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FINAL

SOLID WASTE MANAGEMENT UNIT (SWMU) CONFIRMATORY SAMPLING PROJECT PLANS

HEALTH AND SAFETY PLAN

MCB, CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0371

AUGUST 21, 1997

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
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1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed by Baker Environmental, Inc. (Baker) to accompany the Project Plans for Contract Task Order 0371. The objective of the project is to conduct a Confirmatory Sampling investigation for 62 solid waste management units (SWMUs) at the Marine Corps Base (MCB), Camp Lejeune, North Carolina. The purpose of this HASP is to comply with the safety and health regulations of the OSHA General Industry and Construction Standards and to define the requirements and designate protocols to be followed during confirmatory sampling activities involving potentially contaminated soils, and/or groundwater.

1.1 Policy

It is the policy of Baker Environmental, Inc. (Baker) that all on-site hazardous waste management activities be performed in conformance with a site-specific HASP. The HASP is written based on the anticipated hazards and expected work conditions and applies to activities performed under this Contract Task Order (CTO). Applicability of this HASP extends to all Baker employees, Baker's subcontractors, and visitors entering the site. However, subcontractors are expected to provide their own HASP and relevant Standard Operating Procedures (SOPs) that pertain to the activities they are contracted to perform on the site. All personnel must review the HASP and sign an agreement to comply with its provisions prior to commencing any on-site work. The HASP may be modified/updated with the approval of the Project Health and Safety Officer (PHSO) and Project Manager. Proper notification will be given to the Atlantic Division (LANTDIV), Naval Facilities Engineering Command Navy Technical Representative (NTR) when significant changes to the HASP are implemented.

This HASP, at a minimum, meets the requirements under OSHA Standard 29 CFR 1910.120 and 1926.65 (Hazardous Waste Operations and Emergency Response).

1.2 Project Plans

The Work Plan (detailing the tasks to be performed at each site), the Sampling and Analysis Plan (SAP), and Quality Assurance Project Plan (QAPP) are bound as separate documents, and will accompany the Health and Safety Plan in the field.

1.3 References

The following publications have been referenced in the development and implementation of this HASP.

- American Conference of Governmental Industrial Hygienists (ACGIH). 1995. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1995-1996.

- Lewis, Richard J., Sr. 1991. Hazardous Chemicals Desk Reference, 3rd Edition, Van Nostrand Reinhold, New York, New York.

- Martin, William F. and Steven P. Levine. 1994. Protecting Personnel at Hazardous Waste Sites, 2nd Edition, Butterworth-Heinemann, Stoneham, Massachusetts.

- National Institute for Occupational Safety and Health/Occupational Safety and Health Administration/U.S. Coast Guard/U.S. Environmental Protection Agency. 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October 1985.

- Occupational Safety and Health Administration. 1995. Title 29 Code of Federal Regulations, Parts 1910 and 1926.

- United States Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH. 1994. NIOSH Pocket Guide to Chemical Hazards. June 1994.

- United States Environmental Protection Agency, Office of Emergency and Remedial Response, Emergency Response Division. 1992. Standard Operating Safety Guides. June 1992.

2.0 PROJECT PERSONNEL AND RESPONSIBILITIES

The following personnel are designated to carry out the stated job functions for both project and site activities. (Note: One person may carry out more than one job function; personnel identified are subject to change.) The responsibilities that correspond with each job function are outlined below.

PROJECT MANAGER: Ms. Tammi Halapin

The Project Manager will be responsible for assuring that all activities are conducted in accordance with the HASP. The Project Manager has the authority to suspend field activities if employees are in danger of injury or exposure to harmful agents. In addition, the Project Manager is responsible for:

- Assisting the Project Health and Safety Officer (PHSO), as designated below, in Site-Specific HASP development for all phases of the project.
- Designating a SHSO and other site personnel who will assure compliance with the HASP.
- Reviewing and approving the information presented in this HASP.

PROJECT HEALTH AND SAFETY OFFICER: Mr. Ronald Krivan

The PHSO will be responsible for general development of the HASP and will be the primary contact for inquiries as to the contents of the HASP. The PHSO will be consulted before changes to the HASP can be approved or implemented. The PHSO will also:

- Develop new protocols or modify the HASP as appropriate and issue amendments.
- Resolve issues that arise in the field with respect to interpretation or implementation of the HASP.
- Monitor the field program through a regular review of field health and safety records, on-site activity audits, or a combination of both.
- Determine that all Baker personnel have received the required training and medical surveillance prior to entry onto a site.
- Coordinate the review, evaluation, and approval of the HASP.

SITE MANAGER: [To Be Named Prior To Mobilization]

The Site Manager will be responsible for assuring that all day-to-day activities are conducted in accordance with the HASP. The Site Manager has the immediate authority to suspend field activities if employees are subjected to a situation that can be immediately dangerous to life or health. The Site Manager's responsibilities include:

- Assuring that the appropriate health and safety equipment and personal protective equipment (PPE) have arrived on site and that it is properly maintained.

- Coordinating overall site access and security measures, including documenting all personnel arriving or departing the site (e.g., name, company and time).

- Approving all on site activities, and coordinating site safety and health issues with the SHSO.

- Assisting the SHSO in coordinating emergency procedures with the Naval Activity, emergency medical responders, etc., prior to or during site mobilization activities.

- Assuring compliance with site sanitation procedures and site precautions.

- Coordinating activities with Baker and subcontractor personnel.

- Overseeing the decontamination of field sampling equipment.

- Serving as the backup/alternate Emergency Coordinator.

SITE HEALTH AND SAFETY OFFICER: [To Be Named Prior To Mobilization]

The SHSO will be responsible for the on-site implementation of the HASP. The SHSO also has the immediate authority to suspend field activities if the health or safety of site personnel is endangered, and to audit the subcontractor training, fit testing, and medical surveillance records to verify compliance. These records will be maintained at the Baker Command Post. The SHSO will also:

- Coordinate the pre-entry briefing and subsequent briefings.

- Assure that monitoring equipment is properly calibrated and properly operated.

- Assure compliance with the Baker Standard Operating Procedures (SOPs) in Attachment A.

- Inform personnel of the material safety data sheets (MSDSs) located in Attachment B.

- Manage health and safety equipment, including instruments, respirators, PPE, etc., that is used during field activities.

- Confirm emergency response provisions, as necessary, in cooperation with Naval Activity, emergency medical care, etc., prior to or during site mobilization activities.

- Monitor conditions during field activities to ensure compliance with the HASP and evaluate if more stringent procedures or a higher level of PPE should be implemented, and informing the PHSO and Project Manager.

- Document, as necessary, pertinent information such as accident investigation and reporting, designated safety inspections, a record of site conditions, personnel involved in field activities, and any other relevant health and safety issues. This information will become part of the official site records.

- Act as the Emergency Coordinator.

The Field Team Members will be responsible for:

- Familiarity with the HASP.
- Complying with the contents of the HASP.
- Attending training sessions to review the HASP, and staying informed of additional safety and health information.
- Being alert to identified and unidentified hazards, and reporting unidentified hazards to the SHSO and Site Manager, as soon as possible.
- Offering suggestions, ideas, or recommendations that may improve or enhance site safety.
- Conducting site activities in an orderly and appropriate manner.
- Reporting accidents/injuries, however minor, to the SHSO as soon as possible.

Subcontractor personnel are responsible for:

- Complying with the conditions as outlined under "Field Team Members."
- Complying with all OSHA regulations relevant to their work.
- Obtaining the appropriate training, fit testing, and medical surveillance requirements under 29 CFR 1910.120, 1926.65, and 1910.134 and providing this documentation to the Site Manager prior to or during site mobilization.
- Having a competent safety monitor on site.
- Complying with the training and medical surveillance requirements as outlined in Sections 9.0 and 10.0, respectively, and providing their own PPE that meets or exceeds the level of protection as outlined in this HASP.

SUBCONTRACTOR COMPANIES:
All subcontractor companies are to be announced.

LANTDIV REPRESENTATIVES:

- Ms. Katherine Landman Naval Technical Representative (NTR)
  (804) 322-4818

ACTIVITY/STATION/BASE REPRESENTATIVES: MCB Camp Lejeune Representatives:

- Mr. Tom Morris (910) 451-5972
- Mr. Mick Senus (910) 451-5068

3.0 SITE CHARACTERIZATION

This section presents relevant background information and a description of the physical hazards that may exist during the Confirmatory Sampling investigation.

3.1 Background Information

Table 3-1 presents relevant background information for each SWMU, including a physical description and waste management history.

3.2 Project Plans

The Project Plans include four separate documents: a Work Plan (detailing the task to be performed at each site), a Sampling and Analysis Plan (SAP), a Quality Assurance Project Plan (QAPP), and this Health and Safety Plan (HASP). The work tasks that will be performed during the Confirmatory Sampling investigation include:

- Temporary monitoring well installation
- Soil sampling
- Groundwater sampling
- Surface water and sediment sampling

3.3 Task-specific Physical and Environmental Hazards

3.4 General Physical Hazards

The identified potential physical hazards associated with this project include thermal stress, geoprobe operations, underground utilities, and noise. The following presents a description of these potential hazards.

3.4.1 Thermal Stress

Provisions for monitoring for thermal stress are included in Attachment A - Baker Safety SOPs.

3.4.2 Geoprobe Operations

Prior to operation of the Geoprobe site personnel are to review and follow the manufacturer's safety instructions. A copy of the operator safety instructions from the Geoprobe owner's manual are included in Attachment C.

3.4.3 Utilities

Underground utility clearance must be obtained before any intrusive activities are performed; this clearance will be provided by a representative from the Public Works Department at MCB Camp Lejeune. If underground utilities are identified in these areas, the ground above the utility lines are to be physically marked, such as with spray paint or flags. Base representatives are to be notified at least one week prior to soil intrusive activities to begin acquisition of utility clearances. A 24-inch minimum clearance must be used for work near underground utilities.

3.4.4 Noise

Elevated noise levels may be produced during drilling operations, therefore, hearing protection will be made available. The SHSO is responsible for making this determination based upon past experiences with the type of equipment in use, and specifying hearing protection when appropriate. Employees can receive hearing protection upon request.

3.5 General Environmental Hazards

3.6 Chemical Hazards

A summary of the wastes suspected at each SWMU under investigation is provided in Table 3-1. The general list of wastes include used oil, solvents, pesticides, herbicides, No. 2 fuel oil and No. 6 fuel oil. Table 3-2 lists the physical and toxic properties for many of the chemicals involved at the various SWMUs. Material Safety Data Sheets (MSDSs) for the chemicals listed in Table 3-2 is provided in Attachment B.

