **Source** | | Drum | X | Pit (buried) | | Pond | | Lagoon |
| | | AST | X | UST | X | Soils | X | Groundwater |
| | X | Debris | | Other: | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Waste Form:** | **VOCs** | | | | | | | |
| | X | Gas | X | Liquid | X | Soil (adsorbed) | | Sludge |
| **Characteristic** | | Corrosive | X | Ignitable | | Radioactive | X | Volatile |
| | X | Toxic | | Reactive | X | Other: Carcinogenic | | |
| **Source** | | Drum | X | Pit (buried) | | Pond | | Lagoon |
| | | AST | X | UST | X | Soils | X | Groundwater |
| | X | Debris | | Other: | | | | |

"X" = A characteristic or source that may be associated with the waste type at the East Station site.

# 4
# PERSONAL PROTECTION AND MONITORING

## 4.1 GENERAL

Personnel shall wear suitable clothing and proper protection in the performance of their jobs to afford protection against the environment and work hazards. Proper protection consists of, but is not limited to, reflective vests, approved goggles, spectacles, face shields, helmets, gloves, ear protection, steel toed safety shoes, and respiratory or ventilation systems. No person shall be permitted to wear contact lenses where eye protection is required without a recommendation from a doctor and approval of the Site Safety Supervisor.

### 4.1.1 Personal Protection Equipment (PPE - 29 CFR § 1910.132)

In accordance with 29 CFR § 1910.132, protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of process or environment, chemical hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.

### 4.1.2 Eye and Face Protection (29 CFR § 1910.133)

Protective eye and face equipment shall be required where there is a reasonable probability of injury that can be prevented by such equipment. In such cases, employers shall make conveniently available a type of protector suitable for work to be performed, and workers shall use such protectors. No unprotected person shall knowingly be subjected to a hazardous environmental condition. Suitable eye protectors shall be provided where machines or moving parts present the hazard of flying objects, glare, liquids, metal filings, gases or vapors, or a combination of these hazards.

Each affected person shall use eye protection that provides side protection when there is a hazard from flying objects. Detachable side protectors (e.g., clip-on, or slide-on side shields) meeting the pertinent requirements of this section are acceptable.

### 4.1.3 Head Protection (29 CFR § 1910.135)

Each affected person shall wear protective helmets when working in areas where there is a potential for injury to the head from falling objects. Protective helmets shall comply with the American National Standard for Personnel Protection Requirements (ANSI), ANSI Z89.1.

### 4.1.4 Hand Protection (29 CFR § 1910.138)

Employers shall select and require personnel to use appropriate hand protection when workers' hands are exposed to hazards such as those from the skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns, and harmful temperature extremes.

### 4.1.5 Foot Protection (29 CFR § 1910.136)

Each affected person shall wear protective footwear when working at the site. Protective footwear shall comply with ANSI Z41 and as required by RG&E safety rules (see Attachment G).

Metal toe guards should be worn when using or in the area of heavy equipment. Sneakers or open-toed shoes shall not be worn on any job site or any area where the worker is exposed to a potential foot injury.

### 4.1.6 Hearing Protection (29 CFR § 1910.95)

Per OSHA regulations (29 CFR § 1926.101), hearing protection shall be provided to personnel working in areas of high decibel noise. Hearing protection shall be worn by persons working in high noise areas with an intensity of 85 dBA (decibel average for 8 hours) or greater. If you need to raise your voice to be heard by someone less than two (2) feet away, you should wear hearing protection.

### 4.1.7 Respiratory Protection (29 CFR § 1910.134)

In the control of those occupational diseases caused by breathing air contaminated with harmful dust, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as much as feasible by acceptable engineering control measures. When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to OSHA requirements.

Air-purifying respirators have limited use at hazardous waste sites and can be used only when the ambient atmosphere contains sufficient oxygen (≥19.5%) (29 CFR § 1910.134 (b)). Also, for the respirator cartridge to be effective, the types of air contaminants have to be identified, and concentrations measured to determine if the cartridge can remove the contaminants.

## 4.2 LEVELS OF PROTECTION FOR SPECIFIC SITE ACTIVITIES

Table 4-1 stipulates protective equipment that will be required for different tasks during the work. Table 4-2 indicates the specific protective equipment for each level of protection.

**Table 4-1**
**Levels of Protection for Planned Site Activities**

| Site Activity | Health Risk | Level of Protection | Backup Level of Protection |
|---|---|---|---|
| Soil Borings and Test Pits | Low | Modified D | C |
| Soil Excavation/Stockpiling | Low | Modified D | C |
| Loading of Trucks | Low | Modified D | C |
| Subsurface Structure Removal | Low | Modified D | C |
| Construction of ISS Columns | Low | Modified D | C |
| Backfilling and Regrading | Low | Modified D | C |
| Equipment Decontamination | Low | Modified D | C |
| NAPL Collection Installation | Low | Modified D | C |

## Table 4-2
## Details of Levels of Protection

| **Level C*** | **Modified Level D*** |
|---|---|
| Full face respirator or half face respirator with safety glasses, depending on site conditions (with appropriate filters) | Safety glasses or chemical splash goggles |
| Tyvek™ suit or other chemical resistant clothing | Tyvek™ suit or other chemical resistant clothing (optional) |
| Hard hat | Hard hat |
| Steel-toe footwear | Steel-toe footwear |
| Sound protectors (optional) | Sound protectors (optional) ** |
| Disposable, nitrile or latex inner gloves | Disposable, nitrile or latex inner gloves |
| Chemical resistant outer gloves | Leather or chemical resistant outer gloves (optional) |
| Two-way radio (worn outside protective clothing) (optional) | Two-way radio (worn outside protective clothing) (optional) |

* Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

** Hearing protection will be mandatory in the event that noise exposures exceed OSHA TWA exposure limits (e.g., if a driven sheet pile wall replaces the expected slurry wall installation, noise levels may exceed OSHA TWAs in the vicinity of the installation activities).

## 4.3 AIR MONITORING

This HASP is designed for a field program that requires a level of protection not to surpass Level C for personal protection. Based upon previous MGP site investigations, it is unlikely that levels of protection other than Level D will be necessary. However, field team members will be prepared to use Level C protection should the situation warrant. If protection beyond Level C is needed, the field team will suspend activities until the proper protective equipment is acquired and the HASP is updated. The Site Safety Supervisor may increase or decrease the requirements of a level of protection as he/she deems fit based on sound safety principles and prevailing conditions. The basis for decreasing the protection standards established herein shall be recorded in the daily logbook prior to use of a decreased level of protection.

### 4.3.1 Action Levels

To make a conservative assessment of when different levels of respiratory protection are needed during the field work, it will be assumed that the organic vapors detected by the air monitoring instruments consist of the most toxic volatile compounds expected to be found on the site. Preliminary evaluation of the risks expected at the site indicates that the most toxic volatile compounds that are probably present are VOCs (particularly BTEX). Based on data published by OSHA, ACGIH, and NIOSH, along with contractor knowledge of site contaminants, the levels of personal protection shown in Table 4-3 will be employed when the given concentrations of organic vapor are detected in the breathing zone.

Odors or dusts derived from site contaminants may cause nausea in some workers, although the contaminants are at low levels, well below the safety limits as previously defined. In such cases, workers may use respirators or dust masks to mitigate the impact of nuisance odors or dusts. In addition, dust masks may be worn when airborne dust is originating from uncontaminated sources (e.g., clean backfill). Note that, when practical, work areas should be positioned upwind of organic vapor and dust sources to reduce the potential for worker exposure.

Level D protection should be used when the atmosphere contains no known hazard and work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Level C protection should be used when the atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin. Also, the types of air contaminants must be identified, concentrations measured, and an air-purifying respirator must be available that can remove the contaminants within the requirements set for air-purifying respirators.

Combinations of personal protection equipment other than those described for Level A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

## Table 4-3
## Air Monitoring Action Levels

| **Instrument** | **Reading** | **Level of Respiratory Protection/Action** |
|---|---|---|
| FID/PID | Background – 1 ppm in Breathing Zone | Level D |
| FID/PID | > 1 ppm in Breathing Zone, confirm with Benzene detector tube (15 minute average) | Level C, Institute Vapor Suppression Measures |
| FID/PID | 1-25 ppm (confirmed absence of Benzene) | Level D, Institute Vapor Suppression Measures |
| FID/PID | >25 and <500 ppm above background in Breathing Zone (15 minute average) | Level C, Institute Vapor Suppression Measures |
| FID/PID | > 500 ppm above background (15 minute average) | Level B, Institute Vapor Suppression Measures |
| Dust meter | < 0.2 mg/m$^3$, 15 minute average | Level D |
| Dust meter | 0.2 – 5 mg/m$^3$, 15 minute average or 1.5 x above background | Level C, Initiate dust suppression measures |
| Dust meter | > 5 mg/m$^3$ | Level B |

The Site Safety Supervisor will keep close track of the work schedules listed in the work plan in order to be sure that workers entering the site have had their safety briefing and that the amount of safety equipment kept on-site is sufficient for workers and observers present at any time. Each field team member is responsible for his/her own respirator.

## 4.3.2 Air Monitoring Protocols

### 4.3.2.1 On-site Monitoring

The following monitoring instruments will be available for use during field operations as necessary:

- MiniRAE 2000 PGM-7600 photoionization detector (PID)/data logger or equivalent,
- DataRAM DR-4000 portable particle sizing aerosol monitor/data logger or equivalent, and
- Hand Pump with colorimetric detector tubes for benzene.

These instruments will be used to monitor the action levels shown in Table 4-3. Organic vapor concentrations in the air shall be measured using the PID during the sampling, drilling and excavation activities. During excavation operations, organic vapor concentrations shall be measured at least once every 15 minutes. Organic vapor concentrations shall be measured upwind of the work site to determine background concentrations at least twice per day (once in the morning and once in the afternoon). Measurements will be monitored from the breathing zone height (4 to 5 feet above ground level) at worker locations for determining the actual safety conditions and whether there is a need to change to a higher level of safety (or whether the level of safety can be lowered). The Field Team Leader or Site Manager will interpret monitoring results using professional judgment.

Colorimetric detector tubes shall be used to determine the potential presence of benzene when action levels have been exceeded.

A dust meter shall be used to measure airborne particulate matter during intrusive activities. Monitoring will be continuous and readings will be averaged over a 15 minute period for comparison with action levels.

### *4.3.2.1.1 Air Monitoring Equipment Calibration and Maintenance*

Air monitoring equipment will be maintained and calibrated in accordance with the manufacturer's instructions.

Monitoring instruments must be calibrated and maintained periodically. The limitations and possible sources of errors for each instrument must be understood by the operator. It is important that the operator ensures that the instrument responds properly to the substances it was designed to monitor. Portable air quality monitoring equipment that measures total ionizables present, such as the MiniRAE, must be calibrated at least once per day, before commencing work. Real time aerosol monitors, such as the DataRAM, must also be zeroed at the beginning of each sampling period. The specific instructions for calibration and maintenance provided for each instrument should be followed.

# 5

# WORK ZONES AND DECONTAMINATION

## 5.1 SITE WORK ZONES

To reduce the spread of hazardous materials by workers from the contaminated areas to the cleaner areas, work zones will be delineated at the site. The flow of personnel between the zones will be controlled. The establishment of the work zones will help ensure that: personnel are properly protected against the hazards present where they are working, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency.

### 5.1.1 Exclusion Zone

The exclusion zone will be established at the site for drilling or remedial activities; unprotected onlookers should be located 50 feet upwind of remedial activities whenever possible. In the event that volatile organics are detected in the breathing zone above action levels as discussed in Section 4, personnel within the exclusion zone must upgrade to Level C protection. Exclusion zones will also be established during any activity when Level C protection is established as a result of conditions discussed in Section 4.

Personnel within the exclusion zone will be required to use the specified level of protection. No eating, drinking or smoking will be allowed in the exclusion or decontamination zones.

### 5.1.2 Decontamination Zone

If appropriate, a decontamination zone will be established between the exclusion zone and the support zone, and will include the personnel and equipment necessary for decontamination, as discussed below. Personnel and equipment in the exclusion zone must pass through the decontamination zone before entering the support zone.

### 5.1.3 Support Zone

The support zone will include the remaining areas of the job site. Break areas, operational direction and support facilities (to include supplies, equipment storage and maintenance areas) will be located in this area. No equipment or personnel will be permitted to enter the support zone from the exclusion zone without passing through the personnel or equipment decontamination zone, as necessary. Eating, smoking, and drinking will be allowed only in this area. Smoking will only be allowed in smoking areas designated by RG&E.

## 5.2 DECONTAMINATION PROCEDURES

Decontamination areas will be established for the following activities:

- Equipment decontamination
- Personnel decontamination

### 5.2.1 Large Equipment, Drill Rig and Backhoe Decontamination Pad

Equipment used in intrusive work, including backhoe, ISS equipment, drilling rig, augers, and bits will be cleaned with high pressure hot water and scrubbed with a wire brush to remove dirt, grease, and oil before leaving the project site. The loading of trucks will employ spreading of poly material so that the truck tires will not be in any soil or mud area to prevent the need for heavy cleaning when the trucks leave the Site.

A water-tight decontamination pad will be constructed on a slope with a sump. The sump will be of sufficient volume to contain the wash water. Upon completion of field activities, the decontamination pad will be properly decommissioned by removing liquid from the pad, including the sump area, and cleaning the pad or disposing of the materials used to construct the pad.

### 5.2.2 Small Equipment Decontamination Station

An equipment decontamination station will be established in the decontamination area where small sampling equipment (split spoons, spatulas, bowls) will be cleaned and checked before they are used. The decontamination station will be equipped with water for washing, detergent, spray bottles of methanol and distilled water, and brushes for scrubbing. Once cleaned, the equipment will be transferred to a "clean" carrying tray or wrapped in aluminum foil.

The following is a specific equipment decontamination procedure to be used by site workers wearing protective clothing and equipment from Level D through Level C.

1. knock, scrape, or wipe off excess soil
2. pre-rinse with tap water
3. wash with non-phosphate detergent and tap water
4. rinse with tap water
5. rinse with 10% nitric acid, distilled water, methanol or acetone, as required
6. air dry on a clean surface and wrap in foil.

### 5.2.3 Personnel Decontamination Station

If necessary, a personnel decontamination station will be set up in the decontamination area, the contamination reduction zone (CRZ), to provide an area for workers to clean and remove their protective clothing (e.g., boots and gloves) and other equipment, such as respirators. It will be equipped with basins of water, detergent, and other decontamination fluids. Once personnel have gone through decontamination at this station and taken off their protective gear, they will be able to leave the site and proceed to the field office where they will wash any areas potentially exposed to contaminants.

The following is a specific personnel decontamination procedure to be used by site workers wearing protective clothing and equipment from Level D through Level C.

1. equipment drop
2. outer boot and glove wash and rinse, tape removal, and drop (wash with detergent, rinse with water, and use other decontamination fluids as necessary)
3. respirator wash, rinse, and drop (use same wash and rinse sequence as in Step 2 with a soft-bristle brush and a sponge)
4. hard hat and goggle removal (use same wash as in Step 2)
5. Tyvek™ (or appropriate personal protective clothing) suit removal
6. remove inner gloves
7. wash potentially exposed skin (use water and soap at indoor sink)

Items that cannot be decontaminated will be disposed of properly in a solid waste drum. Visibly clean items will be disposed of in trash containers.

### 5.2.4 Decontamination Equipment Checklist

The following is a list of decontamination equipment that should be kept on-site:

**Table 5-1**
**Decontamination Equipment Checklist**

| Item | Quantity |
|---|---|
| Alconox detergent concentrate | ~ 10 oz., dry |
| Hand pump sprayers | 5 |
| Long-handle, soft bristle brushes | 3 |
| Cleanser for respirators | Several packages |
| Plastic bags | 1 box |
| Methanol | 4 liters |
| Paper towels | 4 rolls |
| Distilled water | ~3 gallons |

# 6
# TRAINING

Formal health and safety training and specific on-site training are essential aspects of any program designed to protect workers in areas suspected of containing hazardous or potentially hazardous materials. The following subsections address both formal health and safety training requirements and a specific on-site training program.

## 6.1 HEALTH AND SAFETY TRAINING

The Ish Inc. team field personnel have attended a 40-hour health and safety training course (29 CFR § 1910.120) in which they were taught the potential hazards of site work, how to minimize exposure, and how to initiate response actions.

The training course consists of classroom instruction, field demonstration, use of respirators and appropriate protective clothing, written tests, and field tests. The major topics covered in this course are:

- Identification of hazardous substances
- Properties of hazardous substances
- Routes of exposure
- Toxicity of different substances, and their individual and synergistic effects
- Practical considerations in health and safety management
- Physical properties of chemicals
- References for threshold limit values (TLV), lower explosion limits (LEL), toxicity data, cross references
- Technical assistance organization
- Air monitoring and survey instruments
- Site entry and egress procedures
- Heat stress monitoring
- Levels of personnel protection

- Controlling access of work zones and other contaminated areas
- Personnel decontamination
- Equipment decontamination
- Site/area safety planning

Everyone attending the course is fit tested for his/her personal respirator and is trained in using a self-contained breathing apparatus and a Level A suit. The course also emphasizes the importance and procedures of decontamination.

## 6.2 FIRST AID AND CPR TRAINING

One or more of the field team members shall be trained in first aid fundamentals including cardiopulmonary resuscitation. Injury response procedures shall conform to OSHA regulation 29 CFR § 1926.950(e).

## 6.3 ON-SITE TRAINING PROGRAM

After the field office has been setup at the East Station former MGP site, but before any intrusive field activities begin, the Site Safety Supervisor (or designee) will conduct an on-site training meeting for personnel and observers who will be involved in the remedial activities. This program will cover specific practices and potential problems inherent to the site. No person will be allowed to work at the site unless he/she has received this training. During the training program, the site HASP will be reviewed and copies made available, if requested. Copies will be kept on-site throughout the field activities. The major components of the on-site training include a review of:

1. suspected chemical hazards, their form (e.g. vapor, gas, liquid), and the warning signs of their presence;
2. potential hazards posed by the planned operations;
3. potential hazards of conducting operations in the presence of underground and overhead utilities;
4. operational procedures:
    - control of site activities

  - control of site access and perimeter
  - zones of hazard
  - levels of protection
  - detection equipment
  - decontamination procedures

5. emergency procedures:
    - first aid
    - emergency communications procedures, and responsible parties
    - location of emergency equipment
    - local response groups and their phone numbers
    - evacuation procedures

In addition, personnel must confirm in writing that they have read the entire site HASP.

Any new personnel who join the field team are required to attend a similar health and safety briefing before they may participate in any aspect of the field program.

Site-specific rules and regulations will be emphasized during the on-site safety meeting, including:

1. No smoking, drinking, or eating is permitted within restricted (contaminated) zones.
2. Personnel, clothing, and equipment in contact with contaminated soils, fuel, or other contamination materials within the restricted area must go through full decontamination before moving into a "clean" area.
3. The Site Safety Supervisor has full authority over start-up and shutdown of operations from a safety perspective. He/she will determine whether conditions are too extreme for work and he/she will establish the working hours at the site.

Additional training meetings will be held if necessitated by changing site conditions, new operational procedures, or the entry of new personnel unfamiliar with important daily safety topics. A record will be kept of safety meeting dates and topics discussed. A sample record is provided as Attachment F. Each morning before work commences, a brief safety meeting will be conducted to review safety procedures and discuss any pertinent safety issues.

# 7
# EMERGENCY PROCEDURES

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This section establishes procedures and provides necessary information should an emergency occur during site field activities. Since emergencies happen unexpectedly and quickly and require an immediate response, contingency planning and advanced training of staff are essential. Specific elements of emergency support procedures that are addressed in the following subsections include: communications, local emergency support units, preparations for medical emergencies, and first aid for injuries incurred on-site.

## 7.1 COMMUNICATIONS

A mobile telephone will be available on-site for the field team and subcontractor use. If the field team divides into two or more groups within the study area, cell phones or a series of two-way radios may be used to maintain verbal communication. Should verbal communication methods breakdown or be hindered by required safety measures, i.e., respirators, standard hand signals will be used to communicate within the study area. The standard hand signals include:

**Table 7-1**
**Standard Hand Signals**

| **Standard Hand Signals** | |
|---|---|
| One or two hands on top of head | I'm all right |
| Thumbs up | I understand, OK |
| Thumbs down | No, negative |
| Grip partners wrist or both hands around wrist | Leave area immediately |
| Waving hands over head | Come over here, quickly |
| Hand gripping throat | Can't breathe |

## 7.2 LOCAL EMERGENCY SUPPORT UNITS

In order to be able to deal with any emergency that might occur, the following information has been obtained and will be posted prominently:

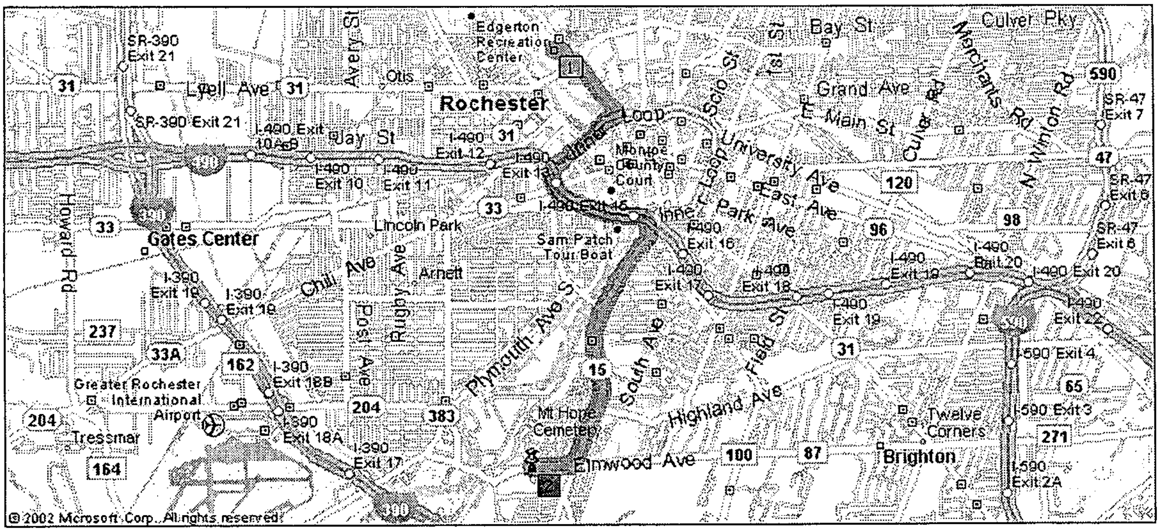
| | | |
|---|---|---|
| **Local emergency medical team:** | | |
| | **Fire Department, including ambulance service** | **911** |
| **Nearest emergency room:** | | **585/275 4551** |
| | **Strong Memorial Hospital**<br>**Rochester, NY** | |
| **Police Department:** | | **911** |
| **Fire Department** | | **911** |
| **Utility Contacts:** | **RG&E Emergency Control Center** | **585/724-8917** |
| | **David Fingado (RG&E)** | **585/724-8108** |
| **or** | **Dan Kennedy (RG&E)** | **585/724-8683** |
| **Utility Emergencies:** | **Dig Safely New York (UFPO)** | **800/962-7962** |
| **NYSDEC Spill Hotline** | | **800/457-7362** |
| **National and State Information Centers:** | | |
| | **National Response Center** | **800/424-8802** |
| | **Upstate New York Poison Center** | **800/222-1222** |

## 7.3 PREPARATION FOR MEDICAL EMERGENCIES

In the event of an accident, personnel from the hospital emergency room will be informed of the events and actions leading up to the incident, as well as being given any pertinent site related Material Safety Data Sheets. This information will assure the proper treatment needed to handle cases of overexposure to any of the contaminants or hazardous materials found or used at the site. These chemicals are described in detail in the appended Material Safety Data Sheets (see Attachment A). Instructions for finding the Emergency Room will be readily available. Figure 7-1 shows the location of the Hospital with respect to the site.

## Figure 7-1
## Route to Local Medical Facility, Strong Memorial Hospital Emergency Room Located at 601 Elmwood Ave., Rochester, NY 14642

| Mile | Instruction | For | Toward |
|---|---|---|---|
| **0.0** | **Depart Suntru St, Rochester, NY 14605 on Suntru St (East)** | **0.2 mi** | |
| 0.2 | Turn LEFT (East) onto Bausch St | 109 yds | |
| 0.2 | Turn RIGHT (South-East) onto St Paul St | 0.5 mi | |
| 0.7 | Turn RIGHT (West) onto Ramp | 0.1 mi | Inner Loop West |
| 0.8 | Continue (South-West) on Inner Loop | 0.3 mi | |
| 1.2 | Continue (South-West) on Ramp | 0.3 mi | I-490 / Inner Loop |
| 1.5 | Merge onto I-490 (South) | 0.7 mi | |
| 2.1 | At I-490 Exit 15, turn off onto Ramp | 0.2 mi | Inner Loop / South Ave / RT-15 |
| 2.3 | Continue (South) on South Ave | 76 yds | |
| 2.3 | Turn RIGHT (West) onto SR-15 [Mt Hope Ave] | 1.8 mi | |
| 4.2 | Turn RIGHT (West) onto Elmwood Ave | 0.3 mi | |
| 4.5 | Turn LEFT (South) onto Hospital Dr | 10 yds | |
| **4.5** | **Arrive 601 Elmwood Ave, Rochester, NY 14620 [601 Elmwood Ave, Rochester, NY 14620]** | | |



Before field work on the Site commences, personnel who will be working there or observing the operations will complete a medical data sheet to include the following information:

- Name, address, and home telephone number
- Age, height, weight
- Name of person to be notified in the case of an emergency
- Prescription and non-prescription medications currently being used
- Allergies
- Particular sensitivities
- Use of contact lenses or eyeglasses
- Short medical history including list of previous illnesses
- Name of personal physician and telephone number

These data sheets will be filled out by each worker during his/her initial site safety training meeting and before he/she performs any work on-site. Medical Data Sheets will be filed in the field office or vehicle, and maintained by the Site Safety Supervisor or his/her designee (see Attachment B for a sample medical data sheet).

If a team member becomes exposed to or suffers from a symptom of exposure to site materials and is taken to the hospital, a copy of his/her medical data sheet will be presented to the attending physician.

## 7.4 FIRST AID FOR INJURIES INCURRED DURING FIELD WORK

Injuries, no matter how slight, will be reported to the Site Safety Supervisor immediately. The Site Safety Supervisor will complete an accident report (Attachment C) for every accident. The following first aid equipment will be available at the site office/command post:

- First aid kit
- Emergency eye wash

During the site safety briefing, project personnel will be informed of the location of the first aid station that will be set up at the command post.

When possible, site workers will refrain from administering first aid for serious injury or illness and wait for the arrival of professional paramedics at the site to take the appropriate action. Unless they are in immediate danger, injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Ish Inc. team members will closely follow any first aid instructions given by doctors or paramedics before an emergency medical unit arrives at the site, or before the injured person is transported to the hospital.

### 7.4.1 First Aid Equipment List

The first aid kit(s) kept at the site will consist of a weatherproof container with individual sealed packages of each type of item listed below:

- Gauze roller bandages 1" and 2"
- Gauze compressed bandages, 4"
- Adhesive tape, 1"
- Bandages, 1"
- Butterfly bandages
- Triangular bandages, 40"
- Ampules of ammonia inhalants
- Burn dressing and sterilized towels
- Surgical scissors
- Eye dressing
- Emergency eye wash
- First Aid Cream
- Tourniquet
- Alcohol
- Hydrogen peroxide

### 7.4.2 Portable Fire Extinguishers (29 CFR § 1910.157)

Portable ABC rated fire extinguisher(s) and sorbent pads will be located near a drill rig or other heavy equipment during on-site activities. Fire extinguisher(s) will be properly maintained and tagged.

An emergency at any site, such as a fire or chemical release, might require that some appropriately trained site workers direct traffic on or near the site. Reflective vests, flares, traffic cones (or equivalent), and flashlights may be used for traffic control on-site.

## 7.5 COLD AND HEAT RELATED EMERGENCIES

### 7.5.1 Frostbite

Frostbite occurs when temperatures drop below freezing. Tissue is damaged in two ways: (1) actual tissue freezing, which results in the formation of ice crystals between the tissue cells, and (2) the obstruction of blood supply to the tissues.

*Signs and Symptoms*

Superficial:

- Skin color is white or grayish yellow.
- Pain may occur early and later subside.
- Affected part may feel only very cold and numb. There may be a tingling, stinging, or aching sensation.
- Skin surface will feel hard or crusty and underlying tissue soft when depressed gently and firmly.

Deep:

- Affected part feels hard, solid, and cannot be depressed.
- Blisters appear in 12 to 36 hours.
- Affected part is cold with pale, waxy skin.
- A painfully cold part suddenly stops hurting.

*First Aid*

- Frostbite injuries follow the same first aid treatment.
- Do not attempt to re-warm if a medical facility is nearby or there is a chance that refreezing may occur.

- Remove any clothing or items that could impair blood circulation.
- Put the frostbitten part(s) in warm (not hot) water (102-106 °F).
- Do not use water greater than 106 °F.
- Do not break any blisters.
- Do not rub the part.
- Do not walk on frostbitten toes, especially after re-warming.
- Do not allow the thawed part to refreeze.
- Do not re-warm with anything other than water, otherwise you cannot control the temperature and may burn the victim.

### 7.5.2 Heat Cramps

Heat cramps are painful muscle spasms in the arms or legs. They may occur when an excessive amount of body fluid is lost through sweating.

*Signs and Symptoms*

- Severe cramping, usually affecting arms or legs.
- Abdominal cramping.
- Skin: normal temperature, but heavy perspiration.

*First Aid*

- Move victim to a cool place.
- Rest the cramping muscle.
- Give the victim a lot of cold water or sports drink.
- Do not massage the muscle.

### 7.5.3 Heat Exhaustion

Heat exhaustion results from either excessive perspiration or the inadequate replacement of water lost by sweating.

*Signs and Symptoms*

- Heavy sweating.
- Weakness.
- Fast pulse.
- Normal body temperature.

- Moist clammy skin.
- Headache, dizziness, vomiting, and nausea.

*First Aid*

- Move victim to a cool place.
- Elevate legs 8 - 12 inches.
- Cool the victim with cold packs or wet towels.
- Give the victim cold water if they are conscious.
- If no improvement in 30 minutes, seek medical attention.

### 7.5.4 Heat Stroke

Heat stroke happens when the body is subjected to more heat than it can handle.

*Signs and Symptoms*

- Dry or wet hot (>104 $^{\circ}$F) skin.
- Confused, lethargy, or unconsciousness.
- Rapid breathing and pulse.

*First Aid*

- Check the A, B, C's (Airways open, Breathing, and Circulation).
- Move victim to a cool place, remove heavy clothing.
- Elevate head and shoulders.
- Cool the victim.
- Seek medical attention immediately.

### 7.5.5 Burns

*First Aid*

First Degree

- Apply cold water until pain stops (10-30 min.) and dry sterile dressing.

Second Degree

- Proceed as first degree.
- Do not break blisters or remove tissue.
- Do not use antiseptic preparation or ointment.
- Seek medical attention.

Third Degree

- Check the A, B, C's (Airways open, Breathing and Circulation).
- Treat for shock.
- Elevate arms or legs to reduce swelling.
- Do not apply cold or ice, conserve heat to prevent hypothermia.
- Do not open any blisters.
- Apply sterile dressing.
- Do not remove melted/burned clothing.
- Seek medical attention immediately.

### 7.5.6 Chemical Burns

A chemical burn causes tissue damage and continues to cause damage until it is inactivated by the tissue, is neutralized, or is diluted with water.

*First Aid*

- Wash with copious amounts of water (acids, alkalis, caustic agents).
- Remove any contaminated clothing.
- Do not apply water under any type of pressure (pressure drives the chemicals deeper) apply water for up to 1 or more hours.
- Brush off dry chemicals before applying water.
- Flush eyes for ≥ 15 minutes with low pressure water.
- Do not attempt to neutralize a chemical, (it may create damaging heat).
- Seek medical attention immediately.

### 7.5.7 Electrical Burns

High voltage electrical currents passing through the body may disrupt the normal heart rhythm, cause cardiac arrest, burns, and other injuries. In case of an electrical burn, immediately contact emergency medical services. Then, check for multiple burn sites and cover the burns with a loose, dry, sterile dressing, and bandage. In addition, provide care for shock. Never touch a person in contact with live current unless properly protected.

*First Aid*

- Check the A, B, C's (Airways open, Breathing and Circulation).
- Treat for shock.
- Treat as heat burn.
- Seek medical attention immediately.

### 7.5.8 Shock

Shock refers to circulatory system failure, which occurs when oxygenated blood and nutrients are not provided in sufficient amounts for every body part.

*Signs and Symptoms*

- Rapid breathing and pulse.
- Pail or bluish skin, nails, and lips.
- Heavy sweating.
- Loss of consciousness in severe shock.
- Dilated pupils.
- Thirst.
- Cool and wet (clammy) skin.
- Nausea and vomiting.

*First Aid*

- Care for life threatening injuries.
- Keep victim on their back (unless stroke or head injury with no spinal injury).
- Put unconscious, semiconscious and vomiting victims on their side.
- Elevate legs 8 - 12 inches.
- Prevent loss of body heat with blankets.
- Do not give the victim food or drink, if driving a long distance they may suck on a wet cloth or towel.
- Seek medical attention.

## 7.6 RECORD OF INJURIES INCURRED ON-SITE

### 7.6.1 Occupational Injuries and Illnesses Form (OSHA 300)

Occupational injuries and illnesses that are required to be recorded under the Occupational Safety and Health Act (OSHA) will be registered on an OSHA Form 300 for each contractor (Attachment D). The Site Safety Supervisor will record occupational injuries and illnesses that occur on-site within 48 hours of occurrence.

### 7.6.2 Employer's First Report of Injury

An "Employer's First Report of Injury" form (Attachment E) will be completed by the Site Safety Supervisor for each accident involving a worker injured at the site. Follow-up procedures will include investigation of each accident or potential accident by the Site Safety Supervisor to assure that no similar accidents occur.

## 7.7 EMERGENCY SITE EVACUATION PROCEDURES

In order to mobilize the manpower resources and equipment necessary to cope with a fire or other emergency, a clear chain of authority has been established. The Site Safety Supervisor will take charge of emergency response activities and dictate the procedures that will be followed for the duration of the emergency. The Site Safety Supervisor will report immediately to the scene of the emergency, assess the seriousness of the situation, and direct whatever efforts are necessary until the emergency response units arrive. At their discretion, the Site Safety Supervisor also may order the closure of the site for an indefinite period.

Project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs, including but not limited to, fire, explosion, or significant release of toxic gas into the atmosphere, an air horn (or vehicle horn) will be sounded on the site by any of the field team members. The horn will be sounded continuously for approximately 15 seconds, signaling that immediate evacuation of personnel is necessary due to some immediate or impending danger. Heavy equipment will be shut down and personnel will evacuate the work areas and assemble at the site entrance, where the Site Safety Supervisor will give further instructions on what to do during the emergency. The field team member, who has been designated as the emergency communications officer at the site safety briefing, will attend the site telephone from the time the alarm sounds until the emergency has ended, as determined by the Site Safety Supervisor.

If a fire or toxic-gas release occurs, the Site Safety Supervisor will determine whether it is upwind of the site office/command post and whether fire/smoke or the gas poses a danger to the health and safety of those assembling at the command post. If so, those assembled at the command post will immediately report to a predetermined alternative meeting location. Incoming visitors will not be allowed to enter the site after the alarm has been sounded. Visitors and observers present in the emergency area will be instructed to leave immediately. A project team member (visitor evacuation officer) will be responsible for guiding visitors from the site.

After sounding the alarm and initiating emergency response procedures, the Site Safety Supervisor will check and verify that access roads are unobstructed. If traffic control is necessary, a field team member designated at the site safety meeting will take over these duties until local police and fire fighters arrive. Personnel involved with traffic control will wear appropriate reflective warning vests. The Site Safety Supervisor will remain at the site to provide any assistance requested by emergency-response squads as they arrive to deal with the situation.

The Site Safety Supervisor will have the authority to restrict access to the site or area until he/she deems it safe. He/she will authorize any changes in the site safety practices necessary to deal with the existing emergency or to prevent further emergencies. Field team members have been assigned the safety responsibilities identified in Table 7-2. If the designated field team member is not on-site, the Field Team Leader/Site Manager for the activities currently taking place or their designee will assume responsibility.

## Table 7-2
## Field Team Member Responsibilities

| **Title** | **Field Team Member** | **Responsibilities** |
|---|---|---|
| Site Safety Supervisor | To be named | Overall responsibility for site safety and emergency response |
| Emergency Communications Officer | To be named | Attend site telephone |
| Visitor Evacuation Officer | To be named | Guide visitors to/from work site<br>Access and security control |

## 8

# SIGNATURES OF FIELD TEAM MEMBERS AND OBSERVERS

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Field team members and site visitors will sign the form below verifying that they have completely read the HASP and agree to adhere to its guidelines. Failure to comply with this HASP may lead to dismissal from the site.

| **Name** | **Signature** |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

# A

# MATERIAL SAFETY DATA SHEETS

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

*Material Safety Data Sheets Collection:*

Sheet No. 757
Coal Tar Creosote

Issued: 7/91

## Section 1. Material Identification

**Coal Tar Creosote** (molecular formula varies with purity) **Description:** Three main derivations: by distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking. It typically contains up to 160 chemicals, mainly aromatic compounds such as phenol, pyrol and pyridine. Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, hop defoliant, and lubricant for die molds; in manufacturing chemicals; and in medicine as an antiseptic, disinfectant, antipyretic, astringent, germicide, and styptic.
**Other Designations:** CAS No. 8001-58-9, Awpa,® brick oil, Caswell No. 225,® coal tar oil, creosote, creosote oil, creosotum, cresylic creosote, heavy oil, liquid pitch oil, naphthalene oil, Preserv-o-sote,® Sakresote,® tar oil, wash oil.
**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.
**Cautions:** Flammable, liquid coal tar creosote is toxic by inhalation, ingestion, and skin contact. The IARC and NTP classify it as *a human carcinogen*.

R 1
I 4
S 4*
K 2
* Skin absorption

NFPA
2
2 0
-

HMIS
H 2
F 2
R 0
PPG†
† Sec. 8

* Skin absorption can occur with phenol, a major component of coal tar creosote.

## Section 2. Ingredients and Occupational Exposure Limits

Coal tar creosote, ca 100%

1990 OSHA PEL
8-hr TWA: 0.2 mg/m³*

1987 IDLH Level
700 mg/m³

1990-91 ACGIH TLV
TWA: 0.2 mg/m³*

1990 NIOSH REL
0.1 mg/m³ (cyclohexane extractable portion)

1985-86 Toxicity Data†
Rat, oral, $LD_{50}$: 725 mg/kg; toxic effects not yet reviewed
Dog, oral, $LD_{Lo}$: 600 mg/kg; toxic effects not yet reviewed
Rat, $TD_{Lo}$: 52,416 mg/kg administered during 91 days prior to mating produces reproductive effects on fallopian tubes and ovaries
Mouse, skin, $TD_{Lo}$: 99 g/kg produces tumors in skin and appendages

* As coal tar pitch volatiles.
† See NIOSH, *RTECS* (GF8615000), for additional mutation, reproductive, tumorigenic, and other toxicity data.

## Section 3. Physical Data

**Boiling Point:** 381 to 752 °F (194 to 400 °C)
**Distillation Range:** 446 to 554 °F (230 to 290 °C)
**Heat of Combustion:** -12,500 Btu/lb
**Heat of Vaporization:** 107 Btu/lb
**Molecular Weight:** Varies with purity
**Density/Specific Gravity:** 1.07 to 1.08 at 68 °F (20 °C)
**Water Solubility:** Slightly soluble

**Appearance and Odor:** Pure coal tar creosote is colorless, but the industrial product is a yellow to black oily liquid with an aromatic smoky smell and a burning caustic taste.

## Section 4. Fire and Explosion Data

| | | | |
|---|---|---|---|
| **Flash Point:** 165.2 °F (74 °C), CC | **Autoignition Temperature:** 637 °F (336 °C) | **LEL:** None reported | **UEL:** None reported |

**Extinguishing Media:** For small fires, use dry chemical, carbon dioxide ($CO_2$), or regular foam. For large fires, use fog or regular foam. Since water is least effective, use it as an extinguishing agent only when the preferred measures are unavailable. However, use water spray to cool fire-exposed containers.
**Unusual Fire or Explosion Hazards:** Vapors may travel to an ignition source and flash back. Containers may explode in heat of fire. Coal tar creosote presents a vapor explosion hazard indoors, outdoors, and in sewers.
**Special Fire-fighting Procedures:** Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Fully decontaminate or properly dispose of personal protective clothing.

## Section 5. Reactivity Data

**Stability/Polymerization:** Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
**Chemical Incompatibilities:** Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.
**Conditions to Avoid:** Avoid excessive heat and contact with chlorosulfonic acid.
**Hazardous Products of Decomposition:** Thermal oxidative decomposition of coal tar creosote can produce oxides of carbon and thick, black, acrid smoke.

## tion 6. Health Hazard Data

inogenicity: In 1990 reports, the IARC, NTP, and OSHA list coal tar creosote as a carcinogen.
mary of Risks: Coal tar creosote is toxic by inhalation, ingestion, and skin contact. It contains a variety of hydrocarbons such as phenol and
yclic aromatic hydrocarbons such as benzo[a]pyrene, benzanthracene, and phenol derivatives. The range of toxicity depends on the exposure
ntration, amount, and duration. Effects may include irritation, burns, and several forms of cancer.
ical Conditions Aggravated by Long-Term Exposure: Chronic respiratory or skin diseases.
et Organs: Eyes, skin, bladder, kidneys, and respiratory system.
ary Entry Routes: Inhalation, ingestion, and skin contact.
e Effects: Skin contact may cause irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and small bumps), or
. Photosensitization (worsening of rash with exposure to sunlight) may occur. Inhalation may be irritating to the respiratory tract. Eye
ct may cause conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. Ingestion may
t in nausea, vomiting, abdominal pain, rapid pulse, respiratory distress, and shock. Systemic absorption by any route (including skin
ption) may cause trouble breathing, thready (continuous or drawn out) pulse, dizziness, headache, nausea, vomiting, salivation, and
ulsions. Exposure to large doses (particularly by ingestion) may be fatal.
nic Effects: Dermatitis, skin cancer, and lung cancer.
T AID
: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical
ty. *Do not* let victim rub eyes or keep them tightly closed. Consult a physician immediately.
: *Quickly* remove contaminated clothing. Wash affected area with soap and flooding amounts of water for at least 15 min. For reddened or
red skin, consult a physician.
lation: Remove exposed person to fresh air and support breathing as needed.
stion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of
or water. *Do not induce vomiting!*
r first aid, get appropriate in-plant, paramedic, or community medical support.
to Physicians: Cresol may be detected in urine.

## tion 7. Spill, Leak, and Disposal Procedures

/Leak: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources–no flares, smoking, or
es in hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If possible with no risk, stop leak. Water
y may be used to reduce vapor but it may not prevent ignition in closed spaces. For small spills, take up with earth, sand, vermiculite, or other
rbent, noncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of liquid spill for later
osal. Follow applicable OSHA regulations (29 CFR 1910.120).
ironmental Degradation: Coal tar creosote is fouling to shoreline. Ecotoxicity values are: TL$_{50}$, goldfish (*Carassius auratus*), 3.51 ppm/24 hr
nixture of creosote and coal tar; LD$_{50}$, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Designations
d as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Material No. U051
d as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per RCRA, Sec. 3001]
A Extremely Hazardous Substance (40 CFR 355): Not listed
d as a SARA Toxic Chemical (40 CFR 372.65)
A Designations
d (as coal tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

## tion 8. Special Protection Data

gles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since
act lens use in industry is controversial, establish your own policy.
pirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if
ssary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an
A. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
er: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact. Applying a layer of petroleum jelly or lanolin castor oil
ment to the face reduces vapor contact and penetration through skin. Frequent change of protective garments is an additional protective
sure.
tilation: Provide general and local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concen-
ons below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by
rolling it at its source.(103)
ty Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
taminated Equipment: Take particular care to avoid any contamination of drains or ventilation ducts. Remove this material from your shoes
equipment. Launder contaminated clothing before wearing.
nments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking,
king, using the toilet, or applying cosmetics.

## tion 9. Special Precautions and Comments

age Requirements: Avoid physical damage to containers. Store in a cool, dry, well-ventilated area. Store coal tar creosote as close to area of
as possible to minimize transporting distance.
ineering Controls: Use engineering controls to keep airborne concentrations below the OSHA PEL. Institute a respiratory protection
gram that includes regular training, maintenance, inspection, and evaluation. Always perform synthesis and purification procedures under a
ical ventilation hood and make regular operational safety checks. Label doors to rooms where coal tar creosote is produced, used, or stored as
taining a carcinogen. Locate emergency equipment at well-marked and clearly identified stations in case emergency escape is necessary.
er Precautions: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney
s, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the
physician considers appropriate. Educate workers about coal tar creosote's carcinogenicity and proper handling procedures to avoid
e.
er Comments: Caution is in order when handling or sawing old creosote-treated lumber since it retains a considerable portion of creosote for
o 25 to 30 years.
ansportation Data (49 CFR 172.101)
T Shipping Name: Creosote
T Hazard Class: Flammable liquid
No.: UN1136
T Label: Flammable liquid

DS *Collection* References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 142, 143, 146, 148, 153, 159

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*Material Safety Data Sheets Collection:*

Sheet No. 491
**Coal Dust, Bituminous**

Issued: 5/82 Revision: A, 8/90

## ion 1: Material Identification 32

**inous Coal Dust Description:** Formed naturally from fossilized plants, coal consists of amorphous carbon with s organic and some inorganic compounds. These compounds form conjugated polyaromatic, polyunsaturated, and iturated ring structures with heterocycles containing oxygen, nitrogen, and sulfur. $C_{102}H_{78}O_{10}N_2$ has been suggested )al molecule. The chief members of the coal family are anthracite (the hardest), bituminous, and lignite (the softest). inous coal includes coal between lignites and anthracites with fixed carbon (<86%), volatile matter (>14%), calorific (>10,500 Btu/lb). Dust or particulate matter <75 µm (through 200-mesh screen) and dispersable in air is of primary it. The source of bituminous coal is through mining, handling, and pulverizing processes with coal. Used in cing coke, coal gas, water gas, and coal tar compounds; and in manufacturing fertilizers, synthetic rubber, food dyes, icides, and disinfectants.

**ifacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

**ons:** Excessive inhalation of bituminous coal dust can cause coalworkers' pneumoconiosis (CWP or "black lung"). This material nmable when exposed to heat or flame.

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H 2
F 2
R 1
PPG*
* Sec. 8

## ion 2: Ingredients and Occupational Exposure Limits

iinous coal

ximate analyses of some air-dried bituminous coals:*

| e | % Moisture | % Volatiles | % Fixed Carbon | % Ash: |
|---|---|---|---|---|
| Virginia | 1.8 | 20.4 | 72.4 | 5.4 |
| ylvania | 1.2 | 34.5 | 58.4 | 5.9 |
| is | 8.4 | 35.0 | 48.2 | 8.4 |
| ning | 11.0 | 38.6 | 40.2 | 10.2 |

OSHA PELs
:WA: 2 mg/m³ (respirable
action with <5% $SiO_2$)
: 0.1 mg/m³ (respirable
. fraction with >5% $SiO_2$)

1989-90 ACGIH TLV
TLV-TWA: 2 mg/m³ (respirable dust fraction with >5% $SiO_2$)

1988 NIOSH REL
None established

1985-86 Toxicity Data†
Rat, inhalation, $TC_{Lo}$: 6600 µg/m³ administered in intermittent 6-hr doses for 86 weeks proved an equivocal tumorigenic agent affecting the blood (lymphoma including Hodgkin's disease)

minous coals also contain trace metals, sulfur (0.4 to 3.5%), and nitrogen (0.9 to 1.5%), depending on source and type.
NIOSH, *RTECS* (GF8281000), for additional tumorigenic data.

## ion 3: Physical Data

**ific Gravity:** 1.3 to 1.6
**tiles at 25 °C:** Negligible
**Vapor Pressure at 25 °C:** Negligible
**Water Solubility:** Negligible

**arance and Odor:** Black powder; little or no odor.

## ion 4: Fire and Explosion Data

| | | | |
|---|---|---|---|
| **1 Point:** None reported | **Autoignition Temperature:*** >1114 °F (601.6 °C) (cloud)<br>>392 °F (200 °C) (layer) | **LEL:** >0.05 oz./ft³† | **UEL:** None reported |

**iguishing Media:** Nitrogen, carbon dioxide, steam, water, or ammonium biphosphate powder. A water spray can be used to cautiously wet coal dust to help prevent ignition.

**ual Fire or Explosion Hazards:** It is a fire hazard when exposed to heat or flame. Airborne coal dust is an explosion hazard.

**ial Fire-fighting Procedures:** Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece ted in the pressure-demand or positive-pressure mode and full protective gear. Avoid creating dusty conditions.

ile of 2- to 7-µm Pittsburgh coal dust heated in air at 336 °F (169 °C) can reach autoignition temperature in one hour.
smallest 20% of particulate determines ignition characteristics. Approximately 1 oz./ft³ (1,000 mg/liter) gives maximum flame energy and is the most ictive concentration. A 10- to 50-mJ spark is needed at 0 to 5% moisture, respectively, to initiate combustion in <200-mesh dust.

## tion 5: Reactivity Data

**/Polymerization:** Coal dust is fairly stable at 25 °C, but can react slowly with oxygen at room temperature. Heat accelerates the process. oal dust may retain heat and a slow heat buildup could lead to spontaneous ignition. Humid air accelerates this ignition of dry coal.

**ical Incompatibilities:** This material is incompatible with strong oxidizing agents, especially when heated.

**iitions to Avoid:** Heating coal releases combustibles by devolatization and pyrolysis.

**ırdous Products of Decomposition:** Thermal oxidative decomposition of coal dust can include oxides of carbon, nitrogen and sulfur, ally oxidized hydrocarbons, soot, and fly ash.

## Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list bituminous coal dust as a carcinogen.
Summary of Risks: Coalworkers' pneumoconiosis is the occupational disease caused by prolonged retention of abnormal amounts of dusts in the lungs. It can occur after years of excessive exposure to respirable coal dust in coal mining, handling, and processing. Since anthracite and hard coal dusts in the respirable size range have greater mass, the risk of developing pneumoconiosis diminishes as one proceeds from anthracite (hard coal) to lignite (soft coal). Respirable quartz particulate can be simultaneously present with the coal, especially in the mine. The amount of free silica in the dust produced in coal-getting operations seldom exceeds 10% by weight and is usually less than 5%. In general, coal dust is deposited in the lungs like quartz, but requires over 10 times as much for adverse effects. There are two forms of coalworkers' pneumoconiosis: simple and complicated (progressive massive fibrosis). Simple pneumoconiosis results from inhalation and retention of excessive airborne dust. Reticulin fibers form, but little collagen is generated. Complicated pneumoconiosis develops in lungs already affected by simple pneumoconiosis. Masses of fibrous tissue appear and gradually enlarge in the lung, and may eventually distort pulmonary architecture. In advanced cases, blood vessel obliteration in lungs may cause heart failure. In many cases, coalworkers' pneumoconiosis does not progress beyond the simple stage.
Medical Conditions Aggravated by Long-Term Exposure: Any individual with a chronic pulmonary disorder should protect against exposure to bituminous coal dust. Pulmonary function could ultimately be diminished.
Target Organs: Lungs.
Primary Entry Routes: Inhalation.
Acute Effects: Symptoms of inhalation of excessive amounts of coal dust include coughing, wheezing, and shortness of breath.
Chronic Effects: Chronic bronchitis and emphysema are reported to result from excessive coal dust inhalation. Individuals having rheumatoid arthritis in conjunction with simple coalworkers' pneumoconiosis may have rapidly developing lung damage (Caplan's Syndrome).
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing with artificial respiration.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: There is no specific treatment for coal workers' pneumoconiosis. Medical surveillance is essential to prevention.

## Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and remove all heat and ignition sources. Cleanup personnel should protect against dust inhalation and eye contact. Clean up coal dust in a manner that avoids dispersing particulates into the air or environment. A water spray may be used to cautiously wet down coal dust to avoid raising dust. Using nonsparking tools, collect dust in a covered metal container for reclamation or for disposal. Follow
applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-3)

## Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For 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.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the ACGIH TLV and OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(10)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
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. Special Precautions and Comments

Storage Requirements: Keep sources of heat and ignition, flammable materials, and strong oxidizing agents away from areas where coal dust may collect. Prevent static sparks. Inerting media such as powdered $CaCO_3$, rock dust laid down over coal dust on mine floor, or a nitrogen-enriched atmosphere in a coal-pulverizing machine may be desirable.
Engineering Controls: Avoid coal dust inhalation. Restrict the time that miners work in hazardous conditions. Monitor airborne dust. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Practice good personal hygiene and housekeeping procedures. Collect dust from settling areas and surfaces in a manner that avoids generating airborne dust. Design dust suppression measures into processes. Meet explosion-proof code requirements for electrical services where coal dust may be present.
Other Precautions: Perform regular chest x-ray examinations for individuals at risk. Simple pneumoconiosis is detectable by x-ray as round, irregular, 1- to 5-mm diameter "coal macules." Remove individuals diagnosed with simple pneumoconiosis from dusty environments.

### Transportation Data (49 CFR 172.101)

DOT Shipping Name: Coal, ground bituminous, sea coal, *or* coal facings
DOT Hazard Class: Flammable solid
ID No.: NA1361
DOT Label: Flammable solid
DOT Packaging Exceptions: 173.165
DOT Packaging Requirements: 173.165

*MSDS Collection* References: 2-4, 14, 38, 43, 47, 73, 89, 103, 126, 127, 134, 138, 139, 143
Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Hardies, MD; Edited by: JR Stuart, MS

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*Material Safety Data Sheets Collection:*

Sheet No. 354
Methyl Alcohol

Issued: 11/77 Revision: D, 11/91

## Section 1. Material Identification

**Methyl alcohol ($CH_3OH$) Description:** Derived from destructive distillation of wood, oxidation of hydrocarbons, or high-pressure catalytic synthesis from hydrogen and carbon dioxide or carbon monoxide. Used as a solvent in manufacturing industrial chemicals and chemical pharmaceuticals, a raw material for making formaldehyde and methyl esters, a softening agent for pyroxylin plastics, a dehydrator for natural gas, a feedstock for manufacturing synthetic proteins by continuous fermentation, an octane booster in gasoline, an extractant for animal and vegetable oils; in antifreeze for automotive radiators, air brakes, gasoline, and diesel oil; and in denaturing ethanol.
**Other Designations:** CAS No. 67-56-1, carbinol, Columbian spirits, methanol, methyl hydroxide, methylol, monohydroxymethane, pyroxylic spirit, wood alcohol, wood naphtha, wood spirit.
**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

**Cautions:** Methyl alcohol is moderately toxic by ingestion and mildly toxic by inhalation and skin absorption. It is flammable, volatile, and a dangerous fire hazard.

R 1
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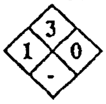
S 1*
K 4
* Skin absorption

NFPA



HMIS
H 2
F 3
R 0
PPG†
† Sec. 8

## Section 2. Ingredients and Occupational Exposure Limits

Methyl alcohol, ca 100%

**1990 OSHA PELs (Skin)**
8-hr TWA: 200 ppm (260 $mg/m^3$)
15-min STEL: 250 ppm (310 $mg/m^3$)

**1990 IDLH Level**
25,000 ppm

**1991-92 ACGIH TLVs (Skin)**
TWA: 200 ppm (262 $mg/m^3$)
STEL: 250 ppm (328 $mg/m^3$)

**1990 DFG (Germany) MAK**
200 ppm (260 $mg/m^3$)

**1990 NIOSH RELs (Skin)**
TWA: 200 ppm (260 $mg/m^3$)
Ceiling: 250 ppm (325 $mg/m^3$)

1985-86 Toxicity Data*
Human, inhalation, $TC_{Lo}$: 300 ppm caused eye (visual field change), CNS (headache), and pulmonary effects
Human, oral, $LD_{Lo}$: 428 mg/kg causes CNS (headache) and pulmonary (respiratory change) effects
Rat, oral, $TD_{Lo}$: 7500 mg/kg administered continuously to the female during the 17th to 19th day of gestation produced behavioral effects on newborns
Rat, inhalation, $TC_{Lo}$: 20,000 ppm/7 hr administered continuously to the female during the 1st to 22nd day of gestation produced specific developmental abnormalities

* See NIOSH, *RTECS* (PC1400000), for additional toxicity data.

## Section 3. Physical Data

**Boiling Point:** 148 °F (64.5 °C)
**Freezing Point:** -144.04 °F (-97.8 °C)
**Vapor Pressure:** 29 mm Hg at 68 °F (20 °C)
**Vapor Density (air = 1):** 1.11
**Viscosity:** 0.00593 P at 68 °F (20 °C)
**Molecular Weight:** 32.05
**Density:** 0.7924 at 68 °F (20 °C)
**Water Solubility:** Soluble
**Other Solubilities:** Soluble in ethanol, ether, benzene, ketones, and most organic solvents

**Appearance and Odor:** Clear, colorless, volatile liquid with a slight alcohol odor when pure, a disagreeably pungent odor when crude, and a low 10-ppm odor threshold.