Other chemical hazards that may be present are from the preservative chemicals that will be in some of the sample containers (such as, hydrochloric acid and nitric acid). An MSDS will be obtained from the laboratory and be available with the field sampling team for all sample preservatives.

3.5 Environmental Hazards

The following paragraphs identify the hazards associated with flora and fauna at MCB Camp Lejeune. If additional concerns are identified, they will be added to this HASP.

Hazardous Flora

An incidence of contact by individuals to poisonous/thorny plants is high while working in wooded areas. Bare skin should be covered (i.e., long pants and shirt, steel toe boots, leather or cotton gloves, safety glasses, and head protection) as much as practical when working in forested or densely vegetated areas. Personnel should avoid entering an area in the direct path of known poisonous flora (i.e., poison ivy, poison oak, or poison sumac); a secondary route should be selected. Care should also be taken when walking in such areas as uneven terrain or vines may present a tripping hazard.

Hazardous Fauna

Mosquitoes and gnats pose a nuisance and physical hazard to field personnel; they distract workers, leading to accidents, and pose a physical threat by transmitting live microorganisms. Avoiding the use of perfumes and scented deodorants and donning light colored clothing is preferable. The use of Avon's "Skin So Soft" or other insect repellent is encouraged and will be provided, as needed.

Poisonous snakes such as the rattlesnake, copperhead, and cottonmouth (water moccasin), all known as pit vipers, are common to the eastern United States. Snakes typically do not attack people but will bite when provoked, angered, or accidentally injured (as when stepped on). When encountering a snake, avoid quick/jerky motions, loud noises, and retreat slowly; do not provoke the snake. If bitten, follow emergency procedures outlined in the Emergency Procedures Section.

There are two spiders commonly found in the United States whose bite can be serious: the black widow spider and the brown recluse spider. These bites may be serious, even life-threatening. Many other spiders will bite, but they do not produce serious complications. The black widow spider measures approximately 1 inch long with its legs extended. It is glossy black in color and has a distinctive yellow-orange marking in the shape of an hourglass on its belly. On its back, however, there is no marking, and unless you happen to turn the spider over, you cannot see this mark. The danger of the black widow spider bite lies in its systemic manifestations. The venom from this spider attacks the nervous system, resulting in severe muscle cramps with boardlike rigidity of the abdominal muscles, tightness in the chest, and difficulty in breathing. Sweating, nausea, and vomiting will also occur.

The brown recluse spider is a little bit smaller than the black widow spider and is dull brown in color. It has a violin-shaped mark on its back, which can be seen when you are looking at the spider from above. The spider gets its name because it tends to live in dark areas, corners, and old unused buildings. The bite from this animal produces local rather than systemic manifestations. The venom of the brown recluse spider causes severe local tissue damage and can lead to an ulcer and gangrene. The bitten area becomes red, swollen, and tender within a few hours after the bite. A small blister forms, and several days later, this may form a large scab, covering a deep ulcer. Death is rarely reported. If a spider bite by a black widow or brown recluse is suspected, follow emergency procedures in Emergency Procedures Section.

There is also a potential to contact other dangerous insects; these include fire ants, chiggers, bees, wasps, hornets, mites, fleas, and ticks. Personnel should perform "checks" periodically and at the end of the work shift, especially when working in grassy or forested areas. Insect bites must be reported to the SHSO.

Before initiating site activities, each individual will be questioned as to any known sensitivities to the previously mentioned organisms or agents.

3.6 Task-Specific Hazards

Listed below are summaries for the hazards associated with each potential task for an area under investigation. Levels of protection outlined in Section 6.0 were selected based on this task-specific hazard identification, information obtained from previous investigations and site visits, and previous experience with similar investigations or activities.

3.5.1 Land Surveying

Chemical

- Skin contact with potentially-contaminated soil.
- Ingestion of contaminated material from hand-to-mouth contact.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.

3.5.2 Surface Soil Sampling

Chemical

- Skin contact with potentially-contaminated soil.
- Ingestion of contaminated materials from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Absorption of constituents through the skin.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.
- Muscle strain from boring with hand auger.

3.5.3 Temporary Monitoring Well Installation (Geoprobe)

Chemical

- Potentially-contaminated mud, soil, or groundwater to be splashed onto body or in eyes.
- Ingestion of contaminated materials from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Absorption of groundwater through the skin.

Physical/Environmental

- Elevated noise levels from heavy equipment operation.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation..
- Interaction with native and feral animal life.
- Contact with underground utility lines.
- Review Attachment B safety instruction information on Geoprobe use

3.5.4 Monitoring Well Development

Chemical

- Potential for groundwater to be splashed onto body or in eyes.
- Ingestion of contaminated materials from hand-to-mouth contact.

- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.

3.5.5 Groundwater Sampling

Chemical

- Potential for contaminated groundwater or bottle preservative to be splashed onto body or in eyes.
- Ingestion of contaminated materials from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants emitting from the well opening.
- Adsorption of groundwater through the skin.

Physical/Environmental

- Skin irritation from contact with insects and vegetation.

3.5.6 Subsurface Sampling - Geoprobe Soil Boring

Chemical

- Potential for contaminated mud, soil, or groundwater to be splashed onto body or in eyes.
- Skin contact with potentially-contaminated soil.
- Ingestion of potentially-contaminated soils from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Elevated noise levels from heavy equipment operations.
- Muscle strain from lifting hazards.
- Skin irritation from contact with insects and vegetation.
- Contact with underground utilities.
- Interaction with native and feral animal life.
- Slips/trips/falls from sloped, uneven terrain; crawling over and under obstacles.
- Review Attachment B safety instruction information on Geoprobe use

4.0 SITE CONTROL

Measures need to be addressed in the HASP for managing the daily control of the site (i.e., access, site conditions, etc.). The following subsections provide a discussion of each site control measure that will be consistent for activities at the various SWMUs where the Baker confirmatory sampling will be undertaken..

4.1 Site Access

The Site Manager is designated to coordinate overall access and security at each SWMU under investigation. Perimeters will be established according to the site boundary procedures identified in Section 4.3, local conditions, the items listed below, and Navy Activity requirements.

- Personnel will not be permitted within the Work Zone (i.e., Exclusion Zone) or Contamination Reduction Zone without proper authorization from the SHSO.
- All personnel arriving or departing the site will be documented in the site log book.
- All activities on site must be cleared through the Site Manager and documented in the site log book.
- The on-site Command Post will be established at the Baker Field Trailer, which is located at Lot 203 Holcomb Blvd.

4.2 Site Conditions

Before activity begins at each SWMU, a review of site conditions will be reviewed by the Site Manager and SHSO. Any site conditions that can effect the safety and health of the field crews will be reviewed during mobilization at each SWMU.

4.3 Work Zones

Work zones will be delineated to reduce the accidental spread of hazardous substances and to keep unauthorized personnel from entering the work zones. The sections below identify the requirements based on the level of protection in use.

4.3.1 Level C Activities

If an upgrade to Level C is required the following boundaries will be physically established:

- Work Zone - The area where the primary investigation activity occurs.
- Hotline - The boundary between the Work Zone and CRZ.
- CRZ - The area between the Work Zone and the Support Zone which is located upwind of the site investigative activities.
- Contamination Control Line - The boundary between the CRZ and the Support Zone.

- Support Zone - The outermost area next to the CRZ and upwind of the site investigative activities.

These boundaries will be demarcated using colored boundary tape, cones, or equivalent for the Hotline or the Decontamination Corridor of the CRZ and/or barriers for the Contamination Control Line such as posted signs and/or barricades.

4.3.2 Level D and D+ Activities

The SHSO is responsible for determining if physical boundaries will be needed around each work area. This determination will be based on the surrounding activities and the health and safety of the field crews and bystanders.

4.4 "Buddy System"

Activities at each SWMU that involve intrusive and sampling activities that present a potential for contact with hazardous materials will be performed by a work team of no fewer than two people (i.e., Buddy System).

4.5 Safe Work Practices

General safe work practices for each task will be reviewed during the HASP training. Routine safe work practices may consist of:

- Conducting operations in a manner to reduce exposure of personnel and equipment.
- Implementing appropriate decontamination procedures.
- Conducting sampling activities from an upwind location.
- Adherence to applicable safety regulations in OSHA Standards 29 CFR 1910 and 1926.
- Setting up barriers to exclude unauthorized personnel from contaminated areas.
- Minimizing the number of personnel and equipment at each area under investigation.
- Establishing work zones within each area under investigation.
- Establishing control points for ingress to and egress from work zones.

4.6 Sanitation Procedures/Site Precautions

Provisions for sanitation procedures and site precautions to be followed on site are outlined below.

- A supply of clearly marked potable water, tightly closed, and equipped with a tap.
- Single service disposal cups.
- Outlets for non-potable water, clearly marked, for fire fighting or other purposes. Cross-contamination of the potable supply shall be prevented.

- One toilet facility for up to 20 personnel which is either chemical, recirculating, combustion, or flush, depending on local code requirements. Two toilet facilities will be required for greater than 20 personnel.

- A place for food handling meeting applicable laws or suitable alternatives to such facilities will be provided (i.e., nearby restaurants, food wagons, etc.).

- Clean wash water will be available in the decontamination zone during Level C or B activities, as well as each Baker Field Vehicle and the Baker Field Trailer.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated. Smoking will also not be allowed in areas where flammable materials are present. Hands and face must be thoroughly washed before breaking for meals and upon leaving the site. "Contaminated" work garments are not to be worn off site.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact lenses are <u>not permitted</u> to be worn on site.

- Facial hair, which interferes with a satisfactory fit of the mask-to-face seal, is not permitted on personnel who are or may be required to wear respirators.

- Contact with contaminated or potentially-contaminated surfaces should be avoided. Wherever possible, do not walk through puddles, leachate, discolored surfaces, lean, sit or place equipment on drums/containers.

- Medicine and alcohol can potentiate the effects of exposure to toxic chemicals, therefore, prescribed drugs should only be taken by personnel when approved by a qualified physician. Alcoholic beverage intake should be minimized or avoided during after-hour operations.

- Alcoholic beverages and firearms are prohibited on site.

- All site personnel will observe any posted sign, warning, fence, or barrier posted around contaminated areas.

- Site personnel must wear the proper attire while on site. At a minimum, this will include steel-toed boots, work pants (e.g., jeans or other durable material), and work shirt (e.g., short or long-sleeved, made of a durable material). Tank tops, muscle shirts, and sweat pants are not permitted.

5.0 ENVIRONMENTAL MONITORING

Environmental monitoring will be performed during the geoprobe and sampling activities. Due to the short duration and variability of field tasks real-time air monitoring will be used to assess action levels. The action levels for the PID are based on a "worst-case" contaminated 8-hour TWA-PEL of 1 ppm (i.e., benzene, etc.), and are consistent with those listed by the USEPA in Section 6.9, of the Standard Operating Safety Guides (June, 1992).