## Section 4. Fire and Explosion Data

| | | | |
|---|---|---|---|
| **Flash Point:** 54 °F (12 °C), CC | **Autoignition Temperature:** 878 °F (470 °C) | **LEL:** 6% v/v | **UEL:** 36.5% v/v |

**Extinguishing Media:** For small fires, use dry chemical, carbon dioxide ($CO_2$), water spray, or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. Do not scatter material with any more water than needed to extinguish fire.
**Unusual Fire or Explosion Hazards:** Methyl alcohol is a dangerous fire hazard when exposed to heat, flame, or oxidizers. It is explosive in its vapor form when exposed to heat or flame. Vapors may travel to an ignition source and flash back.
**Special Fire-fighting Procedures:** Since 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. Also, wear full protective clothing. Structural firefighters' protective clothing is *ineffective* for fires involving methyl alcohol. If possible without risk, remove container from fire area. Apply cooling water to sides of fire-exposed container until fire is well out. Stay away from ends of tanks. Leave area immediately if you hear a rising sound from venting safety device or see any tank discoloration due to fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Methyl alcohol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
**Chemical Incompatibilities:** Methyl alcohol is incompatible with beryllium dihydride, metals (such as potassium or magnesium), oxidants (such as barium perchlorate, bromine, chlorine, hydrogen peroxide, and sodium hypochlorite), potassium tertbutoxide, carbon tetrachloride + metals; reacts explosively with chloroform + heat, and diethyl zinc; and reacts violently with alkyl aluminum salts, acetyl bromide, chloroform + sodium hydroxide, cyanuric chloride, and nitric acid.
**Conditions to Avoid:** Avoid vapor inhalation and contact with oxidizers and other incompatibles.
**Hazardous Products of Decomposition:** Thermal oxidative decomposition of methyl alcohol can produce carbon oxides (CO and $CO_2$), possible formaldehyde (HCHO) and acrid smoke, and irritating fumes.

## on 6. Health Hazard Data

rcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list methyl alcohol as a carcinogen.
mmary of Risks: Methyl alcohol is toxic mainly to the nervous system, particularly optic nerves, where damage can progress to permanent indness. Poisoning may also result in metabolic acidosis. Methyl alcohol oxidizes in the body to form formaldehyde and formic acid. These rivatives are believed responsible for many of methyl alcohol's poisonous and toxic effects. Since it is eliminated slowly from the body, methyl cohol is considered a cumulative poison. The fatal ingestion dose is 100 to 250 ml, although death is reported from less than 33 ml.
edical Conditions Aggravated by Long-Term Exposure: None reported
rget Organs: Eyes, central nervous system, skin, and digestive tract.
imary Entry Routes: Inhalation, ingestion, skin absorption.
cute effects: Inhalation can cause irritation of eyes and nose, headache, fatigue, nausea, visual impairment (optic nerve neuropathy or visual ld changes) or complete and possibly permanent blindness, acidosis, convulsions, circulatory collapse, respiratory failure, and death. Ingestion n cause gastrointestinal (GI) irritation followed by the symptoms described for inhalation and possible kidney impairment. Skin contact results a feeling of coldness, dryness, and cracking possibly leading to dermatitis. Methyl alcohol can absorb through skin and may cause headache, tigue, and visual disturbances. Eye contact causes irritation and watering of eyes, inflamed lids, and painful sensitization to light.
hronic Effects: Chronic inhalation or skin absorption may produce visual impairment or complete blindness.
RST AID
yes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical cility. Do not let victim rub or keep eyes tightly shut. Consult a physician immediately.
kin: *Quickly* remove contaminated clothing. Since methyl alcohol is volatile and flammable, carefully dispose of contaminated clothing. Rinse ith flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
halation: Remove exposed person to fresh air and support breathing as needed.
gestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious and alert* person drink 1 to 2 asses of water, then induce vomiting.
fter first aid, get appropriate in-plant, paramedic, or community medical support.
ote to Physicians: Consider administering 10% ethanol in D5W intravenously to maintain ethyl alcohol blood level at 100 mg/dl. Check formic acid urine and measure blood pH and plasma bicarbonate. After ingestion, there is typically an 18- to 48-hr latency period before clinical toxicity

## ection 7. Spill, Leak, and Disposal Procedures

pill/Leak: Notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources—no flares, smoking, or flames in zard area. Cleanup personnel should wear fully encapsulating, vapor-protective clothing for spills or leaks with no fire. Water spray may reduce apor, but not prevent ignition in closed spaces. For small spills, use nonsparking tools to take up with earth, sand, vermiculite, or other absorbent, ncombustible material and place in suitable containers for later disposal. For large spills, dike far ahead of spill and await disposal. Follow plicable OSHA regulations (29 CFR 1910.120).
vironmental Degradation: Aquatic toxicity rating: TLm 96, over 1000 ppm.
sal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

| esignations | OSHA Designations |
|---|---|
| sted as a RCRA Hazardous Waste (40 CFR 261.33): Hazardous Waste No. U154 | Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A) |
| ERCLA Hazardous Substance (40 CFR 302.4): Not listed | |
| ARA Extremely Hazardous Substance (40 CFR 355): Not listed | |
| ARA Toxic Chemical (40 CFR 372.65): Not listed | |

## ection 8. Special Protection Data

oggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since ontact lens use in industry is controversial, establish your own policy.
espirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if ecessary, wear a NIOSH-approved respirator. Select the respirator based on its suitability to provide adequate worker protection for the given orking conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, actor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
ther: Wear impervious gloves, boots, aprons, and gauntlets to prevent all skin contact.
entilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
afety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
ontaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. emove this material from your shoes and clean personal protective equipment.
omments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, moking, using the toilet, or applying cosmetics.

## ection 9. Special Precautions and Comments

torage Requirements: Avoid physical damage to containers. Store in cool, dry, well-ventilated flammables storage area, away from strong xidizers and other incompatibles. To prevent static sparks, electrically ground all equipment used in methyl alcohol storage, manufacture, and ransportation. Use nonsparking tools.
ngineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous airborne ontaminants and to maintain concentrations at the lowest practical level.
ther Precautions: Consider preplacement and periodic medical examinations of exposed workers emphasizing neurological, kidney, liver, and isual function. Practice good personal hygiene and housekeeping procedures. If respirators are used, institute a respiratory protection program hat includes regular training, maintenance, inspection, and evaluation.

### Transportation Data (49 CFR 172.101, .102)

| | |
|---|---|
| Shipping Name: Methyl alcohol | IMO Shipping Name: Methanol |
| T Hazard Class: Flammable liquid | IMO Hazard Class: 3.2 |
| D No.: UN1230 | ID No.: UN1230 |
| OT Label: Flammable liquid | IMO Label: Flammable Liquid, Poison |
| OT Packaging Exceptions: 173.118 | IMDG Packaging Group: II |
| OT Packaging Requirements: 173.119 | |

*SDS Collection* References: 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 140, 143, 146, 148, 149, 153, 159, 163
repared by: M Gannon, BA; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: AC Darlington, MD, MPH; Edited by: JR Stuart, MS

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*Material Safety Data Sheets Collection:*

Sheet No. 467
Automotive Gasoline, Lead-free

Issued: 10/81 Revision: A, 9/91

## Section 1. Material Identification

**Automotive Gasoline, Lead-free, Description:** A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.

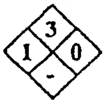
**Other Designations:** CAS No. 8006-61-9, benzin, gasoline, gasolene, motor spirits, natural gasoline, petrol.

**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

| | |
|---|---|
| R | 1 |
| I | 2 |
| S | 2* |
| K | 4 |

* Skin absorption

NFPA



HMIS

| | |
|---|---|
| H | 2 |
| F | 3 |
| R | 1 |
| PPG† | |

† Sec. 8

**Cautions:** Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

## Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

**1990 OSHA PELs**
8-hr TWA: 300 ppm, 900 mg/m$^3$
15-min STEL: 500 ppm, 1500 mg/m$^3$

**1990-91 ACGIH TLVs**
TWA: 300 ppm, 890 mg/m$^3$
STEL: 500 ppm, 1480 mg/m$^3$

**1990 NIOSH REL**
None established

**1985-86 Toxicity Data***
Man, inhalation, $TC_{Lo}$: 900 ppm/1 hr; toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)
Human, eye: 140 ppm/8 hr; toxic effects include mild irritation
Rat, inhalation, $LC_{50}$: 300 g/m$^3$/5 min

* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.
† See NIOSH, *RTECS* (LX3300000), for additional toxicity data.

## Section 3. Physical Data

**Boiling Point:** Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)

**Vapor Density (air = 1):** 3.0 to 4.0

**Density/Specific Gravity:** 0.72 to 0.76 at 60 °F (15.6 °C)

**Water Solubility:** Insoluble

**Appearance and Odor:** A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

## Section 4. Fire and Explosion Data

| | | | |
|---|---|---|---|
| **Flash Point:** -45 °F (-43 °C) | **Autoignition Temperature:** 536 to 853 °F (280 to 456 °C) | **LEL:** 1.3% v/v | **UEL:** 6.0% v/v |

**Extinguishing Media:** Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.

**Unusual Fire or Explosion Hazards:** Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.

**Special Fire-fighting Procedures:** Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Automotive gasoline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.

**Conditions to Avoid:** Avoid heat and ignition sources.

**Hazardous Products of Decomposition:** Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

## [illegible]tion 6. Health Hazard Data

**Carcinogenicity:** In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).
**Summary of Risks:** Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonitis. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.
**Medical Conditions Aggravated by Long-Term Exposure:** None reported.
**Target Organs:** Skin, eye, respiratory and central nervous systems.
**Primary Entry Routes:** Inhalation, ingestion, skin contact.
**Acute Effects:** Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonitis. Other symptoms following acute exposure include acute hemorrhage of the pancreas, fatty degeneration of the liver and kidneys, and passive congestion of spleen.
**Chronic Effects:** Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.

FIRST AID

**Eyes:** Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
**Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
**Inhalation:** Remove exposed person to fresh air and support breathing as needed.
**Ingestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.
**After first aid, get appropriate in-plant, paramedic, or community medical support.**

## Section 7. Spill, Leak, and Disposal Procedures

**Spill/Leak:** Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or [illegible]r noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).
**[illegible]atic Toxicity:** Bluegill, freshwater, $LC_{50}$, 8 ppm/96 hr.
**[illegible]posal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

## Section 8. Special Protection Data

**Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
**Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. 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.*
**Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. Note: Resistance of specific materials can vary from product to product.
**Ventilation:** Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
**Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
**Contaminated Equipment:** Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
**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. Special Precautions and Comments

**Storage Requirements:** Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.
**Engineering Controls:** Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear [illegible]n work clothing daily.

### Transportation Data (49 CFR 172.101, .102)

**DOT Shipping Name:** Gasoline (*including casing-head and natural*)
**DOT Hazard Class:** Flammable liquid
**ID No.:** UN1203
**DOT Label:** Flammable liquid
**DOT Packaging Exceptions:** 173.118
**DOT Packaging Requirements:** 173.119

**IMO Shipping Name:** Gasoline
**IMO Hazard Class:** 3.1
**ID No.:** UN1203
**IMO Label:** Flammable liquid
**IMDG Packaging Group:** II–

*MSDS Collection* References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159
Prepared by: M Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD; Edited by: JR Stuart, MS

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*Material Safety Data Sheets Collection:*

Sheet No. 468
Fuel Oil No. 1

Issued: 3/82 Revision: A, 11/90

## Section 1. Material Identification 33

**Fuel Oil No. 1 Description:** A kerosine-like mixture of petroleum hydrocarbons; a distillate of controlled sulfur content. Fuel oil no. 1 is available for home heating use.

**Other Designations:** Coal oil, heating fuel, kerosene, kerosine, range oil.

**Manufacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

**Cautions:** Fuel oil No. 1 is a skin, eye, and mucous membrane irritant and central nervous system (CNS) depressant. Ingestion may lead to *aspiration pneumonitis*. It is *flammable* when exposed to heat or flame.

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| PPG* | |

* Sec. 8

## Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 1, ca 100%

| 1989 OSHA PEL | 1990-91 ACGIH TLV | 1988 NIOSH REL | 1985-86 Toxicity Data* |
|---|---|---|---|
| None established | None established | None established | Rat, oral, $LD_{50}$: 9 g/kg; produces gastrointestinal effects (hypermotility, diarrhea) |

* Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

## Section 3. Physical Data

**Boiling Range:** 302 to 554 °F (150 to 290 °C)
**Freezing Point:** -40 °F (-40 °C)
**Vapor Pressure, 100 °F (38 °C):** ca 5
**Viscosity:** 160 centistoke at 99.5 °F (37.5 °C)
**Specific Gravity:** 0.8251 at 59 °F (15 °C)
**Water Solubility:** Insoluble
**% Volatile by Volume:** >99

**Appearance and Odor:** Light amber liquid with a mild petroleum odor.

## Section 4. Fire and Explosion Data

| Flash Point: 100 to 162 °F (43 to 72 °C) | Autoignition Temperature: 410 °F (210 °C) | LEL: 0.7% v/v | UEL: 5% v/v |
|---|---|---|---|

**Extinguishing Media:** Use dry chemcial, carbon dioxide, foam, water fog or spray. Do not use a forced water spray directly on burning oil since this scatters the fire. Use a smothering technique to extinguish fire.

**Unusual Fire or Explosion Hazards:** *Caution!* Vapors may spread to an ignition or heat source and burn with explosive violence.

**Special Fire-fighting Procedures:** Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to health and fire or explosion hazard.

## Section 5. Reactivity Data

**Stability/Polymerization:** Fuel oil no. 1 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** Fuel oil no. 1 is incompatible with strong oxidizing agents; heating greatly increases fire hazard.

**Conditions to Avoid:** Avoid heat and ignition sources.

**Hazardous Products of Decomposition:** Thermal oxidative decomposition of fuel oil no. 1 can produce carbon dioxide; incomplete combustion can produce carbon monoxide.

## Section 6. Health Hazard Data

**Carcinogenicity:** Although the IARC has not assigned an overall evaluation, it has evaluated occupational exposures in petroleum refining as IARC probable human carcinogens (Group 2A).

**Summary of Risks:** Fuel oil No. 1 is insufficiently volatile to constitute an acute inhalation hazard. Excessive inhalation of *aerosol* or *mist* can cause respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and exposure time. When removed from exposure area, affected persons usually experience complete recovery. Death may occur by asphyxiation due to

*Continue on next page*

## on 6. Health Hazard Data, *continued*

ılmonary edema and consolidation. Late lung changes are noted in survivors. The characteristic lung lesion is an acute, fulminant, hemorrhagic
onchopneumonia. Other systemic effects include heart (potentially fatal rhythm disturbances), liver, kidney, bone marrow and spleen changes.
ıe mean oral lethal dose is ~4 to 6 oz, with death occurring within 2 to 24 hr. Hemorrhaging and pulmonary edema, progressing to renal in-
ɔlvement and chemical pneumonitis, may result if vomiting occurs after ingestion, and oil is aspirated into the lungs. Death may result from as
tle as 1/2 oz, while survival is noted up to 12 oz ingested. Ingestion's systemic effect is primarily central nervous system (CNS) depression
hich may lead to coma and respiratory depression. Gastrointestinal (GI) lining irritation may cause burning of mouth, esophagus, and stomach,
well as vomiting, intestinal cramping, and blood-tinged diarrhea. Fuel oil No. 1 is irritating to skin and mucous membranes. Percutaneous ab-
ırption may be significant. Prolonged contact may cause significant skin damage (epidermal necrolysis, or scalded skin appearance). Kidney
ımage appears to occur at higher frequency after prolonged skin exposure. Eye contact with liquid or vapor may cause irritation.

**ledical Conditions Aggravated by Long-Term Exposure:** None reported.

**arget Organs:** Central nervous system, skin, and mucous membranes.

**rimary Entry Routes:** Inhalation, ingestion.

**cute Effects:** Systemic effects from ingestion include GI irritation, vomiting, diarrhea, and, in severe cases, CNS depression, progressing to
ɔma and death. Inhalation of aerosol or mists may result in increased respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark
ırplish coloration of skin and mucous membranes caused by deficient blood oxygenation).

**hronic Effects:** Repeated skin contact causes dermatitis.

**IRST AID**

**yes:** Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical
.cility. Consult a physician immediately.

**kin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body are exposed or
irritation persists, get medical help immediately. Wash affected area with soap and water.

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

**ıgestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard.
ontact a physician immediately.

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

**ote to Physicians:** Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe
ıpiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become
ɔnormal or symptoms develop, obtain a chest x-ray.

## ection 7: Spill, Leak, and Disposal Procedures

**pill/Leak:** Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof
ɛntilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards.
se a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclama-
on or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29
FR 1910.120).

**sal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**Designations**

ısted as a RCRA Hazardous Waste (40 CFR 261.21): Ignitable waste
ERCLA Hazardous Substance (40 CFR 302.4): Not listed
ARA Extremely Hazardous Substance (40 CFR 355): Not listed
ARA Toxic Chemical (40 CFR 372.65): Not listed

**SHA Designations**

.ir Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

## ection 8: Special Protection Data

**oggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

**espirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if neces-
ıry, use a NIOSH-approved respirator with mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills,
ɛactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

**ther:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Nitrile or polyvinyl alcohol gloves are recommended.

**entilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and
roductivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

**afety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

**ontaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this
ıaterial from your shoes and equipment. Launder contaminated clothing before wearing.

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

## ection 9: Special Precautions and Comments

**torage Requirements:** Use and storage conditions should be suitable for an OSHA Class II combustible liquid. Store in closed containers in a
ell-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static
parks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools
nd explosion-proof electrical equipment. No smoking in areas of storage or use.

**ngineering Controls:** Avoid prolonged skin contact and vapor or mist inhalation. Use only in a well-ventilated area and with personal protec-
ive gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal
ygiene and housekeeping procedures. Do not wear oil contaminated clothing. Do not put oily rags in pockets. When working with this material,
ear gloves or use barrier cream.

**ransportation Data (49 CFR 172.101)**

**OT Shipping Name:** Fuel oil

**Hazard Class:** Combustible liquid

**.:** NA1993

**OT Label:** None

**OT Packaging Exceptions:** 173.118a

**OT Packaging Requirements:** None

*ISDS Collection* References: 1, 6, 7, 12, 73, 84, 103, 126, 131, 132, 133, 136, 143
repared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD; Edited by: JR Stuart, MS

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*Material Safety Data Sheets Collection:*

Sheet No. 469
Fuel Oil No. 2

Issued: 10/81 Revision: A, 11/90

## Section 1. Material Identification

**Fuel Oil No. 2 Description:** A mixture of petroleum hydrocarbons; a distillate of low sulfur content. Fuel oil no. 2 resembles kerosine. Used as a general-purpose domestic or commercial fuel in atomizing-type burners; as a fuel for trucks, ships and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.

**Other Designations:** CAS No. 68476-30-2, diesel oil.

**Manufacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[(73)] for a suppliers list.

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* Sec. 8

**Cautions:** Fuel oil No. 2 is a skin irritant and central nervous system depressant with high mist concentrations. It is an environmental hazard and a dangerous fire hazard when exposed to heat, flame, or oxidizers.

## Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 2*

| 1989 OSHA PEL | 1990-91 ACGIH TLV | 1988 NIOSH REL | 1985-86 Toxicity Data† |
|---|---|---|---|
| None established | None established | None established | Rat, oral, $LD_{50}$: 9 g/kg; produces gastrointestinal effects (hypermotility, diarrhea) |

* A complex mixture (<95%) of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons; sulfur content (<0.5%); and benzene (<100 ppm). [A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)].

† Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

## Section 3. Physical Data

**Boiling Point Range:** 363 to 634 °F (184 to 334 °C)
**Viscosity:** 268 centistoke at 100 °F (37.8 °C)
**Specific Gravity:** 0.8654 at 59 °F (15 °C)
**Water Solubility:** Insoluble
**Pour Point:*** <21 °F (-6 °C)

**Appearance and Odor:** Brown, slightly viscous liquid.

*Pour point is the lowest temperature at which a liquid flows from an inverted test container.

## Section 4. Fire and Explosion Data

| | | | |
|---|---|---|---|
| **Flash Point:** 100 °F (38 °C) min. | **Autoignition Temperature:** 494 °F (257 °C) | **LEL:** 0.6% v/v | **UEL:** 7.5% v/v |

**Extinguishing Media:** Use dry chemical, carbon dioxide, foam, water fog or spray. Do not use a forced water spray directly on burning oil since this scatters the fire. Use a smothering technique to extinguish fire.

**Unusual Fire or Explosion Hazards:** Vapors may travel to an ignition source and flash back. This fuel oil's volatility is similar to gasoline's.

**Special Fire-fighting Procedures:** Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to health and fire or explosion hazard.

## Section 5. Reactivity Data

**Stability/Polymerization:** Fuel oil no. 2 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** Incompatible with strong oxidizing agents; heating greatly increases fire hazard.

**Conditions to Avoid:** Avoid heat and ignition sources.

**Hazardous Products of Decomposition:** Thermal oxidative decomposition of fuel oil no. 2 yields various hydrocarbons and hydrocarbon derivatives and partial oxidation products including carbon dioxide, carbon monoxide, and sulfur dioxide.

## ction 6. Health Hazard Data

arcinogenicity: Although it has not assigned an overall evaluation to fuel oil No. 2, the IARC has evaluated distillate (light) fuel oils as not classifiable as human carcinogen (Group 3; animal evidence limited).
Summary of Risks: Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and time of exposure. Since intestinal absorption of longer chain hydrocarbons is lower than absorption from lighter fuels, a lesser degree of systemic effects and more diarrhea may result. When removed from exposed area, affected persons usually experience complete recovery. Hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result if oil is aspirated into the lungs. These results are more likely when vomiting after ingestion rather than upon ingestion, as is often the case with lower viscosity fuels. A comparative ratio of oral-to-aspirated lethal doses may be 1 pt vs. 5 ml. Prolonged or repeated skin contact may cause irritation of the hair follicles and may block the sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.
**Medical Conditions Aggravated by Long-Term Exposure:** None reported.
**Target Organs:** Central nervous system (CNS), skin, and mucous membranes.
**Primary Entry Routes:** Inhalation, ingestion.
**Acute Effects:** Systemic effects from ingestion include gastrointestinal (GI) irritation, vomiting, diarrhea, and, in severe cases, CNS depression, progressing to coma and death. Inhalation of aerosol or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish coloration of the skin and mucous membranes caused by deficient blood oxygenation).
**Chronic Effects:** Repeated contact with the skin causes dermatitis.
**FIRST AID**
**Eyes:** Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
**Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body are exposed or if irritation persists, get medical help immediately. Wash affected area with soap and water.
**Inhalation:** Remove exposed person to fresh air and support breathing as needed.
**Ingestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Contact a physician immediately.
**After first aid, get appropriate in-plant, paramedic, or community medical support.**
**Note to Physicians:** Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

## Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Fuel oil no. 2 is an environmental hazard. Report large spills.
isposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
*A Designations*
isted as a RCRA Hazardous Waste (40 CFR 261.21): Ignitable waste
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

## Section 8. Special Protection Data

**Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
**Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with mist filter and organic vapor cartridge. 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.*
**Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
**Ventilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
**Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
**Contaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
**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. Special Precautions and Comments

**Storage Requirements:** Use and storage conditions should be suitable for an OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in areas of storage or use.
**Engineering Controls:** Avoid prolonged skin contact and vapor or mist inhalation. Use only in a well-ventilated area with personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

**Transportation Data (49 CFR 172.101)**
**DOT Shipping Name:** Fuel oil
**OT Hazard Class:** Combustible liquid
**D No.:** NA1993
**DOT Label:** None
**DOT Packaging Exceptions:** 173.118a
**DOT Packaging Requirements:** None

*MSDS Collection* References: 1, 6, 7, 12, 73, 84, 103, 126, 127, 132, 133, 136, 143
Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD; Edited by: JR Stuart, MS

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*Material Safety Data Sheets Collection:*

Sheet No. 470
Diesel Fuel Oil No. 2-D

Issued: 10/81 Revision: A, 11/90

## Section 1. Material Identification

33

**Diesel Fuel Oil No. 2-D Description:** Diesel fuel is obtained from the middle distillate in petroleum separation; a distillate oil of low sulfur content. It is composed chiefly of unbranched paraffins. Diesel fuel is available in various grades, one of which is synonymous with fuel oil No. 2-D. This diesel fuel oil requires a minimum Cetane No. (efficiency rating for diesel fuel comparable to octane number ratings for gasoline) of 40 (ASTM D613). Used as a fuel for trucks, ships, and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.

**Other Designations:** CAS No. 68334-30-5, diesel fuel.

**Manufacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

**Cautions:** Diesel fuel oil No. 2-D is a skin irritant and central nervous depressant with high mist concentrations. It is an environmental hazard and moderate fire risk.

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* Sec. 8

## Section 2. Ingredients and Occupational Exposure Limits

Diesel fuel oil No. 2-D*

| 1989 OSHA PEL | 1990-91 ACGIH TLV | 1988 NIOSH REL | 1985-86 Toxicity Data‡ |
|---|---|---|---|
| None established | Mineral Oil Mist<br>TWA: 5 $mg/m^3$†<br>STEL: 10 $mg/m^3$ | None established | Rat, oral, $LD_{50}$: 9 g/kg produces gastrointestinal (hypermotility, diarrhea) effects |

* Diesel fuel No. 2-D tends to be low in aromatics and high in paraffinics. This fuel oil is complex mixture of: 1) >95% paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, 2) sulfur (<0.5%), and 3) benzene (<100 ppm). [A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)]. Although low in the fuel itself, benzene concentrations are likely to be much higher in processing areas.

† As sampled by nonvapor-collecting method.

‡ Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

## Section 3. Physical Data

**Boiling Point Range:** 340 to 675 °F (171 to 358 °C)
**Viscosity:** 1.9 to 4.1 centistoke at 104 °F (40 °C)
**Specific Gravity:** <0.86
**Water Solubility:** Insoluble

**Appearance and Odor:** Brown, slightly viscous liquid.

## Section 4. Fire and Explosion Data

| | | | |
|---|---|---|---|
| Flash Point: 125 °F (52 °C) min. | Autoignition Temperature: >500 °F (932 °C) | LEL: 0.6% v/v | UEL: 7.5% v/v |

**Extinguishing Media:** Use dry chemical, carbon dioxide, or foam to fight fire. Use a water spray to cool fire exposed containers. Do not use a forced water spray directly on burning oil since this will scatter the fire. Use a smothering technique for extinguishing fire.

**Unusual Fire or Explosion Hazards:** Diesel fuel oil No. 2-D is a OSHA Class II combustible liquid. Its volatility is similar to that of gas oil. Vapors may travel to a source of ignition and flash back.

**Special Fire-fighting Procedures:** Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to pollution and fire or explosion hazard.

## Section 5. Reactivity Data

**Stability/Polymerization:** Diesel fuel oil No. 2-D is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** It is incompatible with strong oxidizing agents; heating greatly increases the fire hazard.

**Conditions to Avoid:** Avoid heat and ignition sources.

**Hazardous Products of Decomposition:** Thermal oxidative decomposition of diesel fuel oil No. 2-D can produce various hydrocarbons and hydrocarbon derivatives, and other partial oxidation products such as carbon dioxide, carbon monoxide, and sulfur dioxide.

## on 6. Health Hazard Data

**rcinogenicity:** Although the IARC has not assigned an overall evaluation to diesel fuels as a group, it has evaluated occupational exposures in troleum refining as an IARC probable human carcinogen (Group 2A). It has evaluated distillate (light) diesel oils as not classifiable as human rcinogens (Group 3).

**mmary of Risks:** Although diesel fuel's toxicologic effects should resemble kerosine's, they are somewhat more pronounced due to additives ch as sulfurized esters. Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, vomiting, and ss of coordination, depending on concentration and exposure time. When removed from exposure area, affected persons usually recover mpletely. If vomiting occurs after ingestion and if oil is aspirated into the lungs, hemorrhaging and pulmonary edema, progressing to renal in- lvement and chemical pneumonitis, may result. A comparative ratio of oral to aspirated lethal doses may be 1 pt vs. 5 ml. Aspiration may also sult in transient CNS depression or excitement. Secondary effects may include hypoxia (insufficient oxygen in body cells), infection, pneumato- le formation, and chronic lung dysfunction. Inhalation may result in euphoria, cardiac dysrhythmias, respiratory arrest, and CNS toxicity. olonged or repeated skin contact may irritate hair follicles and block sebaceous glands, producing a rash of acne pimples and spots, usually on ms and legs.

**edical Conditions Aggravated by Long-Term Exposure:** None reported.

**rget Organs:** Central nervous system, skin, and mucous membranes.

**imary Entry Routes:** Inhalation, ingestion.

**cute Effects:** Systemic effects from ingestion include gastrointestinal irritation, vomiting, diarrhea, and in severe cases central nervous system pression, progressing to coma or death. Inhalation of aerosols or mists may result in increased rate of respiration, tachycardia (excessively rapid art beat), and cyanosis (dark purplish discoloration of the skin and mucous membranes caused by deficient blood oxygenation).

**hronic Effects:** Repeated contact with the skin causes dermatitis.

**RST AID**

**yes:** Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical cility. Consult a physician immediately.

**in:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body have been posed or if irritation persists, get medical help immediately. Wash affected area with soap and water.

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

**gestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. ontact a physician immediately. Position to avoid aspiration.

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

**ote to Physicians:** Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe piration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become normal or symptoms develop, obtain a chest x-ray.

## ection 7. Spill, Leak, and Disposal Procedures

**pill/Leak:** Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ntilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclama- disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 1910.120). Diesel fuel oil No. 2-D spills may be environmental hazards. Report large spills.

**isposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**PA Designations**

CRA Hazardous Waste (40 CFR 261.21): Ignitable waste
ERCLA Hazardous Substance (40 CFR 302.4): Not listed
ARA Extremely Hazardous Substance (40 CFR 355): Not listed
ARA Toxic Chemical (40 CFR 372.65): Not listed

**SHA Designations**

ir Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

## ection 8. Special Protection Data

**oggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

**espirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if neces- ry, use a NIOSH-approved respirator with a mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, actor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

**ther:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

**entilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and roductivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(10)

**afety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

**ontaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this aterial from your shoes and equipment. Launder contaminated clothing before wearing.

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

## ection 9. Special Precautions and Comments

**torage Requirements:** Use and storage conditions should be suitable for a OSHA Class II combustible liquid. Store in closed containers in a ell-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static parks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools nd explosion-proof electrical equipment. No smoking in storage or use areas.

**ngineering Controls:** Avoid vapor or mist inhalation and prolonged skin contact. Wear protective rubber gloves and chemical safety glasses here contact with liquid or high mist concentration may occur. Additional suitable protective clothing may be required depending on working onditions. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good ersonal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. At least weekly laundering of work clothes is recom- ended. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

**ansportation Data (49 CFR 172.101)**

**Shipping Name:** Fuel oil
**Hazard Class:** Combustible liquid
**D No.:** NA1993
**OT Label:** None
**OT Packaging Exceptions:** 173.118a
**OT Packaging Requirements:** None

*SDS Collection* References: 1, 6, 7, 12, 73, 84, 101, 103, 126, 127, 132, 133, 136, 143, 146
repared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: AC Darlington, MD; Edited by: JR Stuart, MS

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*Material Safety Data Sheets Collection:*

Sheet No. 316
Benzene

Issued: 11/78 Revision: E, 8/90

## Section 1. Material Identification

**Benzene ($C_6H_6$) Description:** Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.
**Other Designations:** CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
**Manufacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

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S 2*
K 4
*Skin absorption

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PPG†
† Sec. 8

**Cautions:** Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

## Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, $LD_{Lo}$: 50 mg/kg; no toxic effect noted
Man, inhalation, $TC_{Lo}$: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.
‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

## Section 3. Physical Data

**Boiling Point:** 176 °F (80 °C)
**Melting Point:** 42 °F (5.5 °C)
**Vapor Pressure:** 100 mm Hg at 79 °F (26.1 °C)
**Vapor Density (Air = 1):** 2.7
**Evaporation Rate (Ether = 1):** 2.8
**Molecular Weight:** 78.11
**Specific Gravity (15 °C/4 °C):** 0.8787
**Water Solubility:** Slightly (0.180 g/100 g of $H_2O$ at 25 °C)
**%Volatile by Volume:** 100
**Viscosity:** 0.6468 mPa at 20 °C

**Appearance and Odor:** A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

## Section 4. Fire and Explosion Data

| Flash Point: 12 °F (-11.1 °C), CC | Autoignition Temperature: 928 °F (498 °C) | LEL: 1.3% v/v | UEL: 7.1% v/v |
|---|---|---|---|

**Extinguishing Media:** Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
**Unusual Fire or Explosion Hazards:** Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
**Special Fire-fighting Procedures:** Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

## Section 5. Reactivity Data

**Stability/Polymerization:** Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
**Chemical Incompatibilities:** Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
**Conditions to Avoid:** Avoid heat and ignition sources.
**Hazardous Products of Decomposition:** Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

## on 6: Health Hazard Data

**ogenicity:** The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on fficient human and animal evidence, a human carcinogen (Group 1).

**immary of Risks:** Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. ie most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level posure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.

**edical Conditions Aggravated by Long-Term Exposure:** Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.

**arget Organs:** Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.

**rimary Entry Routes:** Inhalation, skin contact.

**cute Effects:** Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, owsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a ying rash (dermatitis).

**hronic Effects:** Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) leukemia.

**IRST AID**

**yes:** Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical cility. Consult a physician immediately.

**kin:** *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered in, consult a physician. Wash affected area with soap and water.

**halation:** Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support eathing or circulation as necessary. Keep awake and transport to a medical facility.

**gestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be tal. Call a physician immediately.

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

**hysician's Note:** Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any rly indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. cute management is primarily supportive for CNS depression.

## ection 7. Spill, Leak, and Disposal Procedures

**pill/Leak:** *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary ersonnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye ontact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill nd contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined paces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).

**isposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**esignations**

as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019

isted as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]

ARA Extremely Hazardous Substance (40 CFR 355): Not listed

isted as SARA Toxic Chemical (40 CFR 372.65)

**SHA Designations**

isted as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

## ection 8. Special Protection Data

**oggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

**espirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necesary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an CBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

**ther:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

**entilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

**afety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

**ontaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this aterial from your shoes and equipment. Launder contaminated clothing before wearing.

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

## ection 9. Special Precautions and Comments

**torage Requirements:** Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and ncompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all ontainers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing enzene containers, use nonsparking tools. Keep fire extinguishers readily available.

**ngineering Controls:** Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and angers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme aution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate ersonal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. esignate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, ANCER HAZARD."

**ther Precautions:** Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

**Transportation Data (49 CFR 172.101, .102)**

**Shipping Name:** Benzene (*benzol*)
**T Hazard Class:** Flammable liquid
**D No.:** UN1114
**OT Label:** Flammable liquid
**OT Packaging Exceptions:** 173.118
**OT Packaging Requirements:** 173.119

**IMO Shipping Name:** Benzene
**IMO Hazard Class:** 3.2
**ID No.:** UN1114
**IMO Label:** Flammable liquid
**IMDG Packaging Group:** II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

*ISDS Collection* References: 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143

repared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Upfal, MD, MPH; Edited by: JR Stuart, MS

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*Material Safety Data Sheets Collection:*

Sheet No. 366
Chlorobenzene

Issued: 11/82 Revision: B, 11/90

## Section 1. Material Identification

33

**Chlorobenzene ($C_6H_5Cl$) Description:** Produced by chlorinating benzene in the presence of a catalyst. Used in dry cleaning; as a solvent in manufacturing paints, adhesives, polishes, waxes, diisocyanates, natural rubber, and pharmaceuticals; a chemical intermediate for phenol, *o*-, and *p*-chloronitrobenzene, DDT, and aniline; and an intermediate in manufacturing dyestuffs.

**Other Designations:** CAS No. 0108-90-7, benzene chloride; chlorobenzol; MCB; monochlorobenzene; phenyl chloride.

**Manufacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

**Cautions:** Chlorobenzene is a skin and mucous membrane irritant, a fairly strong narcotic, and a central nervous system (CNS) depressant. Chronic inhalation may cause *lung, liver, and kidney damage.* This material is a dangerous fire hazard when exposed to heat or flame.

R 1
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K - 3

NFPA

HMIS
H 2
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PPG*
* Sec. 8

## Section 2. Ingredients and Occupational Exposure Limits

Chlorobenzene, ca 100%

| 1989 OSHA PEL | 1990-91 ACGIH TLV* | 1988 NIOSH REL | 1985-86 Toxicity Data† |
|---|---|---|---|
| 8-hr TWA: 75 ppm, 350 mg/m$^3$ | TWA: 75 ppm, 345 mg/m$^3$ | None established | Rat, oral, $LD_{50}$: 2910 mg/kg; toxic effects not yet reviewed<br>Rat, inhalation, $TC_{Lo}$: 210 ppm administered for 6 hr to a 6- to 15-day pregnant female produces specific developmental abnormalities |
| **1987 IDLH Level**<br>2400 ppm | | | |

* In its "Notice of Intended Changes (for 1990-91)," the ACGIH lists a proposed lower level TWA for chlorobenzene: 10 ppm, 46 mg/m$^3$.(154)

†See NIOSH, *RTECS* (CZ0175000), for additional mutative, reproductive, and toxicity data.

## Section 3. Physical Data

**Boiling Point:** 270 °F (132 °C) at 760 mm Hg

**Melting Point:** -50.1 °F (-45.6 °C)

**Vapor Pressure:** 11.8 mm Hg at 77 °F (25 °C)

**Vapor Density (Air = 1):** 3.88

**Viscosity:** 0.790 centipoise at 70 °F (21 °C)

**Molecular Weight:** 112.56

**Specific Gravity (20 °C/4 °C):** 1.1058

**Water Solubility:** Insoluble

**Appearance and Odor:** A clear, colorless, volatile liquid with a faint, almond-like odor. Threshold odor concentration: 100% recognition, 0.21 ppm.

## Section 4. Fire and Explosion Data

**Flash Point:** 85 °F (29.5 °C), CC

**Autoignition Temperature:** 1180 °F (638 °C)

**LEL:** 1.8% v/v

**UEL:** 9.6% v/v

**Extinguishing Media:** Use carbon dioxide, dry chemical, halon, water spray, or standard foam to extinguish fires involving chlorobenzene. Use water in flooding quantities as fog since solid streams of water may spread fire. Apply water spray from as far as possible to cool fire-exposed containers.

**Unusual Fire or Explosion Hazards:** Chlorobenzene is dangerous when exposed to heat or flame. Vapor may travel to an ignition source and flash back.

**Special Fire-fighting Procedures:** Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Do not extinguish fire unless flow can be stopped. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Chlorobenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** Chlorobenzene is incompatible with strong oxidizers; contact may cause fires and explosions. It reacts violently with dimethyl sulfoxide. Silver perchlorate forms a solvated, shock-sensitive salt with chlorobenzene (explosion). Chlorobenzene is potentially explosive with powdered sodium or phosphorus trichloride + sodium.

**Conditions to Avoid:** Avoid all heat and ignition sources and incompatible materials.

**Hazardous Products of Decomposition:** Thermal oxidative decomposition products of chlorobenzene can include soot, hydrogen chloride, phosgene, and carbon monoxide.

## ction 6: Health Hazard Data

**rcinogenicity:** The NTP, IARC, and OSHA do not list chlorobenzene as a carcinogen.
**mmary of Risks:** Chlorobenzene is a fairly strong narcotic and can cause central nervous system (CNS) depression. Overexposure is irritating the eyes, nasal passages, and upper respiratory tract. It is moderately toxic by inhalation or ingestion and can be absorbed slowly through the in. Short exposures to liquid may cause skin irritation and defatting, while prolonged or repeated skin contact may result in dermatitis or skin ms. Following absorption of toxic doses, liver and kidney degeneration are also observed. Chlorobenzene may also cause hemolysis.
**edical Conditions Aggravated by Long-Term Exposure:** Individuals with skin, liver, kidney, or chronic respiratory disease may be at creased risk from exposure.
**rget Organs:** Respiratory system, eyes, skin, central nervous system, and liver.
**imary Entry Routes:** Inhalation, ingestion, eye and skin contact.
**ute Effects:** Symptoms to be expected from acute exposure are headache, eye and upper respiratory tract irritation, dizziness, drowsiness, anosis, spastic contractions of extremities, and loss of consciousness, depending on the exposure's concentration and duration. Symptoms of gestion include pallor, cyanosis, and coma, followed by complete recovery.
**ronic Effects:** Frequently repeated contact with chlorobenzene may result in skin burns, eye and upper respiratory tract irritation, headaches, zziness, somnolence, and dyspeptic disorders (indigestion). Chronic inhalation may result in lung, liver, and kidney damage.
RST AID
**yes:** Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical cility. Consult a physician immediately.
**in:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a ysician. Wash affected area with soap and water.
**halation:** Remove exposed person to fresh air and support breathing as needed.
**gestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of ater. Consult a physician immediately. If vomiting occurs, administer more water.
**fter first aid, get appropriate in-plant, paramedic, or community medical support.**
**ote to Physicians:** In a *conscious* patient, attempt to induce vomiting with Syrup of Ipecac. Consider activated charcoal cathartic. Administer arcoal slurry with saline, water, or sorbitol. In an *unconscious* patient, do gastric lavage with suction.

## ection 7: Spill, Leak, and Disposal Procedures

**ill/Leak:** *Design and practice a chlorobenzene spill control and counter measure plan (SCCP).* Notify safety personnel, evacuate all unnecesry personnel, eliminate all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect ainst vapor inhalation and contact with liquid. Take up spilled material with a noncombustible absorbent material and place into containers for sposal. For large spills, dike far ahead of spill to contain. Do not release runoff to sewers or waterways since chlorobenzene is harmful to aquatic e in very low concentrations. Aquatic toxicity: A 20-ppm concentration of chlorobenzene administered to bluegill in fresh water during a 96-hr st period is the median tolerance limit (TLm) at which 50% of the aquatic organisms survive. Follow applicable OSHA regulations (29 CFR 10.120).
**sal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Designations
sted as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U037
ERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 100 lb (45.4 kg) [* per Clean Water Act, Sec. 311(b)(4), Sec. 307(a), and per RCRA, Sec. 3001]
ARA Extremely Hazardous Substance (40 CFR 355): Not listed
isted as a SARA Toxic Chemical (40 CFR 372.65)
SHA Designations
isted as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

## ection 8: Special Protection Data

**oggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
**espirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necesry, wear a NIOSH-approved respirator. Use an organic vapor-acid gas respirator where appropriate. For emergency or nonroutine operations leaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient tmospheres.*
**ther:** Wear impervious gloves, boots, aprons, and gauntlets (polyvinyl alcohol is recommended) to prevent prolonged or repeated skin contact.
**entilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and CGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its urce.(103)
**afety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
**ontaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this aterial from your shoes and equipment. Launder contaminated clothing before wearing.
**omments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, noking, using the toilet, or applying cosmetics.

## ection 9: Special Precautions and Comments

**torage Requirements:** Store in tightly closed containers in a well-ventilated, fire-resistant area away from heat and ignition sources and xidizing agents. Outside or detached storage is preferred. Storage and handling must be suitable for an OSHA Class IC flammable liquid. To revent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in producon and storage areas. Protect containers from physical damage.
**ngineering Controls:** Avoid vapor inhalation and contact with liquid. Use only with adequate ventilation and appropriate personal protective ear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal ygiene and housekeeping procedures.
**ther Precautions:** Provide a preplacement questionnaire that emphasizes detecting a history of skin, liver, kidney, or chronic respiratory isease.

### Transportation Data (49 CFR 172.101, .102)

| | |
|---|---|
| **Shipping Name:** Chlorobenzene | **IMO Shipping Name:** Chlorobenzene |
| **T Hazard Class:** Flammable liquid | **IMO Hazard Class:** 3.3 |
| **D No.:** UN1134 | **ID No.:** UN1134 |
| **OT Label:** Flammable liquid | **IMO Label:** Flammable liquid |
| **OT Packaging Exceptions:** 173.118 | **IMDG Packaging Group:** II |
| **OT Packaging Requirements:** 173.119 | |

*SDS Collection* References: 38, 73, 84, 85, 89, 100, 101, 103, 124, 126, 131, 132, 133, 136, 138, 139, 140, 143, 146, 148
repared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: AC Darlington, MD; Edited by: JR Stuart, MS

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*Material Safety Data Sheets Collection:*

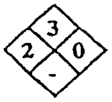
Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

## Section 1. Material Identification

**Ethylbenzene** ($C_6H_5C_2H_5$) **Description:** Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.
**Other Designations:** CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.
**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA


HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

**Cautions:** Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

## Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta & para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

**1991 OSHA PELs**
8-hr TWA: 100 ppm (435 mg/$m^3$)
15-min STEL: 125 ppm (545 mg/$m^3$)
Action Level: 50 ppm (217 mg/$m^3$)

**1990 IDLH Level**
2000 ppm

**1990 NIOSH REL**
TWA: 100 ppm (435 mg/$m^3$)
STEL: 125 ppm (545 mg/$m^3$)

**1992-93 ACGIH TLVs**
TWA: 100 ppm (434 mg/$m^3$)
STEL: 125 ppm (545 mg/$m^3$)

**1990 DFG (Germany) MAK**
TWA: 100 ppm (440 mg/$m^3$)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

**1985-86 Toxicity Data***
Human, inhalation, $TC_{Lo}$: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, $LD_{50}$: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, $TC_{Lo}$: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.(179)

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

## Section 3. Physical Data

**Boiling Point:** 277 °F (136 °C)
**Melting Point:** -139 °F (-95 °C)
**Surface Tension:** 31.5 dyne/cm
**Ionization Potential:** 8.76 eV
**Viscosity:** 0.64 cP at 77 °F (25 °C)
**Refraction Index:** 1.4959 at 68 °F (20 °C)
**Relative Evaporation Rate (ether = 1):** 0.0106
**Bulk Density:** 7.21 lb/Gal at 77 °F (25 °C)
**Critical Temperature:** 651 °F (343.9 °C)
**Critical Pressure:** 35.6 atm
**Molecular Weight:** 106.16
**Density:** 0.863 at 77 °F (25 °C)
**Water Solubility:** Slightly, 14 mg/100 mL at 59 °F (15 °C)
**Other Solubilities:** Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
**Odor Threshold:** 2.3 ppm
**Vapor Pressure:** 7.1 mm Hg at 68 °F (20 °C): 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
**Saturated Vapor Density (Air = 0.075 lb/$ft^3$ or 1.2 kg/$m^3$):** 0.0768 lb/$ft^3$ or 1.2298 kg/$m^3$

**Appearance and Odor:** Colorless, flammable liquid with a pungent odor.

## Section 4. Fire and Explosion Data

| | | | |
|---|---|---|---|
| **Flash Point:** 64 °F (18 °C) CC | **Autoignition Temperature:** 810 °F (432 °C) | **LEL:** 1.0% v/v | **UEL:** 6.7% v/v |

**Extinguishing Media:** Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** 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. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
**Chemical Incompatibilities:** Reacts vigorously with oxidizers.
**Conditions to Avoid:** Exposure to heat and oxidizers.
**Hazardous Products of Decomposition:** Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

## Section 6. Health Hazard Data

**Carcinogenicity:** The IARC,(164) NTP,(169) and OSHA(164) do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat $LD_{50}$, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

*Continue on next page*

## [illegible]ion 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive irway disease). Target Organs: Eyes, respiratory system, skin, CNS, blood. Primary Entry Routes: Inhalation, skin and eye contact. Acute Effects: Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed apidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was ntolerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. Skin exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 mg/cm$^2$/hr. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr bsorbed 118 & 215.7 μg/cm$^2$/hr, respectively. Chronic Effects: Repeated skin contact may cause dryness, scaling, and fissuring. Workers hronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor nhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

FIRST AID

Eyes: *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: *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. Inhalation: Remove exposed person to fresh air and support breathing as needed. Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water o dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface ension will cause it to spread over a large area of the lung tissue.

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

Note to Physicians: BEI = mandelic acid in urine (1.5 g/g of creatinine), sample at end of shift at workweeks end. Since this test is not specific, est for EB in expired air for confirmation.

## Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible mateial and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). Environmental Transport: If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. Ecotoxicity Values: Shrimp (*Mysidopsis bahia*), $LC_{50}$ = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) $LC_{50}$ = 275 mg/L/96 hr; fathead minnow *Pimephales promelas*) $LC_{50}$ = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. Disposal: A candidate for rotary kiln incineration at [illegible] to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F [illegible] to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

## Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. Respirator: Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. 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 respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. Other: Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. Contaminated Equipment: Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. 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. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from ignition sources and oxidizers. Outside or detatched storage is preferred. If inside, store in a standard flammable liquids cabinet. Containers should have flame-arrester or pressure-vacuum venting. To prevent static sparks, electrically ground and bond all equipment used with ethylbenzene. Install Class 1, Group D electrical equipment. Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain levels as low as possible. Purge and ventilate reaction vessels before workers are allowed to enter for maintenance or cleanup. Administrative Controls: Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, skin, blood, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene
DOT Hazard Class: 3
ID No.: UN1175
DOT Packing Group: II
DOT Label: Flammable liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60 L
Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: —

*MSDS Collection* References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179
Prepared by: M Gannon, BA; Industrial Hygiene Review: D Wilson, CIH; Medical Review: W Silverman, MD

# aterial Safety Data Sheet
om Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 439

NITROBENZENE
(Revision A)
Issued: July 1980
Revised: April 1989

## SECTION 1. MATERIAL IDENTIFICATION 28

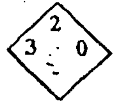
**Material:** NITROBENZENE

**Description (Origin/Uses):** Prepared by treating benzene with a mixture of nitric acid ($HNO_3$) and sulfuric acid ($H_2SO_4$). Used as an intermediate in the manufacture of aniline and benzidine; also used in some shoe and metal polishes.

**Other Designations:** Nitrobenzol; Essence of Mirbane; Oil of Mirbane; $C_6H_5NO_2$; CAS No. 0098-95-3

**Manufacturer:** Contact your supplier or distributor. Consult the latest edition of *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

**Comments:** Simultaneous exposure to ethanol aggravates the poisonous effects of exposure to nitrobenzene. Workers must not drink alcoholic beverages before or after their shifts.



NFPA

| | | | |
|---|---|---|---|
| HMIS | | R | 1 |
| H | 3 | I | 4 |
| F | 2 | S | 2† |
| R | 0 | K | 2 |
| PPG* | | †Absorption risk is high | |
| *See sect. 8 | | | |

## SECTION 2. INGREDIENTS AND OCCUPATIONAL EXPOSURE LIMITS

Nitrobenzene, ca 100%

| OSHA PEL (Skin*) | ACGIH TLV (Skin*), 1988-89 | Toxicity Data† |
|---|---|---|
| 8-hr TWA: 1 ppm, 5 mg/m$^3$ | TLV-TWA: 1 ppm, 5 mg/m$^3$ | Woman, Oral, $TD_{Lo}$: 200 mg/kg<br>Rat, Oral, $LD_{50}$: 640 mg/kg |

*This material can be absorbed through intact skin, which contributes to overall exposure.

†See NIOSH, *RTECS* (DA6475000), for additional data with references to irritative, reproductive, and mutagenic effects.

## SECTION 3. PHYSICAL DATA

| | |
|---|---|
| **Boiling Point:** 410 °F (210 °C) | **Molecular Weight:** 123 g/mol |
| **elting Point:** 42.8 °F (6 °C) | **Solubility in Water (%):** Slight |
| **apor Density (Air = 1):** 4.25 | **Specific Gravity ($H_2O$ = 1):** 1.205 at 59 °F (15 °C) |
| **apor Pressure:** <1 Torr | |

**Appearance and Odor:** A colorless to pale yellow oily liquid or bright yellow solid crystals; a distinctive odor of volatile almond oil. Its identification threshold is 4.7 parts per billion (ppb).

## SECTION 4. FIRE AND EXPLOSION DATA

| | | | |
|---|---|---|---|
| **Flash Point:** 190 °F (88 °C) CC | **Autoignition Temperature:** 900 °F (482 °C) | **LEL:** 1.8% v/v | **UEL:** Not Found |

**Extinguishing Media:** Use dry chemical, "alcohol" foam, carbon dioxide ($CO_2$), or a water spray to put out fires involving nitrobenzene. Water spray can be used to disperse vapor, to cool fire-exposed containers, and to flush nonignited spills or vapor away from sensitive exposures such as incompatible chemicals or sources of ignition. **Unusual Fire or Explosion Hazards:** Nitrobenzene vapor is more than 4 times heavier than air (see sect. 3); it can flow along surfaces, collect in low-lying, confined areas, reach a distant source of ignition, and flash back to its source. This vapor can easily form an explosive mixture with air, especially if the nitrobenzene is heated (heating will cause more nitrobenzene vapor to be given off). **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

## SECTION 5. REACTIVITY DATA

**Stability/Polymerization:** Nitrobenzene is stable in closed containers during routine operations at room temperature. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Nitrobenzene is an oxidizing agent that can react dangerously with reducing agents such as nitric acid ($HNO_3$); phenol ($C_6H_5OH$) and aluminum chloride ($AlCl_3$); aniline and glycerine; silver perchlorate ($AgClO_4$); dinitrogen tetroxide ($N_2O_4$); caustics; and reactive metals such as tin or zinc. **Conditions to Avoid:** Prevent exposure to sources of heat and ignition or to incompatible chemicals. **Hazardous Products of Decomposition:** Thermal oxidative degradation of nitrobenzene can produce toxic gases such as carbon monoxide (CO) and oxides of nitrogen ($NO_x$).

## SECTION 6. HEALTH HAZARD INFORMATION

**Carcinogenicity:** Nitrobenzene is not listed as a carcinogen by the NTP, IARC, or OSHA.

**Summary of Risks:** Nitrobenzene is a deadly poison that can be rapidly absorbed through intact skin. It reacts with hemoglobin in the blood to form methemoglobin, which seriously depletes the blood's oxygen-carrying capacity. The onset of even potentially fatal methemoglobinemia is insidious; severe symptoms can be delayed for up to 4 hours. The exposed person may feel well and have no complaints; he r she may exhibit signs of cyanosis such as blue lips, nose, and ears, which are noticeable but not uncomfortable; headache is commonly he first symptom of intoxication and may become more intense as the condition progresses. Workers can be exposed to dangerous levels of this poison without immediately discernible health effects. Cyanosis, anemia, and deleterious effects on the central nervous system (CNS) and the cardiovascular system (CVS) can develop following significant occupational exposure to nitrobenzene. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of the heart, liver, and blood. **Target Organs:** Skin, eyes, blood, liver, kidneys, testicles, and CVS. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** Symptoms of occupational exposure to nitrobenzene include headache, vertigo, vomiting, nausea, dizziness, anemia, atoxia, shortness of breath, rapid pulse, and irritation of the skin and eyes. Coma and death may ensue. **Chronic Effects:** Chronic exposure produces a reversible anemia. *(cont'd.)*

## SECTION 6. HEALTH HAZARD INFORMATION, continued

**FIRST AID:** Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. Skin. Completely remove nitrobenzene from the exposed person's body. Immediately remove all clothing and wash the entire body from head to foot with soap and water. Pay special attention to the ear canals, fingernails, toenails, hair, and scalp because they are sources of continuing absorption of this poison. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen to alleviate the headache and general sense of weakness that characterize nitrobenzene intoxication. Keep exposed person warm and at rest until medical help is available. Ingestion. Unlikely. If accidental ingestion should occur, have the exposed person drink 1 to 2 glasses of water, then induce vomiting. **Comments:** Do not expose workers with existing heart, liver, or blood disorders to nitrobenzene. Screen prospective employees by testing them for hypersensitivity to hemolytic chemicals such as nitrobenzene. Alcohol ingestion and a heated environment may increase susceptibility. Instruct employees on methemoglobinemia signs and symptoms. Get in-plant, paramedic, or community medical help for all exposures. Seek prompt medical assistance for further treatment and support after first aid. **Physician's Note:** Determine the methemoglobin concentration in the blood; repeat this test hourly for at least 24 hr until a definite decline is noted. Repeat thorough skin cleaning if the methemoglobin level rises after 3 or 4 hr. Patients usually return to normal within 24 to 48 hr if all absorption sources are eliminated. Administer oxygen, using intermittent positive-pressure breathing (IPPB) if its available.

## SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

**Spill/Leak:** *Treat accidental bulk releases of nitrobenzene as emergencies.* Prior planning and designing of emergency response routines are necessary. Notify safety personnel, evacuate nonessential personnel, eliminate sources of heat and ignition, and provide adequate explosion-proof ventilation, particularly at floor level (see sect. 4). Cleanup personnel must wear a complete set of personal protective equipment (see sect. 8) to protect the skin and eyes against any contact with this liquid poison or inhalation of its vapor. Shovel, scoop, or vacuum the released nitrobenzene and place it into appropriate containers for disposal. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

**OSHA Designations**

Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z)

**EPA Designations**

Listed as RCRA Hazardous Waste No. U169 (40 CFR 261.33)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [*per CWA, §311(b)(4) and 307(a); and RCRA, §3001]

Listed as a SARA Extremely Hazardous Substance (40 CFR 355), Threshold Planning Quantity (TPQ): 10000 lb

Listed as a SARA Toxic Chemical* (40 CFR 372.65) [*EPA Form R may apply to your facility; see 40 CFR 372.85 for instructions]

## SECTION 8. SPECIAL PROTECTION INFORMATION

**Goggles:** Always wear protective eyeglasses or chemical safety goggles. Where splashing of nitrobenzene is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Wear a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent any contact of nitrobenzene with your skin. **Ventilation:** Install and operate general and local maximum-explosion-proof ventilation systems powerful enough to maintain airborne concentrations of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. **Comments:** The health effects of nitrobenzene are so dangerous that persons exposed to it should be periodically instructed in safe-handling procedures and in recognizing the symptoms of developing cyanosis (see sect. 6). Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in work areas. Avoid all skin contact with this liquid and inhalation of its vapor.

## SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

**Storage/Segregation:** Store nitrobenzene in closed containers in a cool, dry, well-ventilated, low fire-risk area away from incompatible chemicals (see sect. 5) and sources of heat or ignition. Protect these containers from physical damage; shield them from direct sunlight. **Engineering Controls:** Electrically ground and bond all containers and equipment used in shipping, receiving, or sampling operations in production or storage areas to prevent static sparks.