Personal monitoring will be accomplished using real-time environmental monitoring instrumentation directed at the breathing zone (BZ) (the area bordered by the outside of the shoulders and from the mid-chest to the top of the head) of work party personnel. Breathing zone monitoring will be performed each time a reading is taken at the point source (i.e., after well is opened for groundwater sampling, after breaking ground for soil sampling, etc.). The guidelines below identify the protection levels required according to the concentrations measured using each piece of equipment.

PID [1]

- Background[2] = Level D/D+
- >1 mu (meter unit) above background for up to 1 continuous minute in the BZ =Stop work and consult the PHSO
- >5 mu above background for up to 15 continuous minutes in the BZ = Stop work and consult the PHSO
- Instantaneous peak concentrations >10 mu in the BZ = Stop work and consult the PHSO

(1) PID with 10.2 eV ultraviolet lamp set on the 1X Scale.
(2) Background is typically 1 to 2 mu

5.1 Equipment Maintenance and Calibration

Equipment calibration under the direction of the SHSO will be completed daily before use and calibration information entered into the field log book. Copies of this information will be given to the Project Manager at the completion of the field work.

Procedures for equipment maintenance and calibration follow those guidelines found in the operating manual provided by the manufacturer (included with each piece of equipment) or in Baker's Standard Operating Procedures for Administrative, Field, and Technical Activities Manual.

5.2 Monitoring Documentation

As environmental monitoring is performed, documentation of the results will be entered into the Field Log Book of the SHSO or other personnel performing the monitoring. Documentation is to include the date, time, instrument result, general location, and specific location such as point source, breathing zone, or area, and weather conditions during the monitoring time period. Copies of the Field Log Book with the air monitoring information will given to the Project Manager at the completion of the field work.

6.0 PERSONAL PROTECTIVE EQUIPMENT

Based on the information provided in Section 3.0, Site Characterization, the levels of protection and corresponding PPE have been designated for the following field activities. Upgrading or downgrading the level of protection will be based on realtime monitoring, working conditions, and the discretion of the SHSO.

Note: No single combination of protective equipment and clothing is capable of protection against all hazards. PPE should be used in conjunction with safe work practices, effective decontamination, and good personal hygiene.

EXCEPT IN EMERGENCY SITUATIONS, CHANGES TO THE SPECIFIED LEVELS OF PROTECTION SHALL ONLY BE MADE WITH THE APPROVAL OF THE SHSO AND THE SITE MANAGER, IN CONSULTATION WITH THE PHSO AND PROJECT MANAGER.
PROTECTIVE CLOTHING: Table 6-1 summarizes the level of protective clothing required for the field task to be performed at the site.

7.0 DECONTAMINATION PROCEDURES

Procedures to follow for the decontamination of personnel and equipment, as well as handling of materials generated during decontamination, are discussed in the following sections.

7.1 Personnel Decontamination

Personnel leaving the Work Zone will be thoroughly decontaminated. The following protocol will be used for the decontamination stations according to levels of protection assigned to each field activity:

Level D	Level D+	Level C
1. Equipment drop	1. Equipment drop	1. Equipment drop
2. Hand/Face wash	2. Inner glove removal/disposal	2. Outer boot and glove wash
3. Equipment wipe down	3. Coverall removal/ disposal*	3. Outer boot and glove rinse
	4. Hand/face wash	4. Tape Removal
	5. Equipment cleaning	5. Outer boot and glove removal
		6. Coverall removal/ disposal
		7. Respirator removal
		8. Inner glove removal/ disposal
		9. Hand/face wash
		10. Respirator cleaning/ sanitizing
		11. Equipment cleaning

*Optional - depends on degree of contamination and type of PPE used.

The following decontamination equipment is required for Level C protection levels:

- Two small tubs (one set of wash and rinse water)
- Scrub brush
- Towels*
- Hand and face wash capability*
- Pressurized sprayers for rinsing
- Contaminated clothing disposal bag or drum*

- Contaminated liquids disposal drum
- Respirator cleaning solution
- Liquinox and water as the decontamination solution

*Minimum for Level D decontamination.

7.2 Effectiveness of Personnel Decontamination

The effectiveness of site decontamination methods will be evaluated by the SHSO on a periodic basis. This evaluation may include the observation of personnel decontamination, inspection of PPE before and after decontamination, and questioning site personnel for signs and symptoms of exposure. Additional measures may also be employed by the SHSO at their discretion.

8.0 EMERGENCY PROCEDURES

8.1 Scope

The activities to be conducted under this HASP are not remediation (cleanup), but investigative; therefore the potential for a "release" to air, water, or soil is low. However, other emergencies, such as fire or personal injury may occur. If so, local emergency response groups will be called in to handle the incident, as necessary.

8.2 Pre-Emergency Planning

All applicable Navy/local emergency response contacts (On-Scene Commander, Fire Department, Security, Ambulance, Hospital, etc.) at MCB Cam Lejeune will be contacted prior to or during site mobilization activities. This notification will be performed by the SHSO and/or Site Manager. The information discussed may include:

- A description of site activities.
- Anticipated site hazards.
- Hazardous chemicals/materials brought on site.
- Expected length of time on site.
- Specific requirements the emergency response facilities may require.
- Confirmation of emergency phone numbers.
- Security measures that must be followed by site personnel.

Specific points of contact, where applicable, will be established and added to the HASP. If requested, Material Safety Data Sheets for hazardous chemicals/materials brought on site (which are maintained at the Command Post), will be provided at this time.

8.3 Emergency Coordinator

The SHSO acting as the Emergency Coordinator is responsible for field implementation of these Emergency Procedures. The Emergency Coordinator is responsible for reacting (not responding) to emergencies. As the Emergency Coordinator, specific duties include:

- Familiarizing all on-site personnel with the emergency procedures and the emergency coordinator's authority.
- Identifying the nearest telephone in the event of an emergency.
- Communicating site emergency procedures and requirements to all Baker and subcontractor personnel.
- Specifying the Site Manager as the backup/alternate Emergency Coordinator.
- Controlling activities of subcontractors and contacting the emergency response groups, as necessary.

- Anticipating, identifying, and assessing fires, explosions, chemical releases, and other emergency situations to the best of the coordinator's ability, and providing this information to the emergency group(s) responding.

- Familiarity with site personnel trained in emergency first aid and adult CPR.

All on-site personnel, whether involved in emergency response or not, will be notified of their responsibilities by the Emergency Coordinator in an emergency. They will be familiar with the emergency procedures and the Emergency Coordinator's authority.

8.4 Communications/Telephone Numbers

Internal communications will rely on direct communication (via verbal or two-way radios) between site personnel. External communications will employ a telephone located in the Baker Field Trailer, a mobile telephone for emergency use, and various telephones located throughout the Base (near the investigation areas). Telephone communication at the Command Post will be established during site mobilization.

The "Buddy System" will be in effect at all times; any failure of communication requires an evaluation of whether personnel should discontinue activities.

Air horns will be used for communication during emergency evacuation of personnel. One long (3 second) air horn blast is the emergency signal to indicate that all personnel should evacuate the Work Zone.

Coordination between Baker and subcontractor personnel is the responsibility of the Site Manager. The best means for securing the lines of communication will be determined at the pre-entry briefing.

Emergency telephone numbers will be posted in the Baker Field Trailer and maintained in each Baker Field Vehicle. The list of emergency phone numbers is presented in Table 8-1.

8.5 Assembly Area

In the event of an emergency, personnel will be instructed to meet initially at the Baker Field Vehicle and eventually at the Baker Field Trailer. Where applicable, personnel will exit the work area through the contamination reduction zone. If either location is inappropriate, an alternate assembly area will be designated by the Emergency Coordinator in an upwind location from the site. At this location, emergency needs will be provided such as:

- Assembly for evacuated personnel
- First aid for injured personnel
- Decontamination material
- Communications

8.6 Emergency Hospital Route

An emergency hospital route map and written directions to the hospitals will be posted in the Baker Field Trailer and maintained in the Baker Field Vehicle. Personnel will be informed of the location

of the maps and the directions to the hospitals during the pre-entry briefing. The hospital route maps includes directions to the MCB Camp Lejeune Base Hospital and the Onslow County Hospital. The maps depict the locations from MCB Camp Lejeune (Figure 8-1), Camp Geiger and the Air Station (Figure 8-2). The written directions from these areas are provided in Table 8-2.

8.7 Emergency Medical Treatment

This section provides information on the nearest emergency medical facility and corresponding emergency telephone numbers.

Emergency Medical Services

For chemical and nonchemical exposure incidents, the nearest public hospital is:

Name:	Onslow County Memorial Hospital
Address:	317 Western Blvd.
On-Base Telephone No.	557-2240
Off-Base Telephone No.	910-557-2240

Note In extreme emergencies at MCB Camp Lejeune, personnel may be transported to Building NH100 (Naval Hospital) for initial treatment.

Local ambulance service is available from the base ambulance service at 911 and the City of Jacksonville at 910-455-9119. Contact will be made with emergency personnel prior to the start of activities (see Section 8.2).

8.8 Injuries

If injuries are not serious or life threatening, affected personnel may be transported by other site personnel to the local medical facility, if necessary. Emergency medical response personnel will be contacted in the event of serious or multiple injuries. Medical personnel will be provided with all available information regarding the nature of the incident, chemicals involved, etc. Instances requiring treatment beyond "first aid" will be handled at appropriate facilities and reported to the Project Manager and PHSO within 24 hours.

There will be a minimum of two persons during each phase of field activities that will be trained in standard first aid and adult CPR. These personnel will also be familiar with Baker's program for potential exposure to bloodborne pathogens as outlined in the Baker Safety SOPs in Attachment A. Subcontractors will be responsible for securing proper medical attention for their employees. Baker may assist the subcontractor as necessary.

8.8.1 Physical Injury

If an employee working in a contaminated area is physically injured, first aid procedures are to be followed. If the employee can be moved, he/she will be taken to the edge of the work area and decontaminated, if necessary (refer to Section 8.9). Depending on the severity of the injury, emergency medical response from base personnel may be sought to stabilize victim for transport to public hospitals. Emergency first aid may be administered by Baker personnel prior to transporting to an awaiting ambulance or to a local emergency medical facility, as appropriate.

8.8.2 Chemical Injury

If the injury to a worker is chemical in nature (e.g., direct contact/exposure), the following first aid procedures are to be instituted:

- Eye Exposure - If contaminated solid or liquid gets into the eyes, wash the eyes immediately at the 15-minute emergency eyewash station (or with the personal eye wash bottle when an eye wash station is not immediately available). Obtain medical attention immediately.

  NOTE: Contact lenses will not be worn while working at any site.