**Transportation Data (49 CFR 172.101-2)**

**DOT Shipping Name:** Nitrobenzene, Liquid
**DOT Hazard Class:** Poison B
**DOT ID No.:** UN1662
**DOT Label:** Poison
**DOT Packaging Requirements:** 49 CFR 173.346
**DOT Packaging Exceptions:** 49 CFR 173.345

**IMO Shipping Name:** Nitrobenzene
**IMO Hazard Class:** 6.1
**IMO Label:** Poison
**IMDG Packaging Group:** II

References: 1, 6, 26, 38, 84-94, 100, 116, 118, 119, 122

Prepared by: PJ Igoe, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD

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*Material Safety Data Sheets Collection:*
**Sheet No. 317**
**Toluene**
Issued: 8/79 Revision: E, 9/92

## Section 1. Material Identification

**Toluene ($C_6H_5CH_3$) Description:** Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.
**Other Designations:** CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluol, Tolu-sol.
**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

**Cautions:** Toluene is an eye, skin, and respiratory tract irritant becoming narcotic at high centrations. Liver and kidney damage has occurred. Pregnant women chronically exposed to toluene have shown teratogenic effects. Toluene is highly flammable.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA

HMIS
H 2- Chronic effects
F 3
R 0
PPE-Sec. 8

## Section 2. Ingredients and Occupational Exposure Limits

Toluene, < 100%; may contain a small amount of benzene (~ 1%), xylene, and nonaromatic hydrocarbons.

**1991 OSHA PELs**
8-hr TWA: 100 ppm (375 mg/m$^3$)
15-min STEL: 150 ppm (560 mg/m$^3$)

**1990 IDLH Level**
2000 ppm

**1990 NIOSH RELs**
TWA: 100 ppm (375 mg/m$^3$)
STEL: 150 ppm (560 mg/m$^3$)

**1992-93 ACGIH TLV (Skin)**
TWA: 50 ppm (188 mg/m$^3$)

**1990 DFG (Germany) MAK***
TWA: 100 ppm (380 mg/m$^3$)
Half-life: 2 hr to end of shift
Category II: Substances with systemic effects
Peak Exposure Limit: 500 ppm, 30 min average value, 2/shift

**1985-86 Toxicity Data†**
Man, inhalation, $TC_{Lo}$: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, $LD_{Lo}$: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, $LD_{50}$: 5000 mg/kg
Rat, liver: 30 µmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
†See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

## Section 3. Physical Data

**Boiling Point:** 232 °F (110.6 °C)
**Melting Point:** -139 °F (-95 °C)
**Molecular Weight:** 92.15
**Density:** 0.866 at 68 °F (20/4 °C)
**Surface Tension:** 29 dyne/cm at 68 °F (20 °C)
**Viscosity:** 0.59 cP at 68 °F (20 °C)
**Refraction Index:** 1.4967 at 20 °C/D

**Water Solubility:** Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
**Other Solubilities:** Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
**Vapor Pressure:** 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
**Saturated Vapor Density** (Air = 0.075 lb/ft$^3$ or 1.2 kg/m$^3$): 0.0797 lb/ft$^3$ or 1.2755 kg/m$^3$
**Odor Threshold (range of all referenced values):** 0.021 to 69 ppm

**Appearance and Odor:** Colorless liquid with a sickly sweet odor.

## Section 4. Fire and Explosion Data

| | | | |
|---|---|---|---|
| **Flash Point:** 40 °F (4.4 °C) CC | **Autoignition Temperature:** 896 °F (480 °C) | **LEL:** 1.27% v/v | **UEL:** 7.0% v/v |

**Extinguishing Media:** Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluenes' burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

## Section 6. Health Hazard Data

**Carcinogenicity:** The IARC,[164] NTP,[169] and OSHA[164] do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm$^2$/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims; presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures, with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene

## [illegible]on 6. Health Hazard Data

**Medical Conditions Aggravated by Long-Term Exposure:** Alcoholism and CNS, kidney, skin, or liver disease. **Target Organs:** CNS, liver, kidney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesis, and vertigo progressing to narcotic coma. Death may result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, ransient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and symptoms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and alcohol intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and kidney dystrophy (wasting away). *Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend.*
**FIRST AID** Eyes: *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 an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of danger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against aspiration risk when deciding for or against gastric lavage. **Note to Physicians:** *Monitor cardiac function. If indicated, use epinephrine and other catecholamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances.* Obtain CBC, electrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: hippuric acid in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

## Section 7. Spill, Leak, and Disposal Procedures

**Spill/Leak:** Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye contact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and fluorocarbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, noncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at 10X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants and precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C), or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Blue gill, $LC_{50}$ = 17 mg/L/24 hr; shrimp (*Crangonfracis coron*), $LC_{50}$ = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), $LC_{50}$ = 36.2 mg/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes and biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals. **Disposal:** Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon absorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

[illegible] Designations
[illegible]ed as a RCRA Hazardous Waste (40 CFR 261.33): No. U220
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)]
Listed as a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

## Section 8. Special Protection Data

**Goggles:** Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** 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 < 100 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 200 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. 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:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] *Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.* **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **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. Special Precautions and Comments

**Storage Requirements:** Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static sparks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical equipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric [illegible]d thrombocyte count in cases where benzene *is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.*

### Transportation Data (49 CFR 172.101)

| | Packaging Authorizations | Quantity Limitations | Vessel Stowage Requirements |
|---|---|---|---|
| DOT Shipping Name: Toluene | a) Exceptions: 150 | a) Passenger Aircraft or Railcar: 5L | Vessel Stowage: B |
| DOT Hazard Class: 3 | b) Non-bulk Packaging: 202 | b) Cargo Aircraft Only: 60L | Other: -- |
| ID No.: UN1294 | c) Bulk Packaging: 242 | | |
| DOT Packing Group: II | | | |
| DOT Label: Flammable Liquid | | | |
| Special Provisions (172.102): T1 | | | |

*MSDS Collection* References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
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*Material Safety Data Sheets Collection:*

Sheet No. 318
Xylene *(Mixed Isomers)*

Issued: 11/80 Revision: E, 9/92 Errata: 12/94

## Section 1. Material Identification

Xylene (Mixed Isomers) ($C_8H_{10}$) Description: The commercial product is a blend of the three isomers [*ortho*-(*o*-), *meta*-(*m*-), *para*-(*p*-)] with the largest proportion being *m*- xylene. Xylene is obtained from coal tar, toluene by transalkylation, and pseudocumene. Used in the manufacture of dyes, resins, paints, varnishes, and other organics; as a general solvent for adhesives, a cleaning agent in microscope technique; as a solvent for Canada balsam microscopy; as a fuel component; in aviation gasoline, protective coatings, sterilizing catgut, hydrogen peroxide, perfumes, insect repellants, pharmaceuticals, and the leather industry; in the production of phthalic anhydride, isophthalic, and terephthalic acids and their dimethyl esters which are used in the manufacture of polyester fibers; and as an indirect food additive as a component of adhesives. Around the home, xylene is found as vehicles in paints, paint removers, degreasing cleaners, lacquers, glues and cements and as solvent/vehicles for pesticides.

Other Designations: CAS No. 1330-20-7 [95-47-6; 108-38-3; 106-42-3 (*o*-, *m*-, *p*-isomers)], dimethylbenzene, methyltoluene, NCI-C55232, Violet 3, xylol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Xylene is an eye, skin, and mucous membrane irritant and may be narcotic in high concentrations. It is a dangerous fire hazard.

R 1
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S 2
K 3

NFPA
3
2 0
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HMIS
H 2†
F 3
R 0
PPE ‡
† Chronic Effects
‡ Sec. 8

## Section 2. Ingredients and Occupational Exposure Limits

Xylene (mixed isomers): the commercial product generally contains ~ 40% *m*-xylene; 20% each of *o*-xylene, *p*-xylene, and ethylbenzene; and small quantities of toluene. Unpurified xylene may contain pseudocumene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m$^3$)
15-min STEL: 150 ppm (655 mg/m$^3$)

1990 IDLH Level
1000 ppm

1990 NIOSH RELs
TWA: 100 ppm (435 mg/m$^3$)
STEL: 150 ppm (655 mg/m$^3$)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m$^3$)
STEL: 150 ppm (651 mg/m$^3$)
BEI (Biological Exposure Index): Methylhippuric acids in urine at end of shift: 1.5 g/g creatinine

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m$^3$)
Category II: Substances with systemic effects
Half-life: < 2 hr
Peak Exposure: 200 ppm, 30 min, average value, 4 peaks per shift

1985-86 Toxicity Data*
Human, inhalation, $TC_{Lo}$: 200 ppm produced olfaction effects, conjunctiva irritation, and other changes involving the lungs, thorax, or respiration.
Man, inhalation, $LC_{Lo}$: 10000 ppm/6 hr; toxic effects not yet reviewed.
Human, oral, $LD_{Lo}$: 50 mg/kg; no toxic effect noted.
Rat, oral, $LD_{50}$: 4300 mg/kg; toxic effect not yet reviewed.
Rat, inhalation, $LC_{50}$: 5000 ppm/4 hr; toxic effects not yet reviewed.

* See NIOSH, *RTECS* (XE2100000), for additional toxicity data.

## Section 3. Physical Data

Boiling Point Range: 279 to 284 °F (137 to 140 °C)*
Boiling Point: *ortho:* 291 °F (144 °C); *meta:* 281.8 °F (138.8 °C); *para:* 281.3 °F (138.5 °C)
Freezing Point/Melting Point: *ortho:* -13 °F (-25 °C); *meta:* -53.3 °F (- 47.4 °C); *para:* 55 to 57 °F (13 to 14 °C)
Vapor Pressure: 6.72 mm Hg at 70 °F (21 °C)
Saturated Vapor Density (Air = 1.2 kg/m$^3$): 1.23 kg/m$^3$, 0.077 lbs/ft$^3$

Appearance and Odor: Clear, sweet-smelling liquid.

Molecular Weight: 106.16
Specific Gravity: 0.864 at 20 °C/4 °C
Water Solubility: Practically insoluble
Other Solubilities: Miscible with absolute alcohol, ether, and many other organic liquids.
Octanol/Water Partition Coefficient: logKow = 3.12-3.20
Odor Threshold: 1 ppm
Viscosity: <32.6 SUS

* Materials with wider and narrower boiling ranges are commercially available.

## Section 4. Fire and Explosion Data

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|---|---|---|---|
| **Flash Point:** 63 to 77 °F (17 to 25 °C) CC | **Autoignition Temperature:** 982 °F (527 °C) (*m*-) | **LEL:** 1.1 (*m*-, *p*-); 0.9 (*o*-) | **UEL:** 7.0 (*m*-, *p*-); 6.7 (*o*-) |

**Extinguishing Media:** For small fires, use dry chemical, carbon dioxide ($CO_2$), water spray or regular foam. For large fires, use water spray, fog or regular foam. Water may be ineffective. Use water spray to cool fire-exposed containers. **Unusual Fire or Explosion Hazards:** Xylene vapors or liquid (which floats on water) may travel to an ignition source and flash back. The heat of fire may cause containers to explode and/or produce irritating or poisonous decomposition products. Xylene may present a vapor explosion hazard indoors, outdoors, or in sewers. Accumulated static electricity may occur from vapor or liquid flow sufficient to cause ignition. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide limited protection. If feasible and without risk, move containers from fire area. Otherwise, cool fire-exposed containers until well after fire is extinguished. Stay clear of tank ends. Use unmanned hose holder or monitor nozzles for massive cargo fires. If impossible, withdraw from area and let fire burn. Withdraw immediately in case of any tank discoloration or rising sound from venting safety device. Do not release runoff from fire control methods to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Xylene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Xylene is easily chlorinated, sulfonated, or nitrated. **Chemical Incompatibilities:** Incompatibilities include strong acids and oxidizers and 1,3-dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin). Xylene attacks some forms of plastics, rubber, and coatings. **Conditions to Avoid:** Avoid heat and ignition sources and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of xylene can produce carbon dioxide, carbon monoxide, and various hydrocarbon products.

## Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list xylene as a carcinogen. Summary of Risks: Xylene is an eye, mucous membrane, and respiratory tract irritant. Irritation starts at 200 ppm; severe breathing difficulties which may be delayed in onset can occur at high concentrations. It is a central nervous system (CNS) depressant and at high concentrations can cause coma. Kidney and liver damage can occur with xylene exposure. With prolonged or repeated cutaneous exposure, xylene produces a defatting dermatitis. Chronic toxicity is not well defined, but it is less toxic than benzene. Prior to the 1950s, benzene was often found as a contaminant of xylene and the effects attributed to xylene such as blood dyscrasias are questionable. Since the late 1950s, xylenes have been virtually benzene-free and blood dyscrasias have not been associated with xylenes. Chronic exposure to high concentrations of xylene in animal studies have demonstrated mild reversible decrease in red and white cell

## Section 6. Health Hazard Data, *continued*

strual irregularity was reported in association with workplace exposure to xylene perhaps due to effects on liver metabolism. Xylene crosses the human placenta, but does not appear to be teratogenic under conditions tested to date. **Medical Conditions Aggravated by Long-Term Exposure:** CNS, respiratory, eye, skin, gastrointestinal (GI), liver and kidney disorders. **Target Organs:** CNS, eyes, GI tract, liver, kidneys, and skin. **Primary Entry Routes:** Inhalation, skin absorption (slight), eye contact, ingestion. **Acute Effects:** Inhalation of high xylene concentrations may cause dizziness; nausea, vomiting, and abdominal pain; eye, nose, and throat irritation; respiratory tract irritation leading to pulmonary edema (fluid in lung); drowsiness; and unconsciousness. Direct eye contact can result in conjunctivitis and corneal burns. Ingestion may cause a burning sensation in the oropharynx and stomach and transient CNS depression. **Chronic Effects:** Repeated or prolonged skin contact may cause drying and defatting of the skin leading to dermatitis. Repeated eye exposure to high vapor concentrations may cause reversible eye damage, peripheral and central neuropathy, and liver damage. Other symptoms of chronic exposure include headache, fatigue, irritability, chronic bronchitis, and GI disturbances such as nausea, loss of appetite, and gas.

**FIRST AID** *Emergency personnel should protect against exposure.* **Eyes:** *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:** *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. Carefully dispose of contaminated clothing as it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. Monitor exposed person for respiratory distress. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, *do not induce vomiting!* If spontaneous vomiting should occur, keep exposed person's head below the hips to prevent aspiration (breathing liquid xylene into the lungs). *Aspiration of a few millimeters of xylene can cause chemical pneumonitis, pulmonary edema, and hemorrhage.* **Note to Physicians:** Hippuric acid or the ether glucuronide of *ortho*-toluic acid may be useful in diagnosis of *meta-*, *para-* and *ortho*-xylene exposure, respectively. Consider gastric lavage if a large quantity of xylene was ingested. Proceed gastric lavage with protection of the airway from aspiration; consider endotracheal intubation with inflated cuff.

## Section 7. Spill, Leak, and Disposal Procedures

**Spill/Leak:** Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and ventilate spill area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. If feasible and without undue risk, stop leak. Use appropriate foam to blanket release and suppress vapors. Water spray may reduce vapor, but does not prevent ignition in closed spaces. For small spills, absorb on paper and evaporate in appropriate exhaust hood or absorb with sand or some non-combustible absorbent and place in containers for later disposal. For large spills dike far ahead of liquid to contain. Do not allow xylene to enter a confined space such as sewers or drains. On land, dike to contain or divert to impermeable holding area. Apply water spray to control flammable vapor and remove material with pumps or vacuum equipment. On water, contain material with natural barriers, booms, or weirs; apply universal gelling agent; and use suction hoses to remove spilled material. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** Little bioconcentration is expected. Biological oxygen demand 5 (after 5 days at 20 °C): 0.64 (no stated isomer). **Ecotoxicity values:** $LD_{50}$, Goldfish, 13 mg/L/24 hr, conditions of bioassay not specified, no specific isomer. **Environmental Degradation:** In the atmosphere, xylenes degrade by reacting with photochemically produced hydroxyl radicals with a half-life ranging from 1-1.7 hr. in the summer to 10-18 hr in winter or a typical loss of 67-86% day. Xylenes are resistant to hydrolysis. **Soil Absorption/Mobility:** Xylenes have low to moderate adsorption to soil and when spilled on land, volatilize and leach into groundwater. **Disposal:** As a hydrocarbon, xylene is a good candidate for controlled incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**EPA Designations**
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U239, F003 (spent solvent)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4); per RCRA, Sec. 3001]

**OSHA Designations**
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

## Section 8. Special Protection Data

**Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** 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 >1000 ppm, use any chemical cartridge respirator with organic vapor cartridges; any powered, air-purifying respirator with organic vapor cartridges; any supplied-air respirator; or any self-contained breathing apparatus. 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.* **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. With breakthrough times > 8 hr, consider polyvinyl alcohol and fluorocarbon rubber (Viton) as materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean PPE. **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. Special Precautions and Comments

**Storage Requirements:** Store in clearly labelled, tightly closed, containers in a cool, well-ventilated place, away from strong oxidizing materials and heat and ignition sources. During transferring operations, electrically ground and bond metal containers. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Use hermetically sealed equipment, transfer xylene in enclosed systems, avoid processes associated with open evaporating surfaces, and provide sources of gas release with enclosures and local exhaust ventilation. Use Class I, Group D electrical equipment. **Administrative Controls:** Establish air and biological monitoring programs and evaluate regularly. Consider preplacement and periodic medical examinations including a complete blood count, a routine urinalysis, and liver function tests. Consider hematologic studies if there is any significant contamination of the solvent with benzene. If feasible, consider the replacement of xylene by less toxic solvents such as petrol (motor fuel) or white spirit. Before carrying out maintenance and repair work, steam and flush all equipment to remove any xylene residues.

### Transportation Data (49 CFR 172.101)

| DOT Shipping Name: Xylenes | Packaging Authorizations | Quantity Limitations | Vessel Stowage Requirements |
|---|---|---|---|
| DOT Hazard Class: 3 | a) Exceptions: 173.150 | a) Passenger, Aircraft, or Railcar: 5L | a) Vessel Stowage: B |
| ID No.: UN1307 | b) Nonbulk Packaging : 173.202 | b) Cargo Aircraft Only: 60L | b) Other: – |
| DOT Packing Group: II | c) Bulk Packaging: 173.242 | | |
| DOT Label: Flammable Liquid | | | |
| Special Provisions (172.102): T1 | | | |

*MSDS Collection* References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 176, 180.
Prepared by: MJ Wurth, BS; Industrial Hygiene Review: PA Roy, MPH, CIH; Medical Review: W Silverman, MD

# Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
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GENIUM PUBLISHING CORP.

No. 636

MESITYLENE

Issued: November 1987

## SECTION 1. MATERIAL IDENTIFICATION

24

**Material Name:** MESITYLENE

2
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-

**Description (Origin/Uses):** Used as a raw material in chemical synthesis and as an ultraviolet stabilizer.

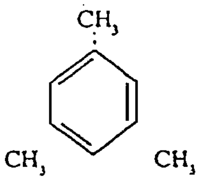
**Other Designations:** 1,3,5-Trimethylbenzene; 1,3,5-Trimethyl Benzol; TMB; *sym*-Trimethylbenzene; $C_9H_{12}$; NIOSH *RTECS* No. DC3220000; CAS No. 0108-67-8

**Manufacturer/Supplier:** Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium. ref. 73) for a list of suppliers.

HMIS
H 1
F 2
R 0
PPG*
*See sect. 8

R 1
I 3
S 2
K 2

## SECTION 2. INGREDIENTS AND HAZARDS

| SECTION 2. INGREDIENTS AND HAZARDS | % | EXPOSURE LIMITS |
|---|---|---|
| Mesitylene, CAS No. 0108-67-8<br><br>*See NIOSH, *RTECS*, for additional data. | ca 100 | ACGIH TLV, 1987-88<br>TLV-TWA: 25 ppm, 125 mg/m³<br>Toxicity Data*<br>Human, Inhalation, $TC_{Lo}$: 10 ppm |

## SECTION 3. PHYSICAL DATA

**Boiling Point:** 328.3°F (164.6°C)
**Vapor Pressure at 20°C, mm Hg:** 1.86
**Water Solubility:** Negligible
**Vapor Density (Air = 1):** 4.15
**Evaporation Rate:** Not Found

**Specific Gravity ($H_2O$ = 1):** 0.8652
**Melting Point:** -48.6°F (-44.8°C)
**% Volatile by Volume:** ca 100
**Molecular Weight:** 120.19 Grams/Mole

**Appearance and odor:** A clear, colorless liquid; peculiar aromatic odor.

## SECTION 4. FIRE AND EXPLOSION DATA

| Flash Point and Method | Autoignition Temperature | Flammability Limits in Air | LOWER | UPPER |
|---|---|---|---|---|
| 112°F (44°C) TCC | 970°F (521°C) | % by Volume (Calculated) | 1.47% | Not Found |

**Extinguishing Media:** Use dry chemical, foam, carbon dioxide, or water fog. Do not use a solid stream of water because the stream will scatter the fire and spread it. Use water spray to cool fire-exposed tanks/containers and to disperse vapors.

**Unusual Fire/Explosion Hazards:** This OSHA class II combustible liquid is a moderate fire hazard when exposed to heat, sparks, or open flame. It can react vigorously with oxidizing materials. **Warning:** When mesitylene is heated, its vapors may form explosive mixtures with air.

**Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

## SECTION 5. REACTIVITY DATA

Mesitylene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

**Chemical Incompatibilities:** Mesitylene is incompatible with strong oxidizing agents.

**Conditions to Avoid:** Prevent contact with heat, sparks, and open flame.

**Hazardous Products of Decomposition:** Thermal decomposition or burning may produce carbon dioxide and/or carbon monoxide.

## SECTION 6. HEALTH HAZARD INFORMATION

Mesitylene is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Mesitylene vapor is somewhat unpleasant and may cause irritation of the eyes, nose, and throat. Overexposure to high concentrations of vapor may cause narcosis and central nervous system depression. The liquid is irritating to the eyes and may cause irritation of the skin, especially if contact is repeated or prolonged. Warning: Aspiration of liquid into lungs can cause chemical pneumonitis.
Medical Conditions Aggravated by Long-Term Exposure: None reported. Target Organs: Central nervous system.
Primary Entry: Inhalation, skin and eye contact. Acute Effects: Central nervous system depression, skin and eye irritation.
Chronic Effects: None reported.

FIRST AID: Eye Contact. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Skin Contact. Immediately wash the affected area with soap and water. Inhalation. Remove victim to fresh air; restore and/or support his breathing as needed.
Ingestion. Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. If the victim is responsive, give him one or two glasses of milk or water to drink. Do not induce vomiting because of possible aspiration hazards.

**GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.**

## SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel of large mesitylene spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate the spill area and limit access to necessary personnel only. Remove leaking containers to a safe place, if feasible. Those involved in cleanup need protection against contact with liquid and inhalation of vapor (see sect. 8). Absorb small spills with paper toweling or vermiculite. Contain large spills and collect them, if feasible, or absorb them with an inert material such as sand, earth, or vermiculite. Place waste liquid or absorbent into closable containers for reclamation or disposal, using nonsparking tools. Water spray may be used to flush spills away from sensitive exposures. Keep waste out of sewers, watersheds, or waterways.

Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

## SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Gloves: Wear impervious gloves.
Respirator: Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. IDLH or unknown concentrations require an SCBA, full facepiece, and pressure-demand/positive-pressure modes. Warning: Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. Ventilation: Install and operate ventilation systems of sufficient power to maintain airborne levels of mesitylene below the cited exposure limit set by the ACGIH in section 2.
**Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling.
**Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Remove and launder contaminated clothing before wearing it again; clean material from shoes and equipment.
**Comments:** Practice good personal hygiene. Keep material off of your clothing and equipment. Avoid transferring material from hands to mouth while eating, drinking, or smoking.

## SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

**Storage Segregation:** Store mesitylene in closed containers in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks, and open flame.
Special Handling/Storage: Storage area must meet OSHA requirements for class II combustible liquids. Protect containers from physical damage.
**Engineering Controls in the Workplace:** All bulk storage facilities must have an explosion-proof design. Ground and bond metal containers and equipment when transferring them to prevent static sparks.
**Other Precautions:** Do not smoke in areas where this material is handled or stored. Emptied containers retain product residues; handle them accordingly!
**Transportation Data (49 CFR 172.101-2)**

DOT Shipping Name: 1,3,5-Trimethylbenzene
DOT Hazard Class: Flammable Liquid
IMO Class: 3.3
DOT ID No. UN2325
IMO Label: Flammable Liquid
DOT Label: Flammable Liquid

References: 1, 2, 5, 7, 9, 12, 37, 59, 73, 81, 82, 84-94, 103. CR/PJI

Approvals Accrocco
Indust. Hygiene/Safety
Medical Review

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*Material Safety Data Sheets Collection:*

Sheet No. 358
*o*-Dichlorobenzene

Issued: 11/77 Revision: C, 8/90

## Section 1. Material Identification

*o*-Dichlorobenzene ($C_6H_4Cl_2$) **Description:** Prepared by the chlorination of benzene or monochlorobenzene in the presence of a catalyst. Used as a solvent for waxes, gums, tars, resins, oils, and asphalts; an insecticide for locust borers and termites; a degreasing agent for metals, leather, and wool; an intermediate in manufacturing dyes; an ingredient of metal polishes; an industrial odor control; a heat transfer medium; and in removing sulfur from illuminating gas.
**Other Designations:** CAS No. 0095-50-1, DCB, 1,2-dichlorobenzene, orthodichlorobenzene.
**Manufacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 3
S 2*
K 2
* Skin absorption

NFPA
2
2 0
-

HMIS
H 2
F 2
R 0
PPG*
* Sec. 8

**Caution:** *o*-Dichlorobenzene is a local irritant, a strong central nervous system (CNS) depressant, and a liver and kidney poison.

## Section 2. Ingredients and Occupational Exposure Limits

*o*-Dichlorobenzene*

**1989 OSHA PEL**
15-min STEL (ceiling): 50 ppm, 300 mg/m$^3$

**1987 IDLH Level**
1700 ppm

**1989-90 ACGIH**
TLV-STEL (ceiling): 50 ppm, 301 mg/m$^3$

**1988 NIOSH REL**
None established

**1985-86 Toxicity Data†**
Rat, inhalation, $LC_{Lo}$: 821 ppm inhaled over 7 hr produces changes in behavior (general anesthetic), liver (hepatitis: hepatocellular necrosis, zonal) and sense organs, and special senses (tearing)
Rat, oral, $LD_{50}$: 500 mg/kg; toxic effects not yet reviewed
Rabbit, eye: 100 mg/30-s rinse produces mild irritation

* This material may contain some impurities. It is at least 85% *o*-dichlorobenzene, but may contain varying percentages of *para*- and *meta*-dichlorobenzene.
† See NIOSH, *RTECS* (CZ4500000), for additional irritative, mutative, reproductive, and toxicity data.

## Section 3. Physical Data

**Boiling Point:** 356.9 °F (180.5 °C) at 760 mm Hg
**Melting Point:** 1.4 °F (-17 °C)
**Vapor Pressure:** 1.47 mm Hg at 25 °C
**Vapor Density (Air = 1):** 5.05
**Molecular Weight:** 147.01
**Specific Gravity 20°C/4°C:** 1.3059
**Water Solubility:** Practically insoluble (137 mg/liter at 25°C)
**%Volatile by Volume:** ca 100
**Evaporation Rate (BuAc = 1):** <1
**Appearance and Odor:** A colorless liquid with a disagreeable, aromatic odor. The high and low odor thresholds are 300 and 12 mg/m$^3$; *o*-dichlorobenzene is irritating at 150 mg/m$^3$. The odor is perceptible at 2 to 4 ppm.

## Section 4. Fire and Explosion Data

**Flash Point:** 151°F (66 °C), CC
**Autoignition Temperature:** 1198 °F (648 °C)
**LEL:** 2.2% v/v
**UEL:** 9.2% v/v

**Extinguishing Media:** Extinguish fires involving this combustible material with water spray, dry chemical, foam, or carbon dioxide.
**Unusual Fire or Explosion Hazards:** Under normal working conditions, *o*-dichlorobenzene should not pose a fire hazard because of its high flash point. However, explosive mixtures may form if this material is heated or in a fire situation.
**Special Fire-fighting Procedures:** Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and a fully encapsulating suit. Use water to cool fire-exposed containers, to flush spills away from exposures, and to protect workers attempting to stop a leak. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** *o*-Dichlorobenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
**Chemical Incompatibilities:** This material can react vigorously with oxidizing materials. If *o*-dichlorobenzene is stored in sealed aluminum containers, a slow reaction with the aluminum could lead to an explosion.
**Conditions to Avoid:** Avoid heat and hot surfaces.
**Hazardous Products of Decomposition:** Thermal oxidative decomposition of *o*-dichlorobenzene can emit toxic fumes of chlorine ($Cl^-$).

## [illegible]on 6: Health Hazard Data

**[illegible]ogenicity:** The IARC does not list *o*-dichlorobenzene as a carcinogen because of inadequate human and animal evidence. However, other ›urces identify *o*-dichlorobenzene as a suspected carcinogen.[126] Experimental studies show *o*-dichlorobenzene has teratogenic, mutagenic, and :productive effects in laboratory animals.

**ummary of Risks:** This material is a skin, eye, and mucous membrane irritant. Noticeable eye irritation at 25 to 30 ppm is reported after a few .inutes' exposure; at 60- to 100-ppm exposure levels eye irritation becomes painful. Voluntary overexposure is unlikely due to good warning 'operties (odor, eye, and respiratory irritation). Excessive vapor inhalation can cause drunkenness, anesthetic effect, and central nervous system :NS) depression.

**ledical Conditions Aggravated by Long-Term Exposure:** Toxic effects can include hematological (blood) disorders and liver and kidney ımage. Leukemia has been reported, but with no definite link to *o*-dichlorobenzene.

**arget Organs:** Liver, kidneys, skin, eyes.

**rimary Entry Routes:** Inhalation, skin absorption.

**.cute Effects:** Inhalation causes nose, eye, and throat irritation. Liquid contact with skin causes irritation. Prolonged or repeated contact may ıuse blister formation. Ingestion of *o*-dichlorobenzene causes burning pain in the stomach, nausea, vomiting, and diarrhea.

**'hronic Effects:** Symptoms include headache, anorexia, nausea, vomiting, weight loss, jaundice, and cirrhosis.

**IRST AID**

**yes:** Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.

**kin:** *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.

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

**ıgestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 2 to 3 glasses of 'ater or milk to dilute. Spontaneous vomiting may occur. Position to prevent aspiration and observe for signs of breathing difficulty and change ı consciousness. Contact a physician immediately.

**hysician's Note:** There is a chemical aspiration hazard if vomiting is induced; treat symptomatically. Serum hydrocarbon levels are not linically useful since they reflect cumulative, rather than acute, exposure and may be misleading. The National Pesticide Telecommunications letwork (800-858-7378) provides 24-hr consultation to health professionals.

## ection 7: Spill, Leak, and Disposal Procedures

**pill/Leak:** Notify safety personnel, remove all heat and ignition sources, provide adequate ventilation, and evacuate all unnecessary personnel. :leanup personnel should protect against vapor inhalation and contact with skin or eyes. Contain spills by diking. Collect liquid if feasible. .bsorb small spills and residues on sand or vermiculite and place in a closed metal drum for disposal or reclamation. Follow applicable OSHA :gulations (29 CFR 1910.120).

**)isposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**:PA Designations**

.isted as a RCRA Hazardous Waste (40 CFR 261.33), No. U070

[illegible]d as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 100 lb (45.4 kg) [* per Clean Water Act, Sec. 311(b)(4) [illegible]ec. 307(a); per RCRA, Sec. 3001]

[illegible] Extremely Hazardous Substance (40 CFR 355): Not listed

.isted as a SARA Toxic Chemical (40 CFR 372.65)

**)SHA Designations**

.isted as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

## ection 8: Special Protection Data

**ioggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

**tespirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if ecessary, wear a NIOSH-approved respirator. A chemical cartridge respirator with an organic vapor cartridge and full facepiece can be used elow 1000 ppm. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-urifying respirators do not protect workers in oxygen-deficient atmospheres.*

**)ther:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Neoprene or vinyl gloves are recommended.

**'entilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and ıCGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its ource.[103]

**iafety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

**:ontaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this naterial from your shoes and equipment. Launder contaminated clothing before wearing.

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

## ection 9: Special Precautions and Comments

**itorage Requirements:** Store in closed containers in a cool, dry, well-ventilated area away from oxidizing agents and heat and ignition sources. )utside or detached storage is preferred. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all ontainers and equipment used in shipping, receiving, or transferring operations in production and storage areas.

**:ngineering Controls:** Avoid vapor inhalation and contact with eyes and skin. Use only with personal protective gear. Institute a respiratory ırotection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping ırocedures.

**)ther Precautions:** Provide a preplacement questionnaire with emphasis on detecting a history of skin, liver, or kidney disease. Such individuals nay be at an increased risk from exposure. Individuals may develop tolerance to high levels of exposure.

**Transportation Data (49 CFR 172.101, .102)**

**)OT Shipping Name:** Dichlorobenzene, ortho, liquid
**)OT Hazard Class:** ORM-A
**[illegible].:** UN1591
**[illegible]Label:** None
**[illegible]T Packaging Requirements:** 173.510
**)OT Packaging Exceptions:** 173.505

**IMO Shipping Name:** *o*-Dichlorobenzene
**IMO Hazard Class:** 6.1
**IMO Label:** St. Andrews Cross
**IMDG Packaging Group:** III
**ID No.:** UN1591

*'ISDS Collection* References: 38, 73, 84, 85, 88, 89, 100, 101, 103, 109, 124-127, 129, 132, 133-136, 138
'repared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Hardies, MD; Edited by: JR Stuart, MS

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*Material Safety Data Sheet Collection*

**Anthracene** MSDS No. 917

Date of Preparation: 6/94

## Section 1 - Chemical Product and Company Identification

**Product/Chemical Name:** Anthracene
**Chemical Formula:** $(C_6H_4CH)_2$
**CAS No.:** 120-12-7
**Synonyms:** anthracin, green oil, paranaphthalene, Tetra Olive N2G

**Derivation:** Occurs naturally in smoke (gasoline, coal, cigarette, etc.), charbroiled foods, and coal tar pitch volatiles. Obtained by distilling crude anthracene oil with alkali carbonate in iron retorts (phenanthrene is removed via carbon disulfide) *or* by salting out from crude anthracene oil and draining; the crude salts are then purified by pressing and the use of various solvents (phen-anthrene and carbazole are removed).

**General Use:** Used in chemical manufacture (phenanthrene, carbazole, anthraquinone), in calico printing; as a component of dyes, scintillation fluid, smoke screens; and in organic semi-conductor research.

**Vendors:** Consult the latest *Chemical Week Buyers' Guide.* (73)

## Section 2 - Composition / Information on Ingredients

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

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

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

## Section 3 - Hazards Identification

### ☆☆☆☆☆☆ Emergency Overview ☆☆☆☆☆☆

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

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

*Skin absorption

| HMIS | |
|---|---|
| H | 1† |
| F | 1 |
| R | 0 |

† Chronic Effects
PPE‡
‡ Sec. 8

### Potential Health Effects

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

## Section 4 - First Aid Measures

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

**[illegible]n 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.

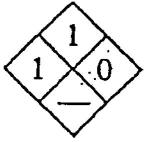
**Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. Vomiting may be spontaneous.

***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

Genium



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

## Section 6 - Accidental Release Measures

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

## Section 7 - Handling and Storage

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

## Section 8 - Exposure Controls / Personal Protection

**Engineering Controls:** To prevent static sparks, electrically ground and bond equipment used with and around anthracene. Enclosure of equipment and mechanization of processes will aid in exposure control.

**Ventilation:** Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)

**Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin.

**Respiratory Protection:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For any detectable concentration, use a SCBA or supplied-air respirator with a full facepiece and operated in pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

**Protective Clothing/Equipment:** Limit work in sunlight as much as possible to prevent photosensitization. Photoprotective creams or pastes must be applied to bare skin regions. Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyvinyl chloride is a suitable material for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

**Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

**[illegible]ntaminated Equipment:** Separate contaminated work clothes from street clothes and place in closed containers until laundered. Remove anthracene from your shoes and clean personal protective equipment.

**Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using anthracene, especially before eating, drinking, smoking, using the toilet, or applying cosmetics. Skin cleansers (ex. 55% kaolin, 25% neutral soap, 20% bran) are recommended.

## Section 9 - Physical and Chemical Properties

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

## Section 10 - Stability and Reactivity

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

## Section 11 - Toxicological Information

### Toxicity Data:*

**Skin Effects:**
Mouse, skin: 118 μg caused mild irritation.
**Mutagenicity:**
Rat, liver cell: 300 μmoL caused DNA damage.

**Acute Oral Effects:**
Mouse, oral, LD: > 17 g/kg caused fatty liver degeneration.
**Tumorigenicity:**
Rat, oral: 20 g/kg intermittently for 79 weeks caused liver tumors.

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

## Section 12 - Ecological Information

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

## Section 13 - Disposal Considerations

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

## Section 14 - Transport Information

### DOT Transportation Data (49 CFR 172.101):

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

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

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

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

* Classified as a hazardous substance when anthracene is in a quantity, in one package, which equals or exceeds the RQ of 5000 lb (2270 kg)

## Section 15 - Regulatory Information

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

## Section 16 - Other Information

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

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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

**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 | NIOSH REL | IDLH Level |
|---|---|---|
| Coal tar pitch volatiles<br>8-hr TWA: 0.2 mg/m$^3$ | 10-hr TWA: 0.1 mg/m$^3$<br>Carcinogen; coal tar pitch volatile, cyclohexane extractable fraction. | 700 mg/m$^3$<br>Coal tar pitch volatiles (benzene soluble fraction) |
| ACGIH TLVs | DFG (Germany) MAK | |
| A2: Suspected Human Carcinogen | None established | |

## 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.

**e 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.

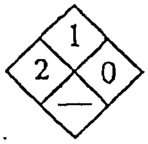
***After first aid, get appropriate in-plant, paramedic, or community medical support.***

**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.

**e-Fighting Equipment:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing paratus (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 sure they are functioning properly.

**ntilation:** 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 (*Littemia 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

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# Material Safety Data Sheet

From Genium's Reference Collection

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GENIUM PUBLISHING CORP.

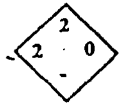
No. 624

NAPHTHALENE

Issued: November 1987

## SECTION 1. MATERIAL IDENTIFICATION 24

**Material Name:** NAPHTHALENE

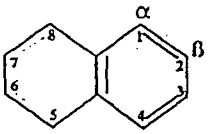


**Description (Origin/Uses):** Used as a moth repellant and in many industrial processes.

**Other Designations:** Naphthalin; Naphthene; Tar Camphor; $C_{10}H_8$;
NIOSH *RTECS* No. QJ0525000; CAS No. 0091-20-3

**Manufacturer:** Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyer's Guide* (Genium ref. 73) for a list of suppliers.

| HMIS | | | |
|---|---|---|---|
| H | 2 | | |
| F | 2 | R | 1 |
| R | 0 | I | 4 |
| PPG* | | S | 1 |
| *See sect. 8 | | K | 2 |

| SECTION 2. INGREDIENTS AND HAZARDS | % | EXPOSURE LIMITS |
|---|---|---|
| Naphthalene, CAS No. 0091-20-3  | ca 100 | IDLH* Level: 500 ppm<br>ACGIH TLVs, 1987-88<br>TLV-TWA: 10 ppm, 50 mg/m³<br>OSHA PEL<br>8-Hr TWA: 10 ppm, 50 mg/m³<br>Toxicity Data**<br>Child, Oral, $LD_{Lo}$: 100 mg/kg<br>Man, Unknown, $LD_{Lo}$: 74 mg/kg<br>Rat, Oral, $LD_{50}$: 1250 mg/kg |

*Immediately dangerous to life and health
**See NIOSH *RTECS* for additional data with references to irritative, mutagenic, reproductive, and tumorigenic effects.

## SECTION 3. PHYSICAL DATA

**Boiling Point:** 424°F (218°C)
**Vapor Density (Air = 1):** 4.4
**Vapor Pressure:** 0.087 Torr at 77°F (25°C)
**Water Solubility:** Insoluble
**Specific Gravity ($H_2O$ = 1):** 1.162 at 68°F (20°C)
**Melting Point:** 176°F (80°C)
**Molecular Weight:** 128 Grams/Mole
**% Volatile by Volume:** ca 100

**Appearance and Odor:** White crystalline flakes; strong coal tar odor.

## SECTION 4. FIRE AND EXPLOSION DATA

| Flash Point and Method | Autoignition Temperature | Flammability Limits in Air | LOWER | UPPER |
|---|---|---|---|---|
| 174°F (79°C) OC; 190°F (88°C) CC | 979°F (526°C) | % by Volume | 0.9 | 5.9 |

**Extinguishing Media:** Use water spray, dry chemical, or carbon dioxide to fight fires involving naphthalene. Caution: Foam or direct water spray applied to molten naphthalene may cause extensive foaming.

**Unusual Fire or Explosion Hazards:** Naphthalene is a volatile solid that gives off flammable vapor when heated (as in fire situations). This vapor is much denser than air and will collect in enclosed or low-lying areas like sumps. In these areas an explosive air-vapor mixture may form, and extra caution is required to prevent any ignition sources from starting an explosion or fire.

**Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

## SECTION 5. REACTIVITY DATA

Naphthalene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

**Chemical Incompatibilities:** Naphthalene is incompatible with strong oxidizing agents, chromic anhydride, and mixtures of aluminum trichloride and benzoyl chloride.

**Conditions to Avoid:** Ignition sources like open flame, unprotected heaters, excessive heat, lighted tobacco products, and electric sparks must not occur in work areas where naphthalene vapor may become concentrated.

**Hazardous Products of Decomposition:** Toxic gases like carbon monoxide are produced during fire conditions. Irritating, flammable vapor forms below the melting point because even solid naphthalene has a significant vapor pressure.

## SECTION 6. HEALTH HAZARD INFORMATION

Naphthalene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Renal shutdown (kidney failure), hemolytic effects (breakdown of red blood cells), hematuria (blood in the urine), oliguria (low volume of urine), jaundice, eye damage, and depression of the central nervous system (CNS) are the primary health concerns associated with exposure to naphthalene. The ACGIH TLVs in section 2 are set to prevent eye damage. These recommended exposure limits may not be low enough to prevent blood changes in genetically hypersensitive individuals.
Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver, and kidneys. Administer medical exams emphasizing these organs. Target Organs: Eyes, skin, kidneys, liver, blood (red blood cell effects), and CNS.
Primary Entry: Inhalation, skin contact. Acute Effects: Inhalation of naphthalene vapor causes excitement, confusion, headache, nausea, and loss of appetite. Chronic Effects: Increased incidence of cataracts.

FIRST AID

Eye Contact: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes to remove particles.
Skin Contact: Immediately wash the affected area with soap and water.
Inhalation: Remove victim to fresh air; restore and/or support his breathing as needed.
Ingestion: Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. Administer a gastric lavage followed by saline catharsis. Monitor blood and electrolytic balance. Other sources recommend giving the victim several glasses of water to drink.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

## SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all ignition sources immediately. Cleanup personnel need protection against contact and inhalation of vapor (see sect. 8). Contain large spills and collect waste. Use nonsparking tools to place naphthalene into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.
Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. U165
CERCLA Hazardous Substance, Reportable Quantity: 100 lbs (45.4 kg)

## SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines of 29 CFR 1910.133. Respirator: Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Respirator usage must be in accordance with the OSHA regulations of 29 CFR 1910.134. IDLH or unknown concentrations require an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. Warning: Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.
Other Equipment: Wear impervious gloves, boots, aprons, gauntlets, etc., as required by the specific work environment to prevent skin contact. Ventilation: Install and operate general and local maximum explosion-proof ventilation systems of sufficient power to maintain airborne levels of naphthalene below the OSHA PEL standard cited in section 2. Safety Stations: Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove and launder contaminated clothing before wearing it again; clean this material from shoes and equipment.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Keep this material off of your clothing and equipment. Avoid transferring this material from hands to mouth while eating, drinking, or smoking. Do *not* smoke, eat, or drink in any immediate work area. Avoid inhalation of vapor!

## SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation: Store naphthalene in a cool, dry, well-ventilated area away from chemical incompatibles (see sect. 5).
Special Handling/Storage: Protect containers from physical damage. All bulk storage facilities must be built with an explosion-proof design. All containers used in shipping/transferring operations must be electrically grounded to prevent static sparks. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.
Comments: All operations with naphthalene must be done carefully to prevent accidental ignition of its flammable/explosive vapor. If the weather is warm, more naphthalene vapor forms and the potential for explosion increases. Do *not* smoke in any use or storage area!

Transportation Data (49 CFR 172.101-2)
DOT Shipping Name: Naphthalene
DOT Hazard Class: ORM-A
IMO Class: 4.1
DOT ID No. UN1334
IMO Label: Flammable Solid
DOT Label: None

References: 1, 2, 12, 73, 84-94, 103. PJI

Approvals Accrocco
Indust. Hygiene/Safety
Medical Review

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*Material Safety Data Sheet Collection*

Phenanthrene MSDS No. 905

Date of Preparation: 6/94

## Section 1 - Chemical Product and Company Identification

Product/Chemical Name: Phenanthrene
Chemical Formula: $(C_6H_4CH)_2$
CAS No.: 85-01-8
Synonyms: Phenantrin
Derivation: A polynuclear aromatic hydrocarbon found as a component of coal tar pitch volatiles (products of bituminous coal distillation). Produced from toluene, bibenzil, 9-methyl fluorene or stilbene by passage through red hot tubes or by diene synthesis of 1-vinyl naphthalene and maleic anhydride.
General Use: Used in the manufacture of dyestuffs and explosives; in biological research or drug synthesis.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

## Section 2 - Composition / Information on Ingredients

Phenanthrene, ca 100 % wt

OSHA PEL*
8-hr TWA: 0.2 mg/m$^3$

ACGIH TLV*
TWA: 0.2 mg/m$^3$

NIOSH REL*
10-hr TWA: 0.1 mg/m$^3$, *cyclohexane extractable fraction*

DFG (Germany) MAK
None established

*Coal tar pitch volatiles (benzene soluble)

## Section 3 - Hazards Identification

### ☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Phenanthrene exists as shiny crystals with a faint, aromatic odor. It can cause photosensitization of the skin. Phenanthrene is combustible and reacts dangerously with oxidizers.

Wilson Risk Scale
R 1
I 3
S 3
K 1

HMIS
H 1
F 1
R 0

PPE*
*Sec. 8

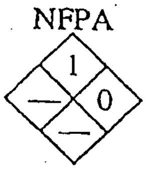
### Potential Health Effects

**Primary Entry Routes:** Skin contact.
**Target Organs:** Skin.
**Acute Effects**
**Inhalation:** Effects not reported.
**Eye:** Effects not reported.
**Skin:** Can cause photosensitization of the skin.
**Ingestion:** Effects not reported.
**Carcinogenicity:** Although it has produced skin cancer in experimental animals, the results were not statistically significant and IARC has assigned phenanthrene a Class 3 (unclassifiable as to carcinogenicity) designation. The NTP and OSHA do not list phenanthrene as a carcinogen.
**Medical Conditions Aggravated by Long-Term Exposure:** Skin disorders.
**Chronic Effects:** None reported.

## Section 4 - First Aid Measures

**Inhalation:** Remove exposed person to fresh air and support breathing as needed.
**Eye Contact:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
**Skin Contact:** *Quickly* remove contaminated clothing. Rinse exposed area with flooding amounts of water to remove loose material and then move quickly to a soap and water wash. For reddened or blistered skin, consult a physician.
**Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.
***After first aid, get appropriate in-plant, paramedic, or community medical support.***
**Note to Physicians:** Treatment is symptomatic and supportive.

## Section 5 - Fire-Fighting Measures



**Flash Point:** 340 °F (171 °C)
**Flash Point Method:** OC
**LEL:** Not reported.
**UEL:** Not reported.
**Flammability Classification:** Class IIIB Combustible liquid
**Extinguishing Media:** Use dry chemical or carbon dioxide; water spray or foam may cause frothing.
**Unusual Fire or Explosion Hazards:** None reported
**Hazardous Combustion Products:** Carbon oxides ($CO_x$) and acrid smoke
**Fire-Fighting Instructions:** Do not release runoff from fire control methods to sewers or waterways.
**Fire-Fighting Equipment:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

## Section 6 - Accidental Release Measures

**Spill /Leak Procedures:** Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against skin contact.
**Small Spills:** To avoid dust generation, *do not* sweep! Carefully scoop up or vacuum (with appropriate filter). Damp mop residue.
**Large Spills**
**Containment:** Flush large spill to containment area for later disposal. Do not release into sewers or waterways.
**Cleanup:** Mop up any residue.
**Regulatory Requirements:** Follow applicable OSHA regulations (29 CFR 1910.120).

## Section 7 - Handling and Storage

**Handling Precautions:** Use nonsparking tools to open containers.
**Storage Requirements:** Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from heat, ignition sources, and strong oxidizers.

## Section 8 - Exposure Controls / Personal Protection

**Engineering Controls:** To prevent static sparks, electrically ground and bond all equipment used with and around phenanthrene.
**Ventilation:** Provide general or local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103)
**Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on the skin.
**Respiratory Protection:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. The following respirator recommendation is for *coal-tar pitch volatiles*: For any detectable concentration, use a SCBA or supplied-air respirator (with auxiliary SCBA) with a full facepiece and operated in pressure-demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
**Protective Clothing/Equipment:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
**Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
**Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.
**Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

## Section 9 - Physical and Chemical Properties

**Physical State:** Solid
**Appearance and Odor:** Colorless, shiny crystals with a faint, aromatic odor.
**Vapor Pressure:** 1 mm Hg at 244.76 °F (118.2 °C); 400 mm Hg at 586.4 (308 °C)
**Formula Weight:** 178.22
**Density ($H_2O$=1, at 4 °C):** 1.179 g/L at 77 °F (25 °C)
**Water Solubility:** 1.6 mg/L at 59 °F (15 °C)
**Other Solubilities:** 1 g in: 2.4 mL toluene, 2.4 mL carbon tetrachloride, 2 mL benzene, 1 mL carbon disulfide, 25 mL absolute alcohol, 60 mL cold 95% alcohol, 10 mL boiling 95% alcohol and 3.3 mL anhydrous ether. Also soluble in glacial acetic acid, chloroform, and hot pyridine.
**Boiling Point:** 644 °F (340 °C)
**Melting Point:** 213 °F (101 °C)
**Refraction Index:** 1.59427
**Octanol/Water Partition Coefficient:** log Kow = 4.57

## Section 10 - Stability and Reactivity

**Stability:** Phenanthrene is stable at room temperature in closed containers under normal storage and handling conditions.
**Polymerization:** Hazardous polymerization does not occur.
**Chemical Incompatibilities:** Strong oxidizers.
**Conditions to Avoid:** Phenanthrene dust generation and exposure to heat ignition sources, or oxidizers.
**Hazardous Decomposition Products:** Thermal oxidative decomposition of phenanthrene can produce carbon oxide(s).

## Section 11- Toxicological Information

### Toxicity Data:*

**Acute Oral Effects:**
Mouse, oral, $LD_{50}$: 700 mg/kg

**Carcinogenicity:**
Mouse, skin: 71 mg/kg produced tumors at site of application.

**Mutagenicity:**
Rat, liver cell: 3 mmol/L caused DNA damage
Human, lymphocyte: 100 µmol/L caused mutation

* See NIOSH, *RTECS* (SF7175000), for additional toxicity data.

## Section 12 - Ecological Information

**Ecotoxicity:** *Neanhes arenaceodentata*, TLm = 0.6 ppm/96 hr, sea water at 71.6 °F (22 °C)
**Environmental Degradation:** If released to soil, some phenanthrene may biodegrade but the majority will bind to the soil without much leaching to groundwater. Volatilization is not expected to be significant. In water, it will adhere to particulates and sediment. Photolysis may occur near the surface producing toxic substances. Photolysis/photooxidation half-life = 8.4 hr. In the air, it will react with photochemically generated hydroxyl radicals (half-life = 1.67 days).
**Soil Absorption/Mobility:** Phenanthrene absorbs strongly to soil and sediment in water.

## Section 13 - Disposal Considerations

**Disposal:** For treatment of phenanthrene contaminated water, the particulate bound portion can be removed by sedimentation, flocculation, and filtration. Chlorination is not recommended as it has been shown to produce mutagenic substances. The dissolved portion requires oxidation for partial removal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

## Section 14 - Transport Information

### DOT Transportation Data (49 CFR 172.101):

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

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

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

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

* Classified as a hazardous substance when phenanthrene is in a quantity, in one package, which equals or exceeds the RQ of 5000 lb (2270 kg)

## Section 15 - Regulatory Information

**EPA Regulations:**
RCRA Hazardous Waste Number: Not listed
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per CWA, Sec. 307(a)
CERCLA Reportable Quantity (RQ), 5000 lb (2270 kg)
SARA 311/312 Codes: 1
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
**OSHA Regulations:**
Listed (coal tar pitch volatiles) as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

## Section 16 - Other Information

References: 23, 73, 103, 124, 132, 133, 136, 139, 159, 164, 187, 190

Prepared By ................................ M Gannon, BA

Industrial Hygiene Review ......... PA Roy, MPH, CIH

Medical Review ........................... W Silverman, MD

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*Material Safety Data Sheets Collection:*

Sheet No. 711
Pyrene

Issued: 4/90

## Section 1. Material Identification 31

**Pyrene Description:** A condensed ring, polyaromatic hydrocarbon compound derived from coal tar. Also synthesized from o,o'-ditolyl. Used in biochemical research and as starting material for synthesizing benzo(a)pyrene. An ingredient of smoked and broiled meat, tobacco smoke, and air pollution.
**Other Designations:** CAS No. 0129-00-0; $C_{16}H_{10}$; beta-pyrene; benzo(d,e,f)phenanthrene; benzo(d,e,f)phenathrene.
**Manufacturer:** Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K --
* Skin absorption

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2 0
-

HMIS
H 2
F 1
R 0
PPG†
† Sec. 8

## Section 2. Ingredients and Occupational Exposure Limits

Pyrene, ca 100%

| OSHA PEL | ACGIH TLV, 1989-90 | NIOSH REL, 1987 | Toxicity Data* |
|---|---|---|---|
| 8-hr TWA: 0.2 mg/m³ | None established | None established | Rat, oral, $LD_{50}$: 2700 mg/kg ingested produces conjunctiva irritation, excitement, and muscle contraction<br>Rat, inhalation, $LC_{50}$: 170 mg/m³ inhaled produces conjunctiva irritation, excitement, and muscle contraction<br>Gene mutation in mammalian cells; human cell types: 12 µmol/l |

* See NIOSH, *RTECS* (UR2450000), for additional mutative, tumorigenic, and toxicity data.

## Section 3. Physical Data

**Boiling Point:** 759 °F/404 °C
**Melting Point:** 313 °F/156 °C
**Vapor Pressure:** $6.85 \times 10^{-7}$ torr at 68 °F/20 °C
**Molecular Weight:** 202.26 g/mol
**Specific Gravity** ($H_2O$ = 1 at 39 °F/4 °C): 1.271 at 73 °F/23 °C
**Water Solubility:** Insoluble (0.135 mg/l)

**Appearance and Odor:** Colorless solid or a slight blue florescent solution. Tetracene impurities give pyrene a yellow color.

## Section 4. Fire and Explosion Data

| Flash Point: None reported | Autoignition Temperature: None reported | LEL: None reported | UEL: None reported |
|---|---|---|---|

**Extinguishing Media:** Use foam, dry chemical, and $CO_2$ to extinguish fire.
**Unusual Fire or Explosion Hazards:** Pyrene is a flammable and combustible material that heat and ignition sources may ignite. It burns rapidly with a flare-like effect.
**Special Fire-fighting Procedures:** Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Avoid skin contact. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Pyrene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
**Hazardous Products of Decomposition:** Thermal oxidative decomposition of pyrene can emit irritating fumes and acrid smoke.

## ion 6. Health Hazard Data

**inogenicity:** Neither the NTP, IARC, nor OSHA lists pyrene as a carcinogen.

**ummary of Risks:** Pyrene is irritating to exposed skin and eyes, moderately toxic by ingestion and intraperitoneal routes, and a poison by ihalation. Experimental studies show pyrene is a tumorigen in animals and a mutagen in humans. Workers exposed to concentrations between 3 nd 5 mg/m$^3$ showed some unspecified teratogenic effects. In general, human exposure occurs mainly through inhalation of tobacco smoke and olluted air. Although ingesting smoked and broiled meats may expose humans to pyrene, there is little indication of serious health effects.

**ledical Conditions Aggravated by Long-Term Exposure:** None reported.

**arget Organs:** Skin, eyes, respiratory tract.

**rimary Entry Routes:** Inhalation, ingestion, skin contact.

**cute Effects:** Vapor inhalation may irritate the nose mucosa and respiratory tract. Vapors may also cause conjunctival irritation. Pyrene is bsorbed through intact skin and causes dermal irritation. Ingestion may irritate and burn the esophagus and gastrointestinal tract.

**hronic Effects:** None reported.

**IRST AID**

**yes:** Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.

**kin:** *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.

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

**ngestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of nilk or water. Do not induce vomiting.

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

**hysician's Note:** Observe patients with dermal exposure for systemic poisoning since pyrene is absorbed through intact skin.

## ection 7. Spill, Leak, and Disposal Procedures

**pill/Leak:** Notify safety personnel, evacuate all unnecessary personnel, and remove all heat and ignition sources. Cleanup personnel should rotect against vapor inhalation and skin and eye contact. Scoop spilled material into appropriate disposal containers. Absorb liquid with inert, oncombustible material and place waste in appropriate disposal containers. Follow applicable OSHA regulations (29 CFR 1910.120).

**isposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**Designations**

A Hazardous Waste (40 CFR 261.33): Not listed

isted as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per Clean Water Act, Sec. 307(a)]

isted as SARA Extremely Hazardous Substance (40 CFR 355), Reportable Quantity: 5000 lb, Threshold Planning Quantity (TPQ): 1000/10,000 lb

ARA Toxic Chemical (40 CFR 372.65): Not listed

**SHA Designations**

ir Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

## ection 8. Special Protection Data

**oggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

**espirator:** Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or onroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.