- Skin Exposure - If contaminated solid or liquid gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If solids or liquids penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately.

- Swallowing - If contaminated solid or liquid has been swallowed, immediately contact the Duke Regional Poison Control Center Poison Control Center at 1-800-672-1697. Do not induce vomiting in an unconscious person. Obtain medical attention as directed by the Poison Control Center.

- Breathing - If a person has difficulty breathing, move the exposed person to fresh air at once. If breathing is not evident, check for pulse and perform appropriate first aid, either rescue breathing or CPR, depending on the condition. Obtain medical attention immediately.

8.8.3 Snakebite Injury

In the event of a snakebite injury, the following procedures will be followed.

Look for signs and symptoms such as the characteristic appearance of two small holes, usually about a half inch apart, with surrounding discoloration, swelling, and pain. Systemic signs (which may or may not occur) include weakness, sweating, faintness, and signs of shock.

Provide treatment as follows:

1. Calm the victim and keep affected area still.

2. Contact ambulance if you cannot provide victim with transportation to the nearest hospital.

3. Wash the wound.

4. Keep the affected area below the level of the heart if bite is on the arm or leg.

5. Treat for shock.

6. Monitor airway, breathing, and circulation.

7. Obtain physical description of snake, if possible.

8. Provide the emergency medical responder (either the ambulance attendant or the emergency room at the hospital) with all pertinent information such as how long ago the bite occurred, the type of snake (if known), any known allergic conditions (if known), etc.

9. Inform the SHSO as soon as possible.

8.8.4 Spider Bite Injury

The emergency treatment for the black widow spider bite is basic life support. Sometimes the individual is not even aware of having been bitten, or where. Apply cold to the site of the bite if it can be identified. There is a specific antivenin for this spider bite that must be administered by a physician. It is particularly important to identify the spider, and bring it in, if you can.

The emergency treatment for the brown recluse spider is similar to that for the black widow spider except that these bites need local surgical treatment, and these patients should be brought to the hospital. Again, if possible, identification of the spider should be carried out.

8.9 Personal Protection and First Aid Equipment

PPE available for emergency response will include the following:

- Polyvinyl chloride boots
- Tyvek® suits, polyethylene coated and uncoated
- Nitrile gloves (inner and outer)
- Neoprene and nitrile gloves (outer)
- Safety glasses

PPE and first aid equipment will be available in the support zone (i.e., Baker Field Vehicle and Baker Field Trailer).

Emergency and first aid equipment can be found at the following locations:

Fire Extinguisher:	Baker Field Trailer and Contractor Field Vehicle
First aid kit:	Baker Field Trailer and Baker Field Vehicle
Air Horn:	With Personnel
Emergency Eye Wash Station:	Near Area With Greatest Potential for Chemical Splash/Exposure

8.11 Notification

If the Emergency Coordinator determines that the site has an uncontrolled situation, such as a spill, fire, or explosion, that could threaten human health or the environment, the coordinator will immediately call the Base Fire Department, the Activity Contact, the Project Manager, and the NTR as soon as possible. The notification report will include:

- Description of incident (e.g., release, fire).
- Name and telephone number of individual reporting the emergency.
- Location of incident.
- Name and quantity of material (s) involved (if known).
- The extent of injuries and number of casualties.
- The possible hazards to human health or the environment and recommended cleanup procedures.
- Assistance that is requested.

8.12 Hazard Assessment

The Emergency Coordinator will assess possible hazards to human health or the environment that may result from an uncontrolled situation, to the best of the individual's abilities, incorporating the following steps, as appropriate.

- Assess the immediate need to protect human health and safety.

- Identify the materials involved in the incident including exposure and/or release pathways and the quantities of materials involved.

- Inform appropriate personnel, as identified in Section 8.11, who will determine if release of material(s) meets USEPA requirements for reportable quantities for spills under the RCRA or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

This assessment may consider both the direct and indirect effects of the chemical release, fire, explosion, or severe weather conditions (e.g., the effects of any toxic, irritating, or asphyxiating gases that are liberated).

8.13 Security

During activation of these Emergency Procedures, the Emergency Coordinator or his/her designated representative will control access to the site and maintain an incident log until the appropriate personnel, such as the Navy On-Scene Commander, arrives and takes control. The incident log will include:

- Activities that have occurred since the incident was first reported.
- Tasks currently being performed and where.
- Rescue and response equipment used.
- Protective equipment being used.

8.14 Emergency Alerting

This section outlines the emergency alerting procedures according to the location and type of emergency.

Personnel Injury in the Work Zone:

- Initiate a verbal warning or one long airhorn blast and move all unaffected site personnel to the support zone (for Level D/D+) or the CRZ (for Level C or higher).

- Send the rescue team into the Work Zone (if required) to remove the injured person to the hotline.

- Have the SHSO and/or Site Manager evaluate the nature of the injury and assure that the affected person is decontaminated according to Section 8.9.

- If required, contact an ambulance and/or the designated medical facility.

In all situations when an on-site emergency results in evacuation of the Work Zone, personnel shall not reenter until:

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed.
3. The HASP has been reviewed and, if appropriate, modified.
4. Site personnel have been briefed on any changes in the HASP.

Personnel Injury in the Support Zone:

- The Site Manager and SHSO will assess the nature of the injury; if the cause of the injury or loss of the injured person does not affect the performance of other site personnel, operations may continue.

- If the injury increases the risk to others, a verbal warning or one long airhorn blast shall be sounded and all remaining site personnel will move to the command post for further instructions.

- Activities on site will stop until the added risk is mitigated.

Fire/Explosion:

- Initiate a verbal warning or one long airhorn blast and move all site personnel to the support zone (for Level D/D+) or the CRZ (for Level C or higher).

- Alert the fire and security departments and move all nonessential personnel to the Baker Command Post to await further instructions.

- Activities will stop until the added risk is mitigated.

Personal Protective Equipment Failure:

- If any site worker experiences difficulty, failure, or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately cease work activities, leave the Work Zone, and repair or replace the defective equipment.

- Reentry will not be permitted until the equipment has been repaired or replaced.

Other Equipment Failure:

- If any other equipment on site fails to operate properly, the Field Team Leader shall notify the Site Manager and SHSO to determine the effect of this failure on site operations. If the failure affects the safety of site personnel, work with the equipment will cease until the situation is evaluated and appropriate actions taken.

8.15 Training

Site personnel will read the details in the Emergency Procedures prior to the pre-entry briefing. The Emergency Procedures will be reviewed by site personnel during the pre-entry briefing.

8.16 Spill Containment Procedures

In the event that a small (less than the reportable quantity), easily-controlled spill of hazardous substances (e.g., gasoline, oil, etc.) occurs during the implementation of field activities, spill containment will be utilized to prevent the additional migration of contaminants through the site area. Large, uncontrolled spills will be handled by qualified response organizations under the direction of qualified Base personnel and/or Navy On-Scene Commander.

Specific spill containment procedures will be dependent on the type of materials spilled and the type of environment affected. Potential spill containment procedures may include diking with absorbent material/pads, then removal or containment of the contaminated materials. Spill containment materials will be located within close proximity to the storage area of the hazardous substances in a manner such that the pathway remains accessible and free of obstructions. Spill containment materials available on site may include:

- Vermiculite
- Ground corn cobs
- Dirt or sand
- Shovel

9.0 TRAINING REQUIREMENTS

Training requirements for site personnel are outlined in the sections below.

9.1 General

All Baker employees, subcontractors, or other personnel entering the site will need to have received training in compliance with the OSHA Standard 29 CFR 1910.120. Baker employees engaged in field activities which potentially expose workers to hazardous substances receive a minimum of 40 hours of instruction off site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor. Key points of the 40-hour training include field demonstrations, respiratory fit testing and training, risk assessment, toxicology, chemical reactivity, use of monitoring equipment, downrange work procedures, site safety procedures, levels of protection, protective clothing, decontamination, and practical field exercises (e.g., donning, doffing, and working in personal protective ensembles for personal protection Levels A, B, and C).

In addition to the initial 40-hour training program, Baker requires site employees to receive an annual 8-hour refresher training course on the items specified by the 29 CFR 1910.120 standard. The general purpose of the 8-hour refresher is to ensure that personnel retain the knowledge necessary to be adequately protected and stay current with proper site health and safety procedures.

Baker also requires that personnel involved with on-site employee supervision receive, in addition to 40 hours initial training and three days of supervised field experience, at least eight additional hours of specialized training at the time of job assignment. Training topics include, but are not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques. The 8-hour supervisory training is required to ensure that supervisors have the knowledge necessary to understand and use the various Health and Safety Programs and to implement the elements of the HASP.

9.2 Site-Specific Training

Site-specific training, as discussed in Section 1.4, will consist of an initial health and safety briefing on the following information:

- Names of individuals responsible for site health and safety and methods of communicating safety and health concerns.
- Roles and responsibilities of site personnel.
- Site-specific health and safety hazards.
- Use of PPE.
- Work practices by which employees can minimize risk.
- Safe use of equipment on site.
- Recognition of symptoms and signs of exposure to hazardous materials.

- Use of monitoring equipment.
- Site control measures.
- Decontamination procedures.
- Emergency procedures.

The SHSO will conduct the initial site-specific training prior to the initiation of field activities for each new area under investigation.

10.0 MEDICAL SURVEILLANCE REQUIREMENTS

10.1 General

All personnel who may be exposed to materials having potentially adverse and deleterious health effects, obtain medical clearance from Baker's Board Certified Occupational Health Physician in accordance with 29 CFR 1910.120(f) prior to entry onto any site. Baker's corporate medical surveillance program establishes a medical baseline and monitors for symptoms of overexposure for individuals who participate in Preliminary Assessments, Site Inspections, Remedial Investigations, Feasibility Studies, and construction-phase services at sites covered by the Department of Labor, OSHA, Hazardous Waste Operations and Emergency Response Standard, 29 CFR 1910.120. The program will include a medical and work history and is intended to determine the individual's capability for performing on-site work, including wearing chemical protective clothing and respiratory protective equipment in a thermally-stressed environment.

All Baker employees that will be engaged in site activities covered by the 29 CFR 1910.120 standard receive a Group III physical examination by a licensed physician who has provided information on the individual's site activities and exposure or anticipated exposure levels. This exam is received initially upon hire, then once every 12 months thereafter. More frequent medical examinations, consultations, and/or laboratory testing will be provided if the examining physician determines that an increased frequency of examination is required. A complete Group III medical exam includes parameters such as height, weight, vision, temperature, blood pressure, and a complete review of occupational and medical histories. Other tests in a Group III exam include chest x-rays, electrocardiogram, spirometry, urinalysis, and blood tests.

10.2 Site Specific

Prior to entry onto the site, all personnel, including subcontractors, will be required to provide medical clearance to the SHSO from their company physician in accordance with 29 CFR 1910.120(f), stating that they are physically capable of performing the activities required of them. The need for additional monitoring, dependent on information obtained during the site characterization, will be evaluated on a case-by-case basis. However, in the event that site employees are injured, receive a health impairment, develop signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or are exposed during an emergency incident to hazardous substances at concentrations that are or may be above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used, medical examinations and/or consultations shall be performed according to the following schedule:

1. As soon as possible following the emergency incident or development of signs or symptoms.

2. At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

11.0 HEALTH AND SAFETY PLAN APPROVAL

This HASP has been reviewed by the following personnel prior to submission to LANTDIV.

Tammi A. Halapin	Project Manager	_____ Signature/Date
Ronald Krivan	PHSO	_____ Signature/Date

12.0 DECLARATION OF HEALTH AND SAFETY PLAN REVIEW*

All site personnel indicated below have reviewed and are familiar with this Health and Safety Plan for the confirmatory sampling at the SWMUs.

(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)

*This page is to be reproduced to accommodate the numbers of personnel who receive training prior to performing activities or visiting a site, and is to remain in the Baker Field Trailer (or Baker Field Vehicle in the absence of a trailer) until demobilization.

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TABLES

TABLE 3-1

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
2	1700 Pond A Base Maintenance	Coal Water Settling Pond - Surface Impoundment	1985 - Present	Reinforced concrete 80 x 40 x 10 ft; the pond captures runoff from the coal storage area.	Coal, water (source: steam plant); polynuclear aromatics, sulfur bearing compounds, and heavy metals may be present
5	575 Rack 2nd LAI, 2D MAR DIV	Wash Rack - Surface Impoundment	Unknown - Present	Concrete 50 ft x 30 ft; concrete vehicle washracks. Constructed in 1980s. Associated washwater collection structure and oil/water separator.	Oil, grease, and fuel
43	IR Number 11 Pest Control Shop	CERCLA Site - Storage Area	1976 - Present	Area used as a disposal area for radioactive-contaminated animal carcasses. The site was remediated for this problem in 1977. In 1976, the site was used as a pesticide/herbicide storage area. Area contains a curbed wash area and an oil/water separator.	Pesticides; herbicides, fuel oil
46	IR Number 15 Montford Point Dump Site (1948 - 1958)	CERCLA Site - Former Disposal Area	1948 - 1958	Former area of disposed sewage treatment sludge.	Litter, asphalt, STP sludge, and sand
53	IR Number 26 Coal Storage Area	CERCLA Site - Storage Area	Present	300 ft x 300 ft concrete area used for the storage of coal piles (for steam plant).	Coal storage runoff
89	SLCH785 - Basin Base Maintenance	Oil/Water Separator	Not currently being used	Concrete 15 ft x 10 ft separator. Associated with vehicle wash rack.	Oily water
253	1205 - AST H&S Company HQSVC CO 2D MEF	Aboveground Storage Tank	AST Removed (present in July 1994)	Steel - 500 gallons.	Used oil

TABLE 3-1 (Continued)

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
254	1408 Dumpster Base Motor Transport	Dumpster - Solid Waste	1960 - Present	6 ft x 6 ft x 7 ft steel container with steel cover.	Solid waste
255	1502 - O/W-1 MCB Logistics Vehicle Maintenance	Oil/Water Separator and Grit Chamber	Unknown	Concrete with steel grate; grit chamber 7 ft x 7 ft x 2 ft; oil/water separator 15 ft x 10 ft x 4 ft.	Waste oil, grease, soap, grit ' and water
256	1700 - O/W-1 Base Maintenance	Oil/Water Separator	1984 - Present	Concrete 15 ft x 25 ft x 12 ft deep in - ground oil/water separator.	Wastes associated with No. 6 fuel oil from Services Loading Area
257	1700 - O/W-2 Base Maintenance	Oil/Water Separator	1984 - Present	Concrete 15 ft x 15 ft x 10 ft; Steam water used to heat No. 6 fuel oil (past) and No. 2 fuel oil is passed through the separator.	Oil/water waste from No. 6 and No. 2 fuel oils generated from Services Loading Area.
258	S1745 - O/W Truck Company Operations, HQ Battery, 2D MAR DIV	Oil/Water Separator and Grit Chamber	Unknown	Concrete units, elevated, with steel grates.	Waste oil, grease, water, and potential paint.
260	1780 - O/W-1 Truck Company Maintenance HQ BN 2D MAR DIV	Oil/Water Separator	1988 - Present	Concrete oil/water separator.	Waste oil, grease, water and debris
261	1780 - UST-1 Truck Company, Maintenance, HQ BN, 2D MAR DIV	Underground Storage Tank	1970 - Present	Steel 550 gallons. Associated with SWMU 297.	Oil, grease, water
262	1780 - UST-2 Truck Company, Maintenance, HQ BN, 2D MAR DIV	Underground Storage Tank	1970 - Present	Steel 550 gallons. Associated with SWMU 298.	Oil, grease, water

TABLE 3-1 (Continued)

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
264	2611 - Container Gun Club	Container	Unknown	Asphalt parking and staging area. Currently used as a staging area for wood chips resulting from hurricane-damaged trees.	Previous tar material
265	2615 - O/W Officer's Club	Oil/Water Separator	Unknown	Concrete unit. Associated with a No. 6 fuel oil loading unit.	No. 6 fuel oil
268	522 Dumpster 2D MAR DIV	Dumpster - Solid Waste	1960? - Present	6 ft x 6 ft x 7 ft steel container with steel cover. The location of this dumpster could not be found during the October 1996 site visit.	Solid waste
269	816 - O/W 8th Engineer 2D FSSG	Oil/Water Separator	O/W Separator removed (present in July 1994)	Oil/water separator associated with a vehicle wash rack.	Oil/water
272	AS137 - O/W MCAS	Oil/Water Separator	Unknown	Concrete unit. New construction within last year.	Oil, gasoline, fuel oil
273	BA 128/BA 105 Dumpster	Dumpster	1960? - Present	6 ft x 6 ft x 7 ft steel container with steel cover. Not present during October 1996 site visit. Potentially removed following the hurricane.	Solid waste
275	BB-48 Dumpster Construction Shop	Dumpster	Unknown	6 ft x 6 ft x 7 ft steel container with steel cover.	Solid waste
276	BB-49 Dumpster Base Maintenance	Dumpster	1960? - Present	8 ft x ft 8 x 8 ft open steel dumpster. Storm drain located adjacent to the dumpster.	Solid waste

TABLE 3-1 (Continued)

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
277	FC 120 - O/W 2nd FSSG, Combat Engineer BN	Oil/Water Separator	Unknown	Concrete unit with steel cover.	Oil
279	FC200 - O/W 8th Engineering 2D FSSG	Oil/Water Separator	1973 - Present	Concrete unit located in a highly erosional area.	Oil, water, diesel
280	FC285 - AST Maintenance Battalion, 2D FSSG	Aboveground Storage Tank	Unknown; AST removed	AST no longer present at the site.	Used oil
283	Release (FC279) 8th Motor Transport 2D FSSG	Release	Unknown	Area of soil approximately 20 ft x 5 ft.	Organics
284	S947 - Container Environmental Management Division	Container	Roll-off box has been removed	Steel roll-off box was formerly present at the site. Contained POL soil. Box has been removed, the area was regraded and paved.	Spilled petroleum and soil
285	S947 - O/W Environmental Management Division	Oil/Water Separator	Approximately from 1980 to present	Concrete in-ground oil/water separator connected to WWTP	Oil, grease, photo fix, grit and water
286	S947 - Pile Environmental Management Division	Waste Pile	Waste pile removed	Waste pile was formerly present at the site. It consisted of POL soil. The pile has been removed, the area was regarded and paved. A new structure (Building S-960) was built to hold the POL soil piles.	Spilled petroleum and soil
291	034 Ditch 5th BN, 10th Marines, 2D MAR DIV	Stormwater Drainage Ditch	1950? - Present	Earthen ditch and scour hole. Historically received runoff from Building 1450 oil/water separator.	Oil, grease, soap, grit and water

TABLE 3-1 (Continued)

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
292	1106/1107 - AST Motor T - Auto Hobby Shop MWR	Aboveground Storage Tank	1980 - Present	Steel AST, 500 gallons.	Waste oil and antifreeze from auto repair/hobby shop
293	1106/1107 - O/W Motor T - Auto Hobby Shop MWR	Oil/Water Separator	1980 - Present	Poured concrete in-ground oil/water separator with baffles; Outlet connected to WWTP.	Oil filters, waste oil, antifreeze, and possibly solvents
294	1203 - O/W Base Maintenance	Oil/Water Separator	1985 - Present	Concrete 5 x 5 x 3 ft in ground oil/water separator with baffles.	Oil, water and debris
295	1601 - AST 2D FSSG	Aboveground Storage Tank	Unknown	Used motor oil from military vehicle maintenance.	Used motor oil
296	1700 - Basin-B Base Maintenance	Runoff Collection Basin	Unknown	Concrete 300 ft x 300 ft in ground basin connected to WWTP.	Coal pile runoff; heavy metals may be present
297	1780 - O/W-2 Truck Company Maintenance, HQ BN, 2D MAR DIV	Oil/Water Separator	Unknown	Steal unit. Associated with SWMU 261.	Oil, grease, water debris
298	1780 - O/W-3 Truck Company Maintenance HQ BN, 2D MAR DIV	Oil/Water Separator	Unknown	Steel unit. Associated with SWMU 262.	Oil, grease, water debris
299	AS114 - AST MCAS Auto Hobby Shop	Aboveground Storage Tank	1992 - Present	Steel, self contained with steps.	Used motor oil from vehicle maintenance operations
300	AS118 - AST Logistic Motor Transportation	Aboveground Storage Tank	1992 - Present	Steel, self contained with steps.	Used motor oil from vehicle maintenance operations

TABLE 3-1 (Continued)