**Warning:** Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.

**ther:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

**entilation:** Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). ocal exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

**afety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

**ontaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this naterial from your shoes and equipment. Launder contaminated clothing before wearing.

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

## ection 9. Special Precautions and Comments

**torage Requirements:** Store in closed containers in a cool, well-ventilated area. Protect containers from physical damage.

**ngineering Controls:** Avoid vapor inhalation and skin contact. Practice good personal hygiene and housekeeping procedures. To prevent tatic sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production nd storage areas. Provide preplacement and periodic medical examinations, including comprehensive medical histories with emphasis on the [illegible] cavity, respiratory tract, bladder, and kidneys. Examine the skin for premalignant and malignant lesions.

**sportation Data (49 CFR 172.101, .102):** Not listed

*MSDS Collection* References: 7, 73, 87, 103, 123, 124, 126, 127, 136

Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Hardies, MD

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*Material Safety Data Sheets Collection:*

Sheet No. 789
Cyanide

Issued: 11/91

## Section 1. Material Identification

36

**Cyanide ($CN^-$) Description:** Derived by combining a carbon ion with a nitride ion. Used in rat and pest poisons, silver and metal polishes, photographic solutions, fumigating products, and electroplating solutions. Cyanide may also be liberated in burning of plastics, natural fabrics (wool or silk), polyurethane bedding or furniture, acrylic baths, nylon carpets, and melamine resin insulation.
**Other Designations:** CAS No. 57-12-5, carbon nitride ion, cyanide anion, isocyanide.
**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
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**Cautions:** Cyanide is severely toxic by all routes of entry and its lethal dose is an estimated 1 µg/ml. Take necessary precautions to avoid all possible exposure to this material.

## Section 2. Ingredients and Occupational Exposure Limits

Cyanide, ca 100%

**1990 OSHA PEL (Skin)**
STEL: 4.7 ppm, 5 $mg/m^3$, as hydrogen cyanide (gas)

**1990 IDLH Level**
50 $mg/m^3$

**1991-92 ACGIH TLV (Skin)**
Ceiling: 10 ppm, 11 $mg/m^3$, as hydrogen cyanide (gas)

**1990 NIOSH REL (Skin)**
STEL: 4.7 ppm, 5 $mg/m^3$ as hydrogen cyanide (gas)

**1990 DFG (Germany) MAK** (*Danger of cutaneous absorption*)
TWA: 10 ppm, 11$mg/m^3$ as hydrogen cyanide (gas)

**1985-86 Toxicity Data***
Mouse, intraperitoneal, $LD_{50}$: 3 mg/kg; toxic effects not yet reviewed

* See NIOSH, *RTECS* (GS7175000), for additional toxicity data.

## Section 3. Physical Data

**Boiling Point:** Varies with specific $CN^-$ compound
**Melting Point:** Varies with specific $CN^-$ compound
**Molecular Weight:** 26.02
**Density:** Varies with specific $CN^-$ compound
**Water Solubility:** Varies with specific $CN^-$ compound
**Appearance and Odor:** Varies with specific $CN^-$ compound, but usually has an almond odor.

## Section 4. Fire and Explosion Data

| | | | |
|---|---|---|---|
| **Flash Point:** None reported | **Autoignition Temperature:** None reported | **LEL:** None reported | **UEL:** None reported |

**Extinguishing Media:** Cyanide is combustible. For small fires, use dry chemical, water spray or foam. *Do not use carbon dioxide ($CO_2$)!* For large fires, use water spray, fog, or regular foam. *Do not scatter* material with more water than needed to extinguish fire.
**Unusual Fire or Explosion Hazards:** Combustible by chemical reaction with heat, moisture, or acid. Many cyanides readily evolve hydrogen cyanide (HCN), a toxic flammable gas.
**Special Fire-fighting Procedures:** Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing *is ineffective* for fires involving cyanide. Wear chemical protective clothing that the shipper or manufacturer specifically recommends. If possible without risk, remove container from fire area. Fight fire from maximum distance. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Remove and isolate contaminated clothing at the site.

## Section 5. Reactivity Data

**Stability/Polymerization:** Cyanide is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
**Chemical Incompatibilities:** Cyanide may react violently with hypochlorite solutions at pH 10 to 10.3, is explosive with nitrites if heated above 450 °C, and is incompatible with chlorates, fluorine, magnesium, nitrates, and all inorganic acids.
**Conditions to Avoid:** Avoid exposure to heat and contact with incompatibles.
**Hazardous Products of Decomposition:** Thermal oxidative decomposition of cyanide can produce carbon dioxide and toxic, flammable vapors of $CN^-$.

## Section 6. Health Hazard Data

**Carcinogenicity:** In 1990 reports, the IARC, NTP, and OSHA do not list cyanide as a carcinogen.
**Summary of Risks:** Cyanide is a potent, fast-acting, chemical asphyxiant (material which causes pulse and breathing obstruction) that prevents tissue utilization of oxygen by inhibiting the enzyme involved (cytochrome oxidase). Death can occur within seconds to minutes after inhalation of some cyanide gases, and may take as long as an hour after ingestion of a large amount of a cyanide salt due to a slower absorption. Toxicity is dependent on the form of cyanide the victim is exposed to. Mortality from acute exposures is high, but recovery is generally complete in nonfatal cases.
**Medical Conditions Aggravated by Long-Term Exposure:** None reported.

*Continue next page*

## tion 6. Health Hazard Data, *continued*

rgans: Brain, heart, lungs, skin, blood.
Entry Routes: Inhalation, ingestion, skin absorption.
e Effects: Inhalation of cyanide gases may cause rapid toxicity where the victim may only have time to utter a warning cry before succumb-
) unconsciousness caused by asphyxiation. If exposure is small there may be a weak, rapid, irregular heartbeat with bright-pink coloration of
kin due to high oxyhemoglobin content in the veins before person loses consciousness. A telltale sign of inhalation or ingestion is the odor of
almonds on the breath, however up to half the population is genetically unable to detect this smell. Dialated pupils are common in severe
nings. Contact with broken skin can cause cyanide absorption into the bloodstream. Cyanide ingestion can cause a bitter, burning taste,
ation, nausea, vomiting, anxiety, confusion, vertigo (dizziness), giddiness, sensation of stiffness in the lower jaw, and dyspnea (difficult
ration). In severe cases symptoms could progress to convulsions, paralysis, coma, cardiac arrhythmias, followed by death due to respiratory
e.
nic Effects: Chronic skin contact may cause cyanide rash, characterized by itching, and macular (blotches), papular (small, solid, conical,
tion of the skin), and vesicular (blister-like) eruptions. Chronic cyanide inhalation may cause appetite loss, headache, weakness, nausea,
ness, and symptoms of irritation of the upper respiratory tract and eyes. Other symptoms of chronic exposure include goiter, B12 and folate
rmalities, chest discomfort, epistaxis (nose bleed), poor appetite and sleeping, and functional changes in hearing.
ST AID: *Emergency personnel should protect against contamination!*
: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical
ity. Consult a physician immediately.
: *Quickly* remove contaminated clothing. Speed is extremely important. Rinse with flooding amounts of water for at least 15 min. Wash
sed area *extremely thoroughly* with soap and water. If irritation and pain persist, consult a physician.
lation: Remove exposed person to fresh air and immediately begin administering 100% oxygen. Avoid mouth-to-mouth resuscitaton during
to prevent self-poisonings.
stion: Obtain and prepare the Lilly cyanide antidote kit [Eli Lilly Co. (Stock No. M76)] for use in symptomatic patients. Never give anything
outh to an unconscious or convulsing person. Do not induce vomiting with Ipecac syrup. Consider gastric lavage. Activated charcoal is said
ineffective.
r first aid, get appropriate in-plant, paramedic, or community medical support.
: to Physicians: If the victim is unconscious, bradycardia and absence of cyanosis may be key diagnostic signs. Consider administration of
nitrite followed by sodium nitrite and sodium thiosulfate (antidote kit). Consider use of 100% oxygen.

## tion 7. Spill, Leak, and Disposal Procedures

/Leak: Immediately notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources—no flames, flares, or
cing in hazard area. Cleanup personnel should wear fully encapsulating, vapor-protective clothing for spills or leaks without fire. For small
pills, carefully scoop into clean, dry, suitable container and cover loosely. For small solution spill, take up with earth, sand, vermiculite, or
r absorbent, noncombustible material and place in suitable containers. For large spills, dike far ahead of solution spills for later disposal.
ow applicable OSHA regulations (29 CFR 1910.120).
osal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
ignations
a RCRA Hazardous Waste (40 CFR 261.33): Hazardous Waste No. P030
a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity: *An RQ is not being assigned to the general class* [* per Clean
'ater Act, Sec. 307(a)]
A Extremely Hazardous Substance (40 CFR 355): Not listed
d as a SARA Toxic Chemical (40 CFR 372.65)
IA Designations
d as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

## tion 8. Special Protection Data

gles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since
act lens use in industry is controversial, establish your own policy.
pirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if
ssary, wear a NIOSH-approved respirator. Select the respirator based on its suitability provide adequate worker protection for the given
king conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills,
tor vessels, or storage tanks), wear an SCBA with a full facepiece operated in pressure-demand or other positive-pressure mode. *Warning!*
*purifying respirators do not protect workers in oxygen-deficient atmospheres.*
er: Wear impervious gloves, boots, aprons, and gauntlets to prevent repeated or prolonged skin contact.
tilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust
ilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
ty Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
taminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing.
nove this material from your shoes and clean personal protective equipment.
nments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking,
king, using the toilet, or applying cosmetics. Cyanide detoxifying kits and instructions should be available in use areas. Instruct employees
king in these areas on how and when to use these kits.

## tion 9. Special Precautions and Comments

age Requirements: Avoid physical damage to containers. Store in tightly closed and properly labeled containers in cool, dry, well-ventilated
away from heat and incompatibles.
gineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous airborne
taminants and to maintain concentrations at the lowest practical level.
er Precautions: If respirators are used, implement a respiratory protection program that includes regular training, maintenance, inspection,
evaluation. Consider preplacement and periodic medical examinations of exposed workers that emphasize the heart, blood, and respiratory
em.

### Transportation Data (49 CFR 172.101, .102)

| | |
|---|---|
| pping Name: Cyanide *or* cyanide mixture, dry | IMO Shipping Name: Cyanides, inorganic, n.o.s. |
| zard Class: Poison B | IMO Hazard Class: 6.1 |
| No.: UN1588 | ID No.: UN1588 |
| T Label: Poison | IMO Label: Poison |
| T Packaging Exceptions: 173.364 | IMDG Packaging Group: I/II; Stow 'away from' acids |
| T Packaging Requirements: 173.370 | |

S *Collection* References: 73, 101, 103, 126, 127, 136, 143, 146, 148, 153, 159, 161, 163
ared by: M Gannon, BA; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: AC Darlington, MPH, MD; Edited by: JR Stuart, MS

# B

# SAMPLE MEDICAL DATA SHEET

# MEDICAL DATA SHEET

# CONFIDENTIAL

## THE FOLLOWING INFORMATION IS REQUESTED
## TO DETERMINE YOUR CURRENT MEDICAL STATUS

| | | | |
|---|---|---|---|
| Name (Last, First, Middle Initial) | | | SSN |
| Employee Address (Number & Street) | | City, State Zip Code | Telephone Number |
| Sex<br>☐M ☐F | Date of Birth | Name and Address of Person to Notify in an Emergency | Telephone Number |
| Personal Physician | Address | Telephone Number | Type of Examination<br>☐ Pre-Placement<br>☐ Periodic<br>☐ Other (Specify) |
| Division or Facility | | Position | Employee Number |
| Work Location | | | |

| | | | | |
|---|---|---|---|---|
| Please Check if you Have been Immunized for: | | | | Are You<br>☐ Right Handed<br>☐ Left Handed<br>☐ Ambidextrous |
| ☐ Tetanus<br>☐ Don't Know | ☐ Small Pox<br>☐ Don't Know | ☐Polio<br>☐ Don't Know | ☐Others<br>☐ Don't Know | |
| Last Date | Last Date | Last Date | Last Date | |

Family History

| Relation | Age | State of Health | If Dead, Cause and Age |
|---|---|---|---|
| Father | | | |
| Mother | | | |
| Spouse | | | |
| Grandparents | | | |
| | | | |
| | | | |
| | | | |
| Brothers and Sisters | | | |
| | | | |
| | | | |
| | | | |
| Children | | | |
| | | | |
| | | | |
| | | | |

Check Each Box (If answer is Yes, state blood relationship)

| | Yes | No | Relation |
|---|---|---|---|
| Cancer | | | |
| Diabetes | | | |
| Stomach Trouble | | | |
| Kidney Trouble | | | |
| Heart Trouble | | | |
| Tuberculosis | | | |
| Mental Disorder | | | |
| Convulsions | | | |
| Arthritis | | | |
| Allergies | | | |
| Other | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# MEDICAL DATA SHEET

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personal History | | | | | | | | |
| Do you have or have you ever had, any of the following? (Check each applicable box) | | | | | | | | |
| | YES | NO | | YES | NO | | YES | NO |
| Asthma | | | Foot Trouble | | | Malaria | | |
| Cancer, Cyst, Tumor, or Growth | | | Frequent Indigestion or Heartburn | | | Nervous Breakdown | | |
| Chest Pain or Shortness of Breath | | | Frequent or Painful Urination | | | Nervous Trouble of any Sort | | |
| Fever, Night Sweats | | | Frequent Trouble Sleeping | | | Numbness, Weakness | | |
| Chronic Cough or Colds | | | Gall Bladder Trouble | | | Palpitation or Pounding Heart | | |
| Convulsions, Fits | | | Goiter or Thyroid Problem | | | Prostate Trouble | | |
| Fall Sickness | | | Hayfever or Allergies | | | Reaction from Medicines | | |
| Coughing up or Spitting or | | | Headaches, Frequent or Severe | | | Recent Gain or Loss of Weight | | |
| Vomiting blood | | | Heart Trouble | | | Rheumatism or Arthritis | | |
| Expression of Excessive Worry | | | Hemorrhoids or Rectal Trouble | | | Scarlet Fever or Rheumatic Fever | | |
| Diabetes or Sugar in Urine | | | Hernia or Rupture | | | Skin Rash or Hives | | |
| Dizziness | | | High Blood Pressure | | | Stomach Troubles, Ulcers | | |
| Ear, Nose, or Throat Trouble | | | Jaundice or Hepatitis | | | Swelling of Ankles or Feet | | |
| Epilepsy | | | Kidney Trouble or Blood in Urine | | | Swollen or Painful Joints | | |
| Eye Trouble | | | Liver Trouble | | | Tuberculosis or Pleurisy | | |
| Fainting | | | "Locked" Knee or "Trick Joint" | | | Varicose Veins | | |
| Fatigue, Chronic or Frequent | | | Loss of Appetite, Chronic | | | Other | | |
| Female Disorders | | | Venereal Disease | | | Other | | |

Injuries: Please Check Any Injuries You Have Had:

- ☐ Fracture/Broken Bones
- ☐ Back Injury
- ☐ Low Back Pain
- ☐ None
- ☐ Other Injury
- ☐ Severe Cuts
- ☐ Severe Burns
- ☐ Lost Consciousness
- ☐ Dislocations
- ☐ Loss of Arm
- ☐ Loss of Leg
- ☐ Loss of Finger(s)
- ☐ Loss of Toe(s)

| Check Yes or No. If Yes, Give Details in Blank Areas | Yes | No | Details |
|---|---|---|---|
| Any time loss from work in the past two years due to illness? | | | |
| Any brace or support worn? | | | |
| Discharged or disqualified from Armed Services for any reason? | | | |
| Military Service - Dates and Locations | | | |
| Applied for, or received Workermen's Compensation? | | | |
| Been exposed to work with dusts, radiation, excessive noise, chemicals? | | | |
| Have you been unable to hold a job because of: | ▨ | ▨ | ▨ |
| a. Sensitivity to chemicals, dust, sunlight, etc. | | | |
| b. Inability to perform certain motions | | | |
| c. Inability to assume certain positions | | | |
| d. Other medical reasons | | | |
| Had surgery recommended or performed. Date and Time. | | | |
| Are you taking medicines now | | | |
| Have you been turned down on a physical examination or been informed of any abnormal findings from a physical examination | | | |
| Do you smoke -- If yes, quantity per day | | | |
| Do you use alcoholic beverages -- If yes, quantity per day | | | |
| Have you live or traveled outside the Continental USA | | | |
| | | | |
| | | | |

# C

# ACCIDENT REPORT FORM

# META ACCIDENT REPORT FORM

Page 1 of 3

Report No. ____

Site: ________________________________ Project No. ______________

Location: ________________________________________________

Date of Report: ________________ Preparer's Name: ________________

Name and Address of Injured/Involved Party: ______________________________

______________________________________________________________

SSN: ________________ Age: ____________ Sex: ____________

Years of Service: ________ Time on Present Job: ________ Title/Classification: ____________

Division/Department: ____________ Date of Accident: ____________ Time: ________

Accident Location: ________________________________________________

Accident Category: ____ Property Damage ____ Injury or Illness ____ Near Miss ____ Other

Contributing Factors:

____ Motor Vehicle
____ Slip or Trip Condition
____ Chemical Exposure
____ Animal or Insect
____ Machine Operation ____ Fire
____ Explosion
____ Electrical Hazard
____ Other, please specify ____________

DAMAGE ASSESSMENT

Property Damaged : $ ________________ Amount of Damage: $ ________________

INJURY ASSESSMENT

Nature of Injury or Illness: ________________________________________

CLASSIFICATION OF INJURY:

____ Fracture
____ Dislocation
____ Sprain
____ Abrasion
____ Laceration
____ Puncture
____ Bite
____ Dermal Allergy
____ Heat Burn
____ Chemical Burn
____ Radiation Burn
____ Bruise
____ Blister
____ Toxic Respiratory
____ Exposure
____ Other, please specify ____________
____ Cold Exposure
____ Frostbite
____ Heat Stroke
____ Heat Exhaustion
____ Concussion
____ Faint/Dizziness
____ Toxic Ingestion

Severity of Injury or Illness:

____ Non-disabling
____ Medical Treatment
____ Disabling
____ Fatality

# META ACCIDENT REPORT FORM

Page 2 of 3

Report No. ________

Part of Body Affected: ________

Degree of Disability: ________

Estimated Number of Days Away from Job: ________

Date Medical Care Was Received: ________

Where Medical Care Was Received: ________

Address (if off-site): ________

ACCIDENT DESCRIPTION (OR NEAR MISS CONDITION)

Describe the causative agents most directly related to accident or near miss (e.g., object, substance, material, machinery, equipment, weather or other conditions):

Describe any unsafe mechanical / physical / environmental condition(s) contributing to the accident or near miss. (Be specific): ________

Describe any unsafe act(s) by the injured/involved party contributing to the accident or near miss. (Be specific, must be answered): ________

Describe any personal factors that may have contributed to the accident or near miss. (Improper attitude, lack of knowledge or skill, slow reaction, fatigue): ________

Was the selection of personal protective equipment in use by the injured/involved party a contributing factor in this accident or near miss? ________

What level of personal protection equipment was required by the project HASP at the time of the accident (note any modification thereof): ________

Report No.

Was injured/involved party using required equipment?

If not, how/why did actual equipment use differ from plan?

What can be done to prevent a recurrence of this type of accident? (e.g., equipment modification, safety equipment, improved procedures or training):

Provide detailed narrative description (e.g., How/why did accident occur? What objects, equipment, tools, circumstances, and assigned duties were involved? Be specific):

Witnesses to accident:

Signature of Preparer:

Signature of Site Leader:

# D
# OSHA FORM 300

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OSHA's Form 300 (Rev. 01/2004)

# Log of Work-Related Injuries and Illnesses

**Attention:** This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

**U.S. Department of Labor**
**Occupational Safety and Health Administration**

Form approved OMB no. 1218-0176

*You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.*

Establishment name ____________________

City ______________ State ________

**Identify the person** | **Describe the case** | **Classify the case** — **CHECK ONLY ONE box for each case based on the most serious outcome for that case:** | **Enter the number of days the injured or ill worker was:** | **Check the "Injury" column or choose one type of illness:**

| (A) Case no. | (B) Employee's name | (C) Job title (*e.g., Welder*) | (D) Date of injury or onset of illness | (E) Where the event occurred (*e.g., Loading dock north end*) | (F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (*e.g., Second degree burns on right forearm from acetylene torch*) | Death (G) | Days away from work (H) | Remained at Work: Job transfer or restriction (I) | Remained at Work: Other record-able cases (J) | Away from work (K) | On job transfer or restriction (L) | (M) Injury (1) | Skin disorder (2) | Respiratory condition (3) | Poisoning (4) | Hearing loss (5) | All other illnesses (6) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  | / month/day |  |  | ☐ | ☐ | ☐ | ☐ | days | days | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|  |  |  |  |  | **Page totals➤** |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | Injury (1) | Skin disorder (2) | Respiratory condition (3) | Poisoning (4) | Hearing loss (5) | All other illnesses (6) |

*Be sure to transfer these totals to the Summary page (Form 300A) before you post it.*

Public reporting burden for this collection of information is estimated to average 14 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

**Page ___ of ___**

# E

# EMPLOYER'S FIRST REPORT OF INJURY FORM

# STANDARD FORM FOR
# EMPLOYER'S FIRST REPORT OF INJURY

PLEASE SUBMIT THIS REPORT IN TRIPLICATE

Page 1 of 2

**Employer**

1. Employer ______
2. Office address: No. & Street ______
City ______ State ______ Zip Code ______
3. Insured by (name of company) ______
4. Give nature of business ______

**Time and Place**

5. (a) Location of site or place where accident occurred ______
(b) If injured in a mine, did accident occur on surface, under ground, shaft, drift or mill ______
6. Date of injury ______ 19 __ Day of week ______ Hour of day ___a.m. ___p.m.
7. Date disability began ______ 19 ___ a.m. _____ p.m. _____
8. Was injured paid in full for this day ______
9. When did supervisor first know of injury ______
10. Name of supervisor ______

**Injured Person**

11. Name of Injured ______
12. Address: No. & Street ______
City ______ State ______ Zip Code ______
13. Check: () Married () Single () Divorced () Widowed () Widower ()Male ()Female
14. Age _____ Did you have on file employment certificate or permit? ______
15. (a) Occupation when injured ______
(b) Was this his or her registered occupation _____. If not, state in what work regularly employed ______
16. (a) How Long employed by you ______ (b) Wages per day $______
17. (a) No. hours worked per day ______ (b) Wages per day $______
(c) No. of days worked per week ______ (d) Average weekly earnings $______
(e) If board, lodging, fuel or other advantages were furnished in addition to wages, give estimate value per day, week or month ______

**Cause of Injury**

18. Machine, tool or thing causing injury ______
19. Kind of power (hand, foot electrical, steam, etc.) ______
20. Part of machine on which accident occurred ______
21. (a) Was safety appliance or regulation provided? ______
(b) Was it in use at the time ______
22. Was accident caused by injured's failure to use or observe safety appliance or regulation? ______
23. Describe fully how accident occurred, and state what employee was doing when injured: ______
24. Names and addresses of witnesses: ______

| | |
|---|---|
| Nature of Injury | 25. Nature and location of injury (describe fully exact location of amputations or fractures, right or left ____<br>26. Probable length of disability ____<br>27. Has injured returned to work? ____<br>If so, date and hour ____ At what wage $____<br>28. At what occupation ____<br>29. (a) Name and address of physician ____<br>(b) Name and address of hospital ____ |
| Cases Fatal | 30. Has injured died ____<br>If so, give date of death ____ |

Date of this report ____ Firm Name ____

Signed by ____

Official Title ____

# F
# SAMPLE RECORD

# RECORD OF SAFETY MEETINGS

**Location:** **Date:**

**Acting HSO:** **Time:**

| Name of Attendee | | Affiliation |
|---|---|---|
| PRINT | SIGN | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# G

# RG&E CONTRACTOR SAFETY AND HEALTH OBLIGATIONS

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Contract No. __________

## --APPENDIX A--
## CONTRACTOR SAFETY AND HEALTH OBLIGATIONS

1. Rochester Gas & Electric Corporation strives to hire Contractors who conduct their activities in a manner consistent with appropriate safety, health and environmental regulations and good practices. A Contractor working for Rochester Gas & Electric Corporation is an independent Contractor as to all work performed under the contract. A Contractor, and its subcontractors, shall be evaluated by Rochester Gas & Electric Corporation on their performance and work practices relating to safety and health issues. The evaluation of a Contractor will include an assessment of its safety, health, and related work practices, record keeping, and if applicable, prior work experience. This evaluation will be one of the criteria used for inviting a Contractor to bid on future Rochester Gas & Electric Corporation projects. The following are minimum safety performance standards that Rochester Gas & Electric Corporation is expecting Contractors to maintain during the performance of all work hereunder. Contractors shall take all additional precautions necessary or proper to prevent injury or death to persons or damage to property and/or the environment.

1.1 The Contractor shall comply with all applicable safety, health and environmental laws, rules and regulations at locations where services are performed for Rochester Gas & Electric Corporation. The Contractor is similarly responsible for requiring compliance by all subcontractors.

1.2 Unless otherwise provided for in written contractual arrangements made with Rochester Gas & Electric Corporation, the Contractor shall provide their employees with appropriate functional equipment, tools, materials and personal protective equipment necessary to perform the job in an efficient, safe and healthy manner.

1.2.1 The Contractor shall ensure that all necessary personal protective equipment is made available to Contractor's employees, and properly used. Where required, employees will be medically evaluated prior to using personal protective equipment. The contractor will be responsible for proper maintenance, sanitation and disposal of all personal protective equipment used by the Contractor's employees.

1.3 Unless otherwise provided for in written contractual arrangements made with Rochester Gas & Electric Corporation or unless statutory requirements dictate otherwise, the Contractor shall verify in writing that their employees have been provided with appropriate safety, health and/or environmental training as required by federal, state or local laws, rules, codes and regulations.

1.3.1 The Contractor shall provide, in writing, a verification within 30 days prior to the start of work that required training has been completed. Documentation of individual employee training shall be subject to audit by the Rochester Gas & Electric Corporation Contract Administrator.

1.3.2 The Contractor shall verify that site-specific and job-specific safety and health rules (Attachment A - Safety Rules and Regulations for Contractors) have been disseminated to their employees and subcontractor's employees. Verification will be sent to Rochester Gas & Electric Corporation Health & Safety Services. Documentation demonstrating that this information has been disseminated shall be subject to audit by Rochester Gas & Electric Corporation.

1.4 The Contractor shall immediately notify the Rochester Gas & Electric Corporation project monitor of any employee accident resulting in reportable injuries, injuries to Rochester Gas & Electric Corporation employees or third parties, or damage to Rochester Gas & Electric Corporation or a third party's property. "Reportable injuries" as used herein shall mean any recordable occupational injuries or illnesses as defined in 29 CFR 1904.12(c). The Contractor shall furnish to the Rochester Gas & Electric Corporation project monitor copies of any regulatory, administrative or statutory reports prepared by them concerning an accident, injury or occupational illness within one day.

The Contractor shall assist Rochester Gas & Electric Corporation in the investigation and documentation of Contractor OSHA Recordable injuries, illnesses or "near misses" if Rochester Gas & Electric Corporation elects to conduct such an investigation.

1.5 The Contractor shall immediately inform Rochester Gas & Electric Corporation of inspection(s) conducted or to be conducted by regulatory agencies and the results of said inspection(s) when such inspections are conducted on or related to a Rochester Gas & Electric Corporation job site covered by this Contract.

1.6 The Contractor shall conduct routine safety and health assessments of their general work practices and operational integrity inspections of theirs and subcontractor's equipment in accordance with the operations manuals relating to such equipment or in accordance with prudent operating or industry standards or recommendations.

1.6.1 Reports of such assessments and inspections shall be signed by the Contractor's supervisor in charge and submitted to the Rochester Gas & Electric Corporation project monitor.

1.7 The Contractor shall take prompt and appropriate action to correct unsafe work practices by their employees and subcontractors that could endanger persons, property or environment.

1.8 Depending on the size and scope of the job, the Rochester Gas & Electric Corporation project monitor may require the contractor to hold daily or weekly safety meetings with their employees. These meetings should address facility and job hazards, accidents and near-misses, site-specific safety and health rules, and applicable policies and procedures. Meeting attendance and topics discussed must be documented and made available to the Rochester Gas & Electric Corporation project monitor.

2. In addition to all applicable federal, state and local laws, rules and regulations, the Contractor shall adhere to site-specific Rochester Gas & Electric Corporation-imposed safety practices while performing work for Rochester Gas & Electric Corporation (see attached Safety Rules and Regulations for Contractors).

3. Nothing contained in this Appendix A shall be interpreted to enlarge the legal duty or liability of Rochester Gas & Electric Corporation to the Contractor, their agents, employees, subcontractors or related third parties.

The Contractor shall communicate the requirements of this Appendix A to all subcontractors of the Contractor and shall be responsible for insuring that all subcontractors are in compliance with the provisions herein.