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
301	AS4115 - AST MHLA 167, MAG 26, 2D MAW	Aboveground Storage Tanks	1983 - Present	Two steel tanks with concrete secondary containment. Labeled as "POL only".	Used oil, hydraulic fluid, and fuel
302	AS504 - AST HMH 362 (AS 566)	Aboveground Storage Tank	1983 - Present	Steel tank with concrete secondary containment.	Engine oil, hydraulic fluid, transmission oil
303	AS515 - AST-E HMM 266 HMM 261	Aboveground Storage Tank	1983 - Present	Two steel tanks with concrete secondary containment, labeled as "Hydraulic Fluid, Engine and Transmission Oils Only, No Solvents or Other Chemicals."	Used engine oil, hydraulic oil, transmission oil
304	BA130 - O/W Motor T, 2D RECON BN, 2D MAR DIV	Oil/Water Separator	1980 - Present	In ground oil/water separator connected to drain field.	Oil, grease, grit and water
305	BB224 - Pile MCB	Soil Pile	Soil pile has been removed	Soil pile removed prior to October 1996. Very little evidence of location of pile.	Grease and contaminated soil
306	FC230 - O/W-1 8th Communications BN, 2D SRIG	Oil/Water Separator	1988 - Present	Concrete 8 ft x 20 ft x 12 ft in ground tank connected to WWTP.	Oil, grease, water and debris from vehicle maintenance operators
307	G649 - Rack Base Maintenance	Vehicle Wash Rack	Unknown	Concrete 10 ft x 25 ft wash pad with associated oil/water separator.	Oil, water, grease, debris
308	GP19 - O/W 8th Engineers 2D FSSG	Oil/Water Separator	1983 - Present	Concrete 4 ft x 6 ft x 6 ft in ground oil/water separator connected to sanitary sewer.	Oil, grease, water from military vehicle maintenance operations
309	NH 118 - UST Near Building NH118	Underground Storage Tank	Active	Potential UST; Newly installed used oil AST nearby. May be the UST replacement.	Used oil

TABLE 3-1 (Continued)

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
310	PT33 - Pond-O/W MCB Kitchen Grease Contractor	Dewatering Unit	Unknown	Two earthen ponds with concrete O/W separator used to dewater grease prior to disposal in sanitary landfill.	Kitchen grease; base directives and training preclude intentional disposal of non-kitchen or hazardous waste in grease trap which are the source of waste
311	S1619 - O/W 8th Communications BN, 2D SRIG	Oil/Water Separator	1989 - Present	Concrete in ground oil/water separator connected to WWTP.	Oil, grease, water and debris from vehicle maintenance operations
312	S1735 - O/W Base Maintenance	Oil/Water Separator	1984 - Present	Concrete in ground oil/water separator connected to WWTP.	Oil/water, possibly No. 6 fuel oil
313	S1753 - O/W-AST Small Craft CO; HQ BN, 2D MAR DIV	Aboveground Storage Tank and Oil/Water Separator	Unknown	5 x 10 x 8 ft in ground oil/water separator with steel AST.	Oil, grease, water
314	SM187 - O/W Marine Corps Supported Services School Group	Oil/Water Separator	1990 - Present	Concrete in ground oil/water separator connected to WWTP.	Oil, water and debris from military vehicle maintenance operations
315	SM269 - O/W Near Building M200	Oil/Water Separator	Active	Concrete in ground unit.	Oil, grease, water and debris, possibly No. 6 fuel oil
316	TC773 - O/W School of Infantry	Oil/Water Separator	1985 - Present	Concrete in ground unit connected to WWTP; flush mounted in parking area.	Oil, water and debris from military vehicle maintenance operations

TABLE 3-1 (Continued)

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
317	TT2453 - Release Near Building TT2453	Release	Facility does not appear to be in use	A one-time release generated from Auto Care/Tune Up facility. Existing UST investigations being conducted in the immediate area.	Oil/grease
318	AS515 - O/W Near Building AS515	Oil/Water Separator	Active	6 ft x 6 ft concrete in ground oil/water separator.	Oily water
319	Camp Geiger Wastewater Treatment Plant	Tertiary Wastewater Treatment Plant	1941 - Present	Fair condition -- The facility has the following units; influent pump station, grit chamber and communitors, aerated equalization basin, dual primary clarifiers, dual trickling filters, dual secondary clarifiers, dual anaerobic digestors, sludge drying beds, dural tertiary treatment units (polymer addition, settling, and sand filtration), and chlorine contact chamber.	Domestic sewage
336	AS4106 Paint Stripper Building 4106, MALS 29	Paint Stripper - Tank	Unknown	Two 5.5 gallon containers elevated about 5 ft off the ground in an enclosed building; both containers are about 4 x 3 x 2 ft and made of either steel or aluminum.	One container holds methylene chloride used in stripping paint; the other contains water and residue methylene chloride; contents from both containers are drained into 55-gallon drums and disposed of as hazardous waste

TABLE 3-1 (Continued)

SWMU BACKGROUND INFORMATION
SWMU CONFIRMATORY SAMPLING HEALTH AND SAFETY PLAN, CTO - 0371
MCB CAMP LEJEUNE, NORTH CAROLINA

SWMU Number	SWMU Name	Type of Unit	Period of Operation	Description	Wastes and/or Hazardous Constituents Managed
337	AS518 - Paint Stripper MALS 26 Maintenance, MAG-26, 2ND Marine Aircraft Wing	Paint Stripper - Tank	Unknown	Two 5.5 gallon containers elevated about 5 ft off the ground in an enclosed building; both containers are about 4 x 3 x 2 ft and made of either steel or aluminum.	One container holds methylene chloride use din stripping paint; the other contains water and residue methylene chloride; contents from both containers are drained into 55-gallon drums and disposed of as hazardous waste
339	AS4146 - Sandblaster MALS 26	Sandblaster	December 1995 - Present	10 ft x 15 ft enclosed tarp which has sandblast grit and equipment inside; paint is removed from equipment inside of the tarp. Used sand/grit placed in 55-gallon drums. Disposed as hazardous waste due to lead.	Heavy metals (lead)

TABLE 3-2

PHYSICAL & TOXICOLOGICAL PROPERTIES OF CHEMICALS
SWMUs -MCB CAMP LEJEUNE

Chemical Compound (a)	Hazard Rating (b) H F R	Volatility (c)	Skin Absorp. (d)	Carc. (e)	TWA (f)	STEL (g)	IDLH (h)	IP (i)
Volatile:								
Benzene	2 3 0	75	No	Yes	1 ppm	5 ppm	500 ppm	9.24
Ethyl Benzene	2 3 0	7	No	No	100 ppm	125 ppm	800 ppm	8.76
Fuel Oil No. 2	0 2 0	<1	No	Yes	5 mg/m^3 (mist)	10 mg/m^3 (mist)	-	<11.7
Fuel Oil No. 6	0 2 0	0.2	No	Yes	5 mg/m^3 (mist)	10 mg/m^3 (mist)	-	<11.7
Total Petroleum Hydrocarbons	0 2 0	<1	No	No	5 mg/m^3 (mist)	10 mg/m^3 (mist)	-	<11.7
Toluene	2 3 0	22	No	No	100 ppm	150 ppm	2,000 ppm	8.82
Xylene	2 3 0	7	No	No	100 ppm	150 ppm	900 ppm	8.56
Pesticides:								
DDD	NA	NA	Yes	Yes	1 mg/m^3	-	-	-
DDE	NA	NA	Yes	Yes	1 mg/m^3	-	-	-
Chlorinated:								
1,1-Dichloroethane	2 3 0	182	No	No	100 ppm	-	3,000 ppm	11.06
1,1-Dichloroethene	2 4 2	500	No	Yes	5 ppm	20 ppm	-	10.00
1,1,1-Trichloroethane	2 1 1	100	No	No	350 ppm	450 ppm	700 ppm	11.00

TABLE 3-2 (Continued)

PHYSICAL & TOXICOLOGICAL PROPERTIES OF CHEMICALS
SWMUs -MCB CAMP LEJEUNE

Chemical Compound (a)	Hazard Rating (b) H	F	R	Volatility (c)	Skin Absorp. (d)	Carc. (e)	TWA (f)	STEL (g)	IDLH (h)	IP (i)
Trichloroethylene	2	2	0	58	No	Yes	50 ppm	100 ppm	1,000 ppm	9.45
1,1,2,2-Tetrachloroethane	2	0	0	5	Yes	Yes	1 ppm	-	100 ppm	11.10

Notes:

(a) Chemical compound of potential concern obtained from previous investigation.
(b) Hazard Rating - based upon Health (H), Fire (F), or Reactivity (R) hazard from NFPA 704 Standard Rating System (0 = no hazard, 4 = high hazard)
(c) Volatility Rating - based upon vapor pressure in mm Hg at 68° F, 20° C
(d) Skin Absorption - "Yes" indicates potential exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact - ACGIH
(e) Carcinogen - "Yes" indicates a compound is a confirmed or suspect human carcinogen by the IARC, NIOSH, NTP, EPA or ACGIH
(f) TWA - Time Weighted Average from the 1995-1996 TLV - Threshold Limit Value of the ACGIH or OSHA Permissible Exposure Limits (PEL), whichever is lower
(g) Short Term Exposure Limit - "STEL" denotes a 15 minute time weighted average which may not be exceeded
(h) IDLH - Immediately Dangerous to Life and Health.
(i)) Ionization Potential - expressed in electron volts (eV) from the NIOSH Pocket Guide To Chemical Hazards

TABLE 6-1

SUMMARY OF PROTECTIVE CLOTHING REQUIREMENTS

Task	Level of Protection	Required Personal Protective Equipment
Land Surveying	D	• Steel-toed Safety Boots • Work Clothes or Coveralls (long sleeves)
Surface Soil Sampling Temporary Monitoring Well Development Groundwater Sampling	Modified D	• Steel-toed Safety Boots • Safety Glasses • Nitrile Gloves • Work Clothes or Coveralls (long sleeves)
Geoprobe Subsurface Sampling - Soil Borings Temporary Monitoring Well Installation (Geoprobe)	Modified D	• Steel-toed Safety Boots • Safety Glasses • Nitrile Gloves • Hearing Protection (recommended) • Work Clothes or Coveralls (long sleeves)

TABLE 8-1

EMERGENCY PHONE NUMBERS
MCB CAMP LEJEUNE

Agency/ Facility	Phone Number Off-Base	Contact
Security	(910) 451-2555	Response Operator
Ambulance (On-Base)	(910) 451-3004 or (910) 451-3005	Base Fire Dept. Dispatcher
Ambulance (Public)	(910) 451-9111	Response Operator
Hospital Emergency Room (On-Base)	(910) 451-4840 (910) 451- 4841 (910) 451- 4842	Response Operator
Onslow County Hospital (Off-Base)	(910) 577-2240	Response Operator
Emergency One Call	911 or (910) 451-9111 (910) 451-3004 or (910) 451-3005	Response Operator Base Fire Dept. Dispatcher
On-Scene Coordinator	(910) 451-5815	Fire Chief
Environmental Management Division (EMD)	(910) 451-5068	Mr. Neal Paul Ms. Jennifer Casey Mr. Rick Raines Mr. Mick Senus
Duke Regional Poison Control Center	1-800-672-1697	Response Operator
National Response Center	1-800-424-8802	Response Operator
CHEMTREC	1-800-424-9300	Response Operator
ATSDR	1-404-639-0700	Response Operator

TABLE 8-2
HOSPITAL DIRECTIONS

MCB Camp Lejeune

Directions to the Base Naval Hospital (Building NH100)(Refer to Figure 8-1):
(Nearest hospital; only to use in extreme emergency)

1. Proceed north to Holcomb Boulevard (towards Route 24).
2. Turn left onto Brewster Boulevard (heading west).
3. Continue on Brewster Boulevard until intersection with the driveway to the Naval Hospital.
4. Turn onto Hospital driveway and proceed to emergency room.

Directions to Onslow County Memorial Hospital (317 Western Boulevard)(Refer to Figure 8-1):

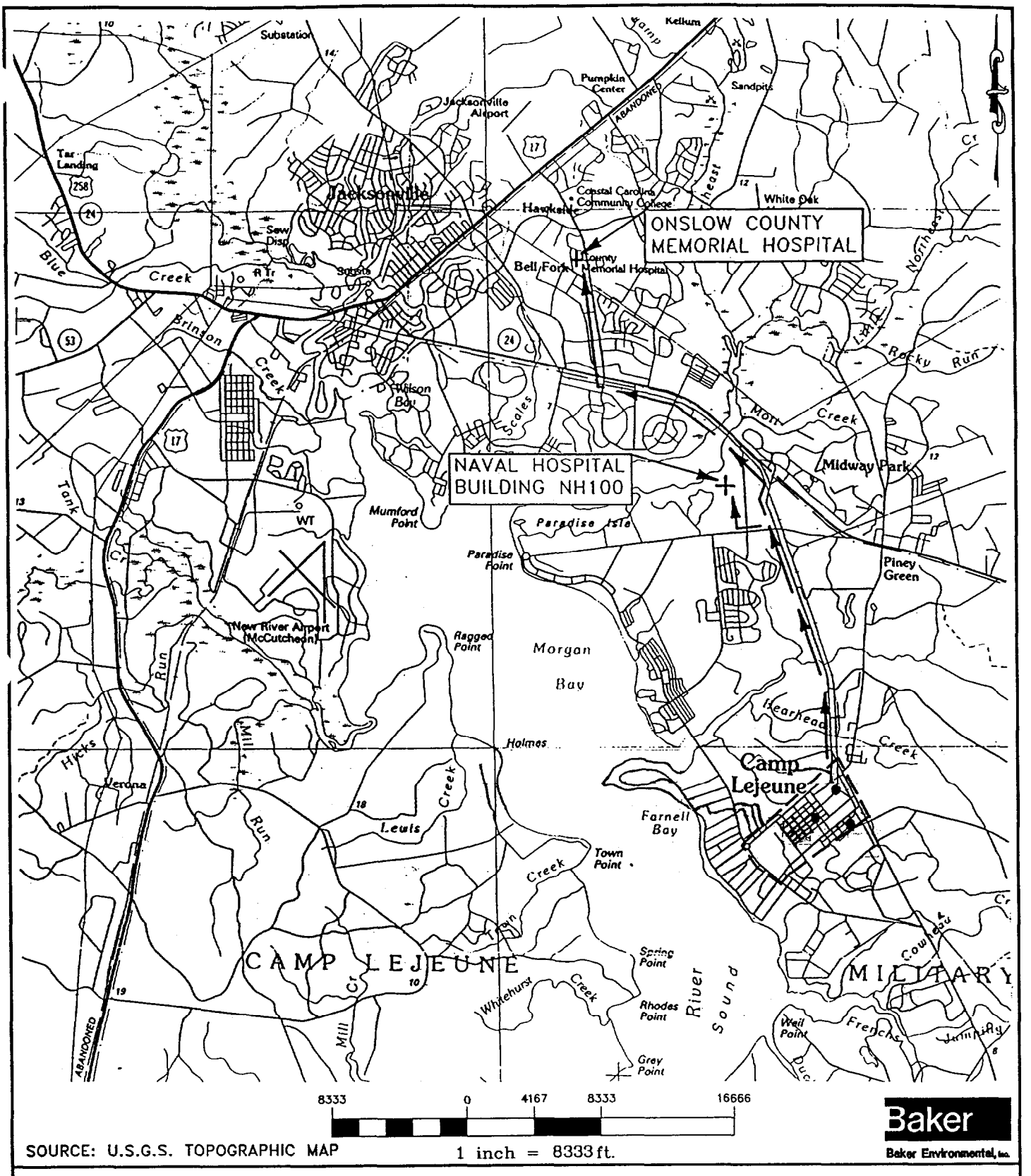
1. From Holcomb Boulevard exit base through the main gate.
2. Follow Highway 24 west until intersecting with Western Boulevard.
3. Turn right onto Western Boulevard.
4. The Onslow County Hospital is on the left, approximately 2 miles (fifth light) from Highway 24.

Air Station and Camp Geiger

Directions to the Onslow County Hospital (317 Western Boulevard)(Refer to Figure 8-2):

1. Proceed through the main gate make a right and head north on Ocean Highway 17.
2. Follow Ocean Highway 17 north to Highway 24 and head east.
3. Travel east until Western Boulevard, make a left onto Western Boulevard.
4. The Onslow County Hospital is on the left, approximately 2 miles (fifth light) from Highway 24.
5. Follow the directions to the emergency room.

FIGURES



SOURCE: U.S.G.S. TOPOGRAPHIC MAP

FIGURE 8-1
EMERGENCY HOSPITAL ROUTE

MCB CAMP LEJEUNE, NORTH CAROLINA
CTO-0371

371157PP

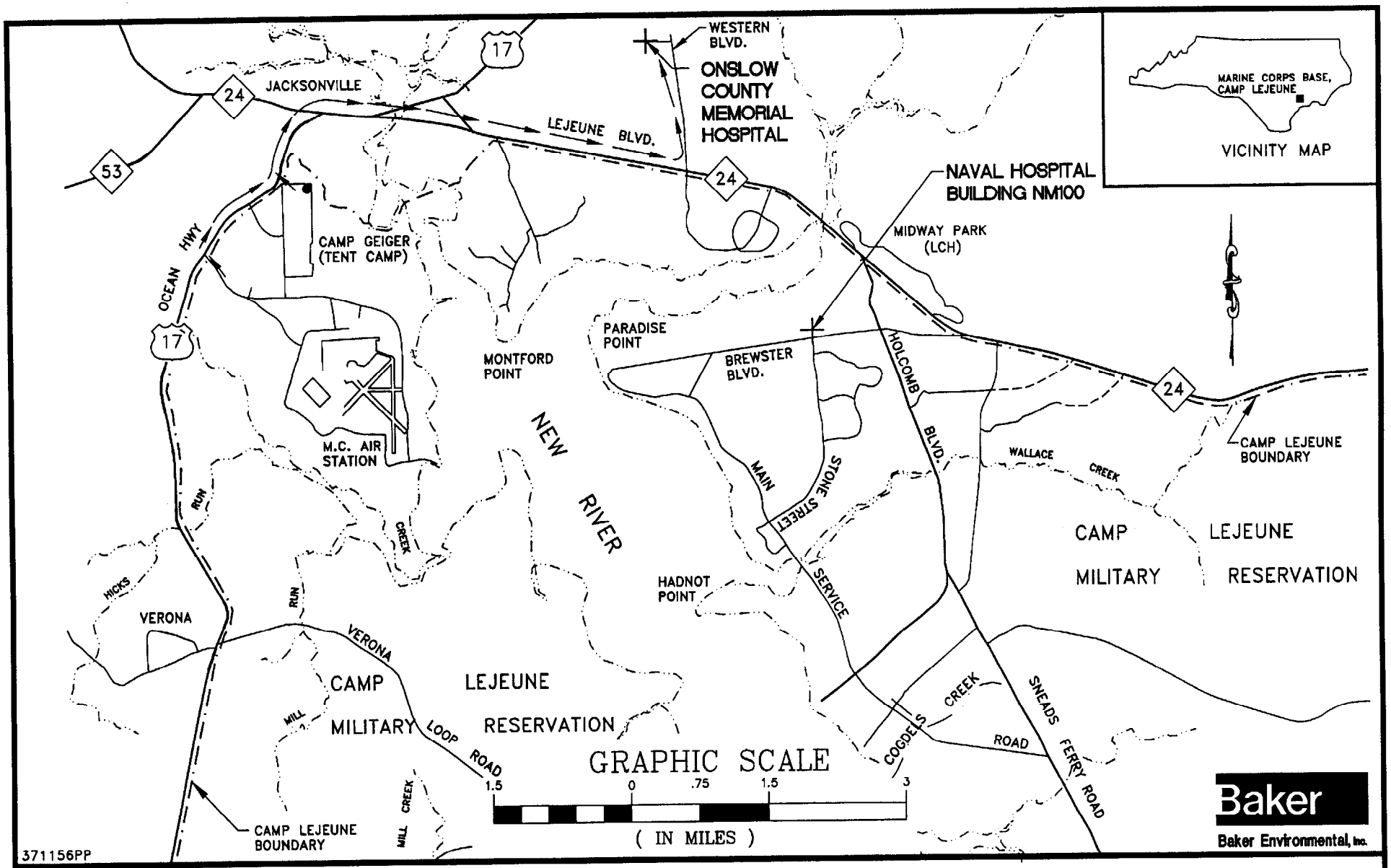


FIGURE 8-2
EMERGENCY HOSPITAL ROUTE

CAMP GEIGER & M.C. AIR STATION
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

ATTACHMENT A
BAKER SAFETY STANDARD OPERATING PROCEDURES (SOPs)

ATTACHMENT A

BAKER ENVIRONMENTAL, INC.
SAFETY STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

1.0 Confined Space Entry Program*

2.0 Respiratory Protection Program

3.0 Care and Cleaning of Personal Protective Equipment

4.0 Bloodborne Pathogens

5.0 Heat Stress

6.0 Cold Stress

7.0 Safe Boat Operations*

8.0 Cutting and Welding

*Not Applicable

Baker
Baker Environmental, Inc.

2.0 - RESPIRATORY PROTECTION PROGRAM

This Respiratory Protection Program presents the elements necessary for administering a successful program. Attached at the end of this program is a copy of the following Baker Environmental, Inc. (Baker) forms:

- Qualitative Respirator Fit Test Record
- Air-Supplying Respirator Inspection Form
- Air-Purifying Respirator Inspection Form

2.1 PURPOSE

The purpose of the Baker Respiratory Protection Program is to govern the selection and use of respiratory protection by Baker personnel. This program is also designed to meet requirements of the Occupational Safety and Health Administration (OSHA) standards 29 CFR 1910.134 and 1926.103, "Respiratory Protection."

2.2 SCOPE

This program applies to Baker SRN personnel including temporarily-assigned SRI and SII personnel who may be involved with potential respiratory hazards as part of their job duties. This program outlines the procedures to follow when respiratory equipment is required.