Rochester Gas & Electric Corporation shall have the right during the performance of this Contract to inspect or audit the Contractor's records and worksites to insure that the Contractor is in compliance with this Appendix A and all State, Federal and local laws, rules and regulations. The Contractor shall cooperate and provide all records or documentation requested in such audit in a timely manner. Failure to cooperate or to have maintained sufficient records to document compliance with this Appendix A shall be considered a material breach of Contract.

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work and shall provide all necessary protection to prevent damage, injury or loss to:

a) all employees on the work and all other persons who may be affected thereby;
b) all the work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his subcontractors; and
c) other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadway, structures and utilities not designated for removal, relocation or replacement in the course of construction.

Contractor shall submit to Rochester Gas & Electric Corporation, Material Safety Data Sheets for all materials and chemicals used in connection with the work prior to delivery of these materials to any Rochester Gas & Electric Corporation location. Contractor shall also comply with Rochester Gas & Electric Corporation's chemical labeling procedures. Rochester Gas & Electric Corporation will make available copies of the following to Contractors working at Rochester Gas & Electric Corporation's locations where these materials are used or stored:

(i) The chemical labeling procedures;
(ii) The locations of the Material Safety Data Sheets; and
(iii) The list of chemicals at the work location.

Contract No. __________

## ATTACHMENT A
## SAFETY RULES AND REGULATIONS FOR CONTRACTORS

Rochester Gas & Electric Corporation's intent in issuing this document is to provide the Contractor with minimum safety requirements when working on Rochester Gas & Electric Corporation Projects. All work performed shall be in accordance with Rochester Gas & Electric Corporation's contract specifications.

Contractors shall comply with all applicable federal, state, local and Rochester Gas & Electric Corporation standards, ordinances, regulations and the rules and regulations of any agency having jurisdiction on the premises. In the case of conflicting requirements, the most stringent shall prevail. Each Contractor shall have a current written safety program on file with Rochester Gas & Electric Corporation Contract Administration. Any conditions deemed unsafe by Rochester Gas & Electric Corporation shall be immediately corrected by the Contractor.

Contractors may be required to provide documentation of employee qualifications for specific safety requirements such as working with electrical equipment, asbestos, lead, trenching & shoring, mercury, confined spaces, fall protection, etc.

Contractors shall communicate the required safety rules and regulations to their employees in a documented tailboard meeting prior to the start of the job. Contractors are responsible for interpreting these rules for non-English speaking and reading-impaired employees.

Contractors are responsible for informing all subcontractors of the safety rules and regulations set forth here and in the contract terms and conditions.

All questions pertaining to this document shall be directed to the local Rochester Gas & Electric Corporation Project Monitor or Rochester Gas & Electric Corporation Health and Safety Representative.

### A. <u>ACCIDENTS</u>

1. The Rochester Gas & Electric Corporation Project Monitor shall be notified immediately of any accidents involving personal injury or property damage. Appropriate reports shall be completed in 10 working days.

### B. ASBESTOS (ref: 29 CFR 1926.1101)

Contractors shall not disturb known or suspected asbestos-containing materials. When these materials are encountered and could potentially be disturbed by the work being performed, work should immediately be stopped. The Contractor shall immediately notify the Rochester Gas & Electric Corporation project monitor.

### C. CONFINED SPACES (ref: 29 CFR 1926.21)

The Contractor is responsible for complying with all applicable confined-space work practices and standards. Contractor employees working in confined space conditions must have demonstrated competency in proper confined-space work practices (achieved by training and experience). The Contractor shall have a means of emergency rescue arranged prior to start of work in permit required confined spaces.

D. **CRANES** (ref: 29 CFR 1926.550)

Rochester Gas & Electric Corporation cranes shall not be used by the Contractor. Specific exceptions to this rule shall be written and made part of the contract. Cranes will be operated by qualified employees, with licenses when required. If a license is required, the operator will have the license with them when operating subject cranes. Lift plans may be necessary before work begins. Documentation will be submitted to the Rochester Gas & Electric Corporation project monitor.

E. **DRUGS AND ALCOHOL**

1. Possession or use of unauthorized drugs or alcoholic beverages is strictly prohibited on Rochester Gas & Electric Corporation premises or while working for Rochester Gas & Electric Corporation. Reporting to work on Rochester Gas & Electric Corporation property under the influence of unauthorized drugs or alcohol is strictly prohibited; any person under the influence of unauthorized drugs or alcohol shall not be permitted on the premises of a Rochester Gas & Electric project.

2. When applicable, Contractors must comply with U.S. Department of Transportation and Nuclear Regulatory Commission regulations.

3. When applicable, Contractors must comply with the Rochester Gas & Electric Corporation Drug and Alcohol Abuse Policy for Contractors and Consultants.

F. **ELECTRICAL** (ref: 29 CFR 1926.402-408, 416, 417; 29 CFR 1926, subpart V)

1. Only authorized and qualified personnel shall work on installation and maintenance of electrical equipment. The project monitor may request documentation of employee qualification.

2. All equipment used shall have required approvals and be free from known defects.

3. The Contractor will utilize a lockout/tagout procedure or recognized isolation/tagging procedure, as specified by Rochester Gas & Electric Corporation.

4. GFCIs (ground fault circuit interrupters) in working order shall be used for all electrical tools and equipment unless an assured equipment grounding conductor program is in place.

5. All non-qualified Contractor employees and equipment shall stay a minimum of 10 feet away from overhead, energized lines. Non-qualified Contractor employees are not permitted to enter an energized substation unless they are accompanied by qualified personnel.

6. Mobile radio antennas shall be lowered prior to taking any vehicles inside a substation.

7. No metal measuring tapes or tapes containing a metal wrap shall be used near uninsulated energized circuits, equipment, poles or substation structures. Metal tapes may be used at the project monitor's discretion for making critical measurements at ground level or on dead and grounded portions of the structure.

8. Metal tools utilizing cable slings, winch cable, chains, loose sections and ends of conductors, or other similar objects, shall be kept under control by the worker to prevent contact with energized conductors or equipment and the worker's body.

## G. EXCAVATIONS (ref: 29 CFR 1926.650-652)

1. The general requirements of the OSHA 1926.650, 651, 652 excavation standard, including the provision for a competent person, shall be understood and followed by all Contractor employees.

2. All excavations which workers may enter that are 5 feet or more in depth, or a depth where there is danger of cave-in, shall be protected by a shoring or shielding system, or by a benching or sloping system.

Requirements include but are not limited to the following items:
_ contractor shall provide adequate barriers/barricades (special considerations for excavations left overnight)
_ air monitoring where indicated
_ Notification to Underground Facilities Protective Organization
_ providing adequate access and egress
_ hand dig when within two feet of any underground facility

3, The Contractor shall promptly notify appropriate utilities of any damage done, prior to closing the trench.

## H. FIRE REGULATIONS (ref: 29 CFR 1926.150, 152)

1. Contractors shall provide fire extinguishers sealed, fire service ready, inspected and in good working order and properly maintained at all times when live gas work is being done. At least one 20 pound dry chemical fire extinguisher shall be on the ground near the edge of the excavation.

2. Contractors shall provide a trained fire watch as dictated by the job hazard assessment.

3. When required, hot work permits shall be obtained from the Rochester Gas & Electric Corporation project monitor for such activities as welding, cutting, burning, anything that causes a spark, uses an open flame, or involves temperatures high enough to ignite combustible materials.

4. All acetylene and oxygen cylinders shall be stored and used in accordance with OSHA regulations (ref: 29 CFR 1926.350), and transported per DOT specifications. Flashback arresters shall be installed at the welding tip and at the regulator.

5. Open flames, sparks or smoking shall be prohibited in areas so marked or designated, and where a recognized combustible/flammable hazard exists.

6. Fire detection and/or suppression systems shall not be disabled or blocked without notifying the Rochester Gas & Electric Corporation project monitor and obtaining his/her consent.

7. Flammable/combustible material shall be stored in approved containers and locations. Quantities in excess of one day's use shall be reported to the Rochester Gas & Electric Corporation project monitor.

### . HAZARD COMMUNICATION (ref: 29 CFR 1926.59)

1. The Contractor must have a written program that complies with OSHA's Hazard Communication standard.

2. Contractors shall provide to the Rochester Gas & Electric Corporation project monitor a list of chemicals and Material Safety Data Sheets (MSDS) for each chemical that they will bring onto Rochester Gas & Electric Corporation property or use on a Rochester Gas & Electric Corporation project.

3. Contractor chemical containers will be properly labeled. Rochester Gas & Electric Corporation Contractor chemical labels will be used as required.

4. All unused chemicals which Contractors have brought onto Rochester Gas & Electric Corporation property or used for a Rochester Gas & Electric Corporation project shall be the responsibility of the contractor to properly dispose of and/or remove.

5. The Rochester Gas & Electric Corporation project monitor shall make Contractors aware of Rochester Gas & Electric Corporation's Hazard Communication Program, notify them of any chemicals that they may be exposed to while working on ROCHESTER GAS & ELECTRIC CORPORATION property, and provide access to the applicable MSDS.

### J. HOUSEKEEPING (ref: 29 CFR 1926.25)

1. Good housekeeping practices shall be strictly adhered to daily. The work site shall be kept clean and orderly.

2. Trash shall be promptly removed from the work site and from the customer's property.

3. Boards with protruding nails shall not be left lying around. All nails shall be withdrawn or hammered down.

4. Contractors shall not block means of access or egress, or safety equipment.

### K. LADDERS AND SCAFFOLDING (ref: 29 CFR 1926.451, 1050-1053, 1060)

1. Contractors shall not use Rochester Gas & Electric Corporation ladders without permission from the Rochester Gas & Electric Corporation project monitor.

2. Contractors are required to furnish their own ladders and equipment free of defects. Specific exceptions to this rule shall be written and made part of the contract.

3. All straight and extension ladders shall be properly maintained and equipped with approved safety feet.

4. Metal ladders shall not be used while working in proximity to energized electrical facilities.

5. All scaffolding erection and use shall be in compliance with OSHA standards. A professional engineered approval of scaffolding plan(s) shall be submitted as required.

L. **LEAD** (ref: 29 CFR 1926.62)

Contractors shall not disturb known or suspected lead-containing materials. When these materials are encountered and could potentially be disturbed by the work being performed, work shall be stopped immediately. The Contractor shall immediately notify the Rochester Gas & Electric Corporation project monitor.

M. **MEDICAL SERVICES** (ref: 29 CFR 1926.50)

1. When a medical facility is not reasonably accessible for the treatment of injured employees, personnel trained to render first aid and CPR shall be available at the worksite. The personnel designated to provide CPR and first aid must have current certifications and must carry evidence of their training while on site.

2. First aid supplies approved by a consulting physician shall be readily available at the worksite.

N. **MOTOR VEHICLES** (ref: 29 CFR 1926.600-02)

1. Contractors shall not use Rochester Gas & Electric Corporation vehicles without permission. Contractors shall transport employees in a safe manner (e.g., riding in the back of a pick-up and in places other than the operator's seat, (i.e., a backhoe bucket or fender) is prohibited).

2. Contractor employees shall possess the necessary license classification for vehicle(s) being driven.

O. **OVERHEAD WORK** (ref: 29 CFR 1926.500-503)

1. Personnel shall be protected from falling tools, equipment and material.

2. All girders, beams and overhead surfaces shall be kept free of loose material.

P. **PERSONAL SAFETY EQUIPMENT** (ref: 29 CFR 1926.28,52,95,100-103,353,500-503)

1. Eye and Face Protection - Approved and appropriate eye and/or face protection shall be worn when an eye or face hazard exists. Personnel involved in welding operations shall wear eye protection with filter lenses or plates of the proper shade number. The eye and face protection must meet the requirements of ANSI Z87.1-1968.

2. Head Protection - OSHA approved hard hats shall be worn at the work site. Bump caps, metal hard hats, and metal hard caps are prohibited.

3. Clothing - Contractors employees shall be properly clothed at all times. Natural fabric clothing or flame retardant clothing is required while working on energized gas pipelines, energized electrical equipment and whenever a flame hazard exists.

4. Gloves - Suitable gloves will be worn when there is a potential for hand injury.

5. Footguards - Footguards must be worn when using jackhammers, tampers or similar equipment and when there is a potential foot hazard. Additional safety footwear will be selected based on the potential hazard.

6. Hearing Protection - All personnel subjected to sound exceeding OSHA permissible noise exposures shall have available and wear appropriate hearing protection.

7. Respirators - The contractor shall provide respirators based on the hazard encountered. Contractor respirator use will be in compliance with OSHA requirements.

8. Fall protection - Whenever work site conditions involve a potential for a fall hazard of 6 feet or more, the contractor shall use appropriate fall protection.

Q. **RADIATION** (ref: 29 CFR 1926.53)

1. The Contractor shall inform the Rochester Gas & Electric Corporation project monitor whenever an ionizing radiation source is used.

2. The Rochester Gas & Electric Corporation project monitor will inform the Contractor when work is necessary near a Rochester Gas & Electric Corporation ionizing radiation source.

3. If work is required in the proximity of an ionizing radiation source, the Contractor shall comply with all applicable regulations.

R. **TOOLS** (ref: 29 CFR 1926.301-304)

1. Contractors shall not use Rochester Gas & Electric Corporation tools without permission.

2. Tools shall be kept defect free and if defects are found, immediately taken out of service.

3. Tools shall be maintained as per manufacturer's specifications and governing regulations.

4. Tools shall not be retrofitted or changed.

S. **WATER** (ref: 29 CFR 1926.106)

When Contractors work over or near water and where the danger of drowning exists, the contractor must comply with all provisions of OSHA (i.e., training, Coast Guard approved life jackets, ring buoys, skiffs, fall protection etc.).

T. **WORK AREA PROTECTION**

1. Adequate work area protection shall be used by Contractors. All work area protection shall be in accordance with the New York Manual of Uniform Traffic Control Devices.

2. All contractors working in the road right-of-way:
   a. must wear high visibility orange clothing or reflective vests.
   b. shall use reflective vests for flagging and night work.

**MISCELLANEOUS REQUIREMENTS** (ref: 29 CFR 1926.20-21)

1. Contractor employees shall not enter any building or area where their work does not require their presence.

2. Firearms and weapons are forbidden on Rochester Gas & Electric Corporation work sites.

3. Unauthorized explosives or explosive materials are forbidden on Rochester Gas & Electric Corporation work sites.

4. The Contractor shall maintain current safety and health signs and erect new ones if the hazard changes. The contractor shall also remove signs from the work site when there is no longer a hazard present.

5. The Contractor shall have a program to provide for frequent and regular inspections of the job site, materials, and equipment by designated competent persons.

6. The Contractor shall instruct each employee in the recognition and avoidance of unsafe conditions and in the regulations applicable to his/her work environment to control or eliminate any hazards or other exposure to illness or injury.

7. The Contractor shall permit only those employees qualified by training or experience to operate equipment and machinery.

# APPENDIX B
# COMMUNITY AIR MONITORING PLAN

# COMMUNITY AIR MONITORING PLAN (CAMP) FOR INTERIM REMEDIAL MEASURE FOR THE EAST STATION FORMER MGP SITE ROCHESTER, NEW YORK

## SITE #: V00358-8

## INDEX #: B8-0535-98-07

Prepared for:

**Rochester Gas & Electric Corporation**
89 East Avenue
Rochester, New York 14649

Prepared by:

**Ish Inc.**
804 Salem Woods Drive
Raleigh, NC 27615

March 2007

# CONTENTS

# 1
# INTRODUCTION

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A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when remedial design investigation and remedial construction activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measures of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities do not spread contamination off-site through the air. The proper implementation of the Community Air Monitoring Program is essential to the protection of public health.

# 2
# PURPOSE

---

The purpose of this CAMP is to provide real-time monitoring for airborne volatile organic compounds (VOCs) and particulates at the upwind and downwind perimeter of the work area during remedial design investigation and remedial construction activities to be carried out at the East Station Former MGP site (Site).

# 3
# SCOPE

The chemicals of potential concern at the Site are VOCs (primarily benzene, toluene, ethylbenzene, xylenes (BTEX), and methylene chloride) and polycyclic aromatic hydrocarbon (PAH) compounds. VOCs will be monitored using a photoionization detector with a 10.6 eV electrode-less ultraviolet discharge lamp. PAHs are non-volatile and airborne emissions would be associated with particulates. Particulates will be monitored using a particulate air monitoring equipped with a micro-processor to measure and record real-time recordings of airborne particulate concentration in micrograms per cubic meter (mcg/m$^3$).

During the course of remedial design investigation and remedial construction activities, air monitoring will be conducted continuously at the upwind and downwind locations of the work area as described herein.

The CAMP air monitoring program will be conducted with the following equipment (or equivalent):

3 - MiniRAE 2000 PGM-7600 photoionization detector (PID)/data logger

3 - DataRam DR-4000 portable particle sizing aerosol monitor/data logger

# 4
# AIR QUALITY MONITORING

Air quality monitoring will be performed for organic vapors and airborne particulates as outlined below.

## 4.1 VOC MONITORING RESPONSE LEVELS AND ACTIONS

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The field personnel will be prepared to monitor multiple (up to three) locations in the event that there is little wind or the wind direction changes frequently. Up to two downwind perimeter locations will be established during these conditions and the air monitoring technician will check each of these stations frequently during investigation and construction fieldwork activities. Monitoring instrumentation will include a PID and a particulate air monitor as described in Section 3.0. The monitoring instruments will be calibrated at least daily. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area exceeds 5 parts per million (ppm) above background for 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.
- If total organic vapor levels at the downwind perimeter of the work area persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the work area or half the distance

to the nearest potential receptor or residential/commercial structure, whichever is less-but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

The 15-minute readings will be recorded and will be available for State (NYSDEC and NYSDOH) personnel to review. Instantaneous readings, if used for decision purposes also should be recorded.

## 4.2 PARTICULATE MONITORING, RESPONSE LEVELS, AND ACTIONS

Particulate concentrations will be monitored continuously during ground intrusive activities involving test pits or excavations at the downwind perimeter of the work area.

The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The monitoring equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate level does not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind

PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust migration.

Readings will be recorded and be available for State (NYSDEC and NYSDOH) personnel to review.

## 4.3 SITE CONTROLS

Site controls are intended to limit emissions and odors from on-site activities and to ensure that ambient conditions in the community meet established health-based guidelines. A three-tiered set of controls are proposed for the project:

- Level I - general approaches and procedures that can be built into the design of the program to minimize the effect of emissions;
- Level II - simple procedures that are initiated in response to specific increases in emissions, but are not likely to have a significant impact on the schedule of site activities; and
- Level III– more aggressive procedures, also initiated in response to specific events, which are likely to have a more significant impact on production schedules and site activities.

The site manager is required to work through these options until emission sources are controlled, and ambient conditions no longer have the potential to pose a health risk.

### 4.3.1 Level I Controls

Level I controls are built into the design of the site remediation activities. They can include physical controls, site layout, and scheduling.

#### 4.3.1.1 Physical Controls

The simplest physical control involves the use of visual barrier cloth on the site perimeter fencing. The resistance caused by the barrier will elevate the discharge point for off-site emissions to promote better mixing and ambient dispersion.

#### 4.3.1.2 Site Layout

Stockpiles containing impacted material will be covered if inactive for a period of more than 4 hours. If stockpiled materials must be staged near a fence line, they will be kept small enough to be covered by a single tarp, if necessary.

#### 4.3.1.3 Scheduling

Every effort will be made to minimize the amount of time that impacted material is stored on-site by direct loading when possible and scheduling trucks to remove materials as soon as possible after excavation.

### 4.3.2 Level II Controls

Air monitoring will be routinely conducted at the downwind perimeter of the site during work activities. The results will be compared to site-specific action levels for VOCs, odor, and dust. These levels may be modified if required to ensure that site conditions are safe for site workers and the community.

If the action levels are exceeded, additional monitoring will be conducted to confirm the result. Level II controls will be enacted if the exceedance is confirmed. The site manager must then work through the applicable list of site controls until the downwind monitoring results for parameters are determined to be less than their associated action levels. Specific Level II controls are discussed below.

#### 4.3.2.1 Suppressing Agents

Several agents that can be sprayed over source areas have been determined to be effective in controlling emissions. They include water spray and odor suppressant sprays (e.g. BioSolve solution) and foam.

#### 4.3.2.2 Water Spray

A spray of water can be used to minimize the amount of dust created. A water hose is effective for controlling dust over a small area, while lawn sprinklers or a water truck may be more efficient for extended control over larger areas.

#### 4.3.2.3 Tarps

Tarps can provide effective control for source areas that are likely to be inactive for extended periods of time. However, to be effective, the size of the source area should be controlled so that it can be covered using a single tarp. It is recommended that the base of the stockpile be no larger than 30 feet by 70 feet, thereby allowing a 50 foot by 100 foot reinforced tarp to cover the entire pile. Rolls of 3 or 5 mil polyethylene are not recommended for site use due to their lack of durability.

### 4.3.3 Level III Controls

Level III controls are to be implemented when Level II controls have been implemented and ambient concentrations continue to exceed the site action levels. Each of the control options listed in this subsection has the potential to significantly affect the schedule/production rate of site activities. However, these delays/inefficiencies may be required from time to time, to ensure that safe conditions exist, and are preferable to a complete work stoppage to control an emission event.

#### 4.3.3.1 Production/Schedule

It may be necessary to reduce the excavation rate to reduce the surface area of disturbed media or slow the generation rate of residuals. These activities would result in smaller source areas that could be more effectively controlled using Level II techniques.

### 4.3.3.2 Meteorological Conditions

It may be necessary to limit certain activities to those periods when preferred meteorological conditions, such as wind direction or low temperatures, are in effect.

### 4.3.3.3 Relocation of Activities

One option is to move the remedial activities to lesser-impacted areas until adequate control measures can be implemented, or more favorable meteorological conditions return.

Additionally, it may be beneficial to temporarily relocate material loading and transfer activity areas to other areas of the site to take advantage of natural dispersion of emissions in the atmosphere.

# APPENDIX C
# ODOR MANAGEMENT PLAN

# ODOR MANAGEMENT PLAN (OMP) FOR INTERIM REMEDIAL MEASURE FOR THE EAST STATION FORMER MGP SITE ROCHESTER, NEW YORK

## SITE #: V00358-8

## INDEX #: B8-0535-98-07

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Prepared for:

**Rochester Gas & Electric Corporation**
89 East Avenue
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Prepared by:

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804 Salem Woods Drive
Raleigh, NC 27615

March 2007

# CONTENTS

# 1

# INTRODUCTION

The purpose of this Odor Management Plan (OMP) is to provide actions to control odors during intrusive remedial design investigation and remedial construction activities at the RG&E property at East Station, Rochester, New York. This property is the Site of a former manufactured gas plant (MGP). The remedial program will involve soil excavation, construction of ISS wall, and installation of a NAPL recovery trench that may generate nuisance odors. RG&E considers the control of odors to be a priority during activities to be implemented at the Site.

This plan is part of the Work Plan for Phase III (ISS application) of the Draft Remedial Design Work Plan for controlling NAPL seeps as an Interim Remedial Measure (IRM) at the East Station former MGP site, and a companion document to the Community Air Monitoring Plan (CAMP) and the site-specific Health and Safety Plan (HASP). The CAMP requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated remedial work area. The HASP specifies procedures that are to be used to protect site workers and the public during the remedial design and construction activities.

This portion of the work plan is intended to provide site managers, representatives of NYSEC and NYSDOH, and the public with information summarizing typical odor control options, and to provide guidance for their implementation. A description of potential sources of odors and methods to be used for odor control is presented in the following sections.

## 1.1 POTENTIAL SOURCES OF ODORS

Generally, the materials encountered at former MGP sites are well-defined. They principally contain VOCs, polynuclear aromatic hydrocarbons (PAHs), and a number of inorganic constituents, including metal-complexed cyanide compounds, and metals. Constituents of MGP tar or petroleum products can produce distinctive odors when they are unearthed during intrusive subsurface activities. MGP materials can produce odors that are similar to mothballs, roofing tar, or asphalt driveway sealer.

# 2
# ODOR MONITORING

The CAMP specifies continual monitoring of VOCs and particulates during intrusive subsurface field work. This OMP specifies the procedures and actions to be employed should VOCs and/or particulates be detected above action levels specified in the CAMP, or to minimize nuisance odors during the field work.

The field remedial design investigation and remediation construction oversight personnel will record observations of odors generated during the implementation of the Work Plan. Odors will be recorded as weak, moderate, or strong, based on olfactory responses. When odors attributable to MGP material are noted in the work area, observations also will be made at the downwind limit of the RG&E property, in order to assess the potential for off-site migration of odors. The downwind odor monitoring will be performed in conjunction with the VOC and particulate monitoring program described in the CAMP.

Upon detection of moderate or strong odors at the site perimeter, site controls, starting in the work area, will be implemented. The site controls described in the following sections will be used to assist with odor mitigation. The goal of the OMP is to minimize, and to prevent where practicable, the off-site migration of odors. Site controls will be implemented pro-actively when odors are detected in the breathing zone at the work area.

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# ODOR MITIGATION

If odor mitigation becomes necessary due to activities on-site, site controls will be implemented, as described in this section. Based on the scope of the remedial activities planned, some form of odor mitigation will most likely be required for this effort.

## 3.1 SITE CONTROLS

Site controls are intended to limit the production of odors from on-site activities and to minimize the off-site migration of nuisance odors.

### 3.1.1 Primary Controls

Several primary odor controls will be implemented such as:

- Every effort will be made to minimize the amount of time that ambient air is exposed to odiferous material at the site. During excavation activities, layers of cleaner soil or polyethylene sheeting/tarps may be used to cover these soils to prevent or minimize fugitive odors.
- Soil stockpiles will be covered when they are not being manipulated.
- Meteorological conditions are also a factor in the generation and migration of odors. Some site activities may be limited to times when specific meteorological conditions prevail, such as when winds are blowing away from a specific receptor.

### 3.1.2 Secondary Site Controls

If moderate or strong odors remain at the RG&E downwind property line after primary odor controls have been implemented, secondary controls will be used to control those odors. The field team leader will work through the applicable list of secondary controls until the perimeter odor issues are resolved. The field team leader will work closely with RG&E during this task.

Final selection of controls will be dependent on field conditions encountered and the effectiveness and availability of the control technology.

Secondary controls may include the following:

- For stockpiled impacted soil, temporary tarps or polyethylene covers will be used to control odors.
- Three agents that can be sprayed over impacted soil have been determined to be effective in controlling emissions. They include odor suppressant foam, BioSolve® vapor suppression, and hydro-mulch. These agents may be used where tarps cannot be effectively deployed over the source material such as during active excavation and stockpiling, or where tarps are ineffective in controlling odors:
  - **BioSolve®** is a biodegradable, water based product that has the unique ability to encapsulate hydrocarbon VOC vapor. The product is mixed with water at a 3 to 5% concentration and can be applied with wide variety of water application spray methods. BioSolve® emulsifies and encapsulates the hydrocarbon almost instantly, and is not subject to breaches or drawdown (like some foam applications) that allow for re-volatilization, making it an ideal choice in windy conditions, and on sloped surfaces.
  - **Hydromulch** - Although it is unlikely that it will be necessary, modified hydromulch slurry may be used to cover inactive sources for extended periods of time (up to several days). The hydromulch, typically cellulose fibers (HydroSealR), is modified by mixing a tackifier (glue) with the mulch and water to form slurry. It is applied using a standard hydro-seed applicator to a thickness of about ¼ inch. The material forms a sticky, cohesive, and somewhat flexible cover. Reapplication may be necessary if the applied layer becomes desiccated or begins to crack
  - **Odor Suppressant Foam** - Although it is unlikely that it will be necessary, odor suppressant foam can provide immediate, localized control of odor emissions. The foam is made by the injection of air into a foam concentrate/water mixture

using a Pneumatic Foam Unit (PFU). The foam is applied via a hose to cover source areas to a depth of 3 to 6 inches. Short-term foam (such as Rusmar AC-645) is recommended to control VOC and odor emissions from active excavations and stockpiles. It is shipped as a concentrate and is diluted with water at the Site. Under normal conditions this foam can last between 12-17 hours. However, it has been observed to degrade quickly in direct sunlight, so frequent and liberal application to areas that require odor control is advisable. For longer-term odor suppression needs, such as over weekends, long-term foam (such as Rusmar AC-904 which lasts between 15-30 days) should be used.

- The placement of portable barriers close to small active source areas (excavation areas) can elevate the discharge point of emissions to facilitate dispersion and minimize the effect on downwind receptors. The barriers can be constructed using materials such as plastic "Jersey barriers", or fence poles and visual barrier fabric/plastic. The barriers are placed as temporary two or three-sided structures around active test pit or other intrusive activity areas, oriented such that the barriers are placed on the upwind and downwind sides of the source. If only one side of the source can be accessed, then the barrier should be placed on the downwind side.

## 3.2 RECORD KEEPING AND COMMUNICATION

Similar to readings recorded during the monitoring specified in the CAMP, odor monitoring results will be recorded in the field log book or in other air monitoring forms, as well as download daily onto portable computer. These records will be available on-site for State (NYSDEC and NYSDOH) personnel to review.

In the event that odors persist after these efforts, work will be temporarily discontinued until a mutually agreeable solution with RG&E, NYSDEC, and NYSDOH staff can be worked out which allows the work to be completed while minimizing the off-site migration of nuisance odors.