2.3 RESPONSIBILITY

Baker provides the necessary respiratory equipment to protect the safety and health of each Baker employee. The Baker SRN Project Health and Safety Officer (PHSO) and Project Manager are responsible for identifying the need for this Respiratory Protection Program at project sites. The Baker Site Health and Safety Officer (SHSO) and Site Manager are responsible for implementing and administering the Respiratory Protection Program in the field. Baker employees are to use and maintain the respiratory protection provided in accordance with training received and instructions outlined in this program.

2.4 HAZARD ASSESSMENT

The key elements of a respiratory protection program must start with an assessment of the inhalation and ingestion hazards present in the work area. Because Baker's services involve a variety of environmental and industrial hygiene studies, it is not practical to identify all possible hazards to which all employees could be exposed within the scope of this document. Therefore, it is essential that a task specific assessment be conducted prior to the initiation of any activities on a given project. This task specific assessment shall be part of the site-specific Health and Safety Plan (HASP).

After a task-specific assessment is completed and it is determined that there is a potential for airborne exposure concentrations to exceed the recommended limits, engineering and administrative controls should be implemented. If the exposure cannot be reduced, or it is not feasible to reduce

the airborne exposure below the recommended limits, respirators will be selected by the PHSO and/or SHSO on the basis of:

- Toxicity
- Maximum expected concentration
- Oxygen levels
- Warning properties of the substance(s) involved
- Sorbent limitations
- Facepiece fit
- Mobility requirements
- Type of use (routine, escape, or emergency entry)
- Possibility of ingestion of toxic materials
- Respirator attributes

2.5 TRAINING

Each respirator wearer shall be given training, by a qualified individual, which will include explanations and discussions of:

- Opportunity to wear respiratory protection in an uncontaminated environment.
- Respirator fit testing (qualitative)
- The respiratory hazard(s) and what may occur if the respirator is not used properly.
- The reasons for selecting a particular type of respirator.
- The function, capabilities, and limitations of the selected respirator.
- The method of donning the respirator and checking its fit and operation.
- The proper wearing of the respirator.
- Respirator maintenance, repair, and cleaning.
- Recognizing and handling emergency situations.

Employees who have attended the 40-hour training in accordance with 29 CFR 1910.120 (HAZWOPER) will be provided with the basic information necessary to comply with the OSHA training requirements and will only need to attend a supplementary session provided by qualified Baker personnel. The annual HAZWOPER 8-hour refresher will serve to reinforce these issues on an annual basis. Records of the training and fit-testing will be maintained for a minimum of 30 years following termination of employment for each employee.

2.6 TYPES OF RESPIRATORS

Baker purchases and provides, as necessary, the following respirators:

- North half-face (Model 7700) and full-face (Model 7600) air-purifying respirators

- North positive pressure 30-minute Self-Contained Breathing Apparatus (SCBAs) (Model 800)

- North positive pressure supplied airline respirators with 5-minute escape air cylinders (Model 85500).

- MSA Ultra Twin full-face respirator (Model 480263)

- MSA Comfo II half-face respirator (Model 479529)

Only respiratory equipment certified by the appropriate approval agencies (e.g., NIOSH, MSHA) according to Title 30, Part II of the Code of Federal Regulations, will be distributed to Baker employees. All Baker employees who regularly perform tasks requiring respiratory protection will be issued their own half-face and/or full-face respirator, provided the employee can achieve a proper fit and is medically capable of wearing the equipment.

Because 30-minute SCBAs, positive pressure supplied airline respirators, and 5-minute escape air cylinders are used less frequently, this equipment will be distributed on an as-needed basis.

2.7 AIR QUALITY

Compressed air used for respiration shall be of high purity. Breathing air shall meet at least the requirements of the specification for Grade D Breathing Air (or higher) as described in Compressed Gas Association Commodity Specification G-7.1-1966. Breathing air may be supplied to respirators from cylinders; oxygen must never be used with air-line respirators.

Air cylinders shall be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR Part 178). Air-line couplings shall be incompatible with outlets for other gas systems to prevent inadvertent servicing of air-line respirators with nonrespirable gases or oxygen.

Breathing gas containers (air cylinders) shall be marked in accordance with American National Standard Method of marking Portable Compressed Gas Containers to Identify the Material Contained, A48.1-1954; Federal Specification BB-A-1034a, June 21, 1968, Air, Compressed for Breathing Purposes; or Interim Federal Specification GG-B00675b, April 27, 1965, Breathing Apparatus, Self-Contained.

Breathing air, as supplied by air compressors, shall be of high purity and meet the requirements of the specification for Grade D Breathing air (or higher) as described in Compressed Gas Association Commodity Specification G-7.1-1966.

The compressor for supplying air shall be equipped with necessary safety and standby devices. A breathing air-type compressor shall be used. Compressors shall be constructed and situated so as to avoid entry of contaminated air into the system and suitable in-line air-purifying sorbent beds and filters installed to further assure breathing air quality. A receiver of sufficient capacity to enable the respirator wearer to escape from a contaminated atmosphere in the event of compressor failure, and alarms to indicate compressor failure and overheating shall be installed in the system. If an oil-lubricated compressor is used, it shall have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the compressor shall be frequently tested for carbon monoxide to insure that it meets the specifications outlined above.

2.8 CLEANING AND MAINTENANCE

Respiratory equipment that is used on an as-needed basis shall be maintained by qualified personnel. This equipment shall be cleaned/sanitized, then rinsed and air-dried, after each use.

Respiratory equipment that has been issued to an employee shall be cleaned/sanitized then rinsed and air-dried by the wearer, (specified by OSHA in 29 CFR 1910.134) which ensures that it will be maintained in clean and good operating condition. Inspections shall be conducted on a regular basis during usage and prior to each project requiring the potential usage of the equipment.

All respirators shall be stored in a plastic bag within a cool/dry location, in a manner that will protect them against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. They shall be stored to prevent distortion of rubber or other elastomer parts. Cartridges will not be stored while attached to an air-purifying respirator at anytime.

Parts replacement and repairs shall be performed only by appropriate personnel. Equipment requiring repairs shall be reported to appropriate Baker personnel. Examples of inspection forms are included at the end of this text.

2.9 INSPECTIONS

At the time of cleaning, and before and after each use, respirators will be inspected. Deteriorated components will be replaced before the respirator is placed back into service, or the respirator will be replaced. Repair components must be obtained from the manufacturer of the respirator to maintain the NIOSH certification. Emergency-use respirators and self-contained breathing apparatuses (SCBAs) will be inspected after each use or at a minimum, once a month. Sample inspection forms for both air-purifying respirators and air supplying respirators are attached. These forms are required to be completed each time a respirator is inspected. However, during field projects in which a field logbook is in use, personnel may enter the appropriate information into their field logbook as an alternative to the inspection form. A list of the items to be covered during an inspection are as follows:

- Air-Purifying Respirator (full or half-face)
  - Face Piece
    - -- Clean and sanitized?
    - -- Cracks, tears or holes absent?
    - -- Proper shape and flexibility retained?
    - -- Air-purifying element holders intact?
    - -- Stored properly, free from heat, dirt, and sunlight?
  - Headstraps or Headbands
    - -- Signs of wear or tears?
    - -- Buckles function properly?
  - Respirator Interior
    - -- Foreign material under valve seat?
    - -- Cracks or tears in valves/valve bodies?
    - -- Valve covers/bodies installed properly?
- Supplied Air Respirators
  - Cylinder undamaged?
  - Facepiece and hoses undamaged?
  - Connections undamaged?

- Apparatus complete?
- Facemask cleaned and sanitized?
- Hoses and connections cleaned?

Note: The date and the initials of the qualified individual performing the inspection must be entered into the field logbook.

2.10 FIT-TESTING

Each respirator wearer shall be provided with a respirator that can properly form a secure face-to-mask seal. Each wearer shall be fit-tested prior to issuance of the respirator using either an irritant smoke or odorous vapor, or other suitable test agent (see example of form at end of text). Retesting shall be performed, at a minimum, on an annual basis or if a different model respirator, other than the model the wearer was previously fit-tested for, is to be used. Air-purifying respirators fit-tested qualitatively will be assigned a protection factor of 10 (APF = 10). A copy of Baker's Fit-Test Form is attached.

Facial hair, which interferes with the normally effective face to mask seal, is prohibited. Each respirator wearer shall be required to check the seal of the respirator by negative and positive pressure checks prior to entering a harmful atmosphere.

2.11 MEDICAL SURVEILLANCE

Personnel who are or may be assigned to tasks requiring use of respirators shall participate in a medical surveillance program on an annual basis. The medical surveillance program shall include, but may not be limited to, a history of respiratory disease, work history, a physical exam, and spirometry conducted by the company's physician and at the expense of the company. These parameters are conducted prior to fit testing an employee on a negative pressure respirator. Test parameters included in Baker's medical surveillance program are in each site-specific HASP.

2.12 LIMITATIONS

Wearing any respirator, alone or in conjunction with other types of protective equipment, will impose some physiological stress on the wearer. Therefore, selection of respiratory protective devices will be based on the breathing resistance, weight of the respirator, the type and amount of protection needed as well as the individual's tolerance of the given device. Additional concerns regarding the limitations of different types of PPE and the monitoring requirements for heat stress/strain will be addressed in the "Heat Stress" SOP.

2.13 SUBCONTRACTOR REQUIREMENTS

In compliance with Baker's respiratory protection program, all subcontractors under the direction of Baker personnel will be expected to comply with pertinent sections of OSHA Standards 1910.134 and 1926.103. Additionally, the subcontractor will be required to:

- Provide documentation that their employees have been fit-tested on the air-purifying respirator the employee is expected to use.

- Provide documentation that their employees have been medically certified to wear a respirator.

3.0 - CARE AND CLEANING OF PERSONAL PROTECTIVE EQUIPMENT

3.1 INTRODUCTION

The following procedures cover the care and cleaning of Levels D, D+, C, and B personal protective equipment (PPE). Note: These are general procedures that apply to most situations and are not all inclusive. Procedures are subject to change at the direction of the Site Health and Safety Officer (SHSO).

3.2 INSPECTION

Proper inspection of personal protective equipment (PPE) features several sequences of inspection depending on articles of PPE and its frequency of use as follows:

- Inspection and operational testing of PPE received from the factory or distributor.
- Inspection of PPE as it is issued to workers.
- Inspection after use or training, and prior to maintenance.
- Periodic inspection of stored equipment.
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

The primary inspection of PPE in use for activities at the site will occur prior to immediate use, will be conducted by the user to ensure that the specific device or article has been checked out by the user, and that the user is familiar with its use.

3.2.1 Chemical Resistant Suit (Levels D+ through B)

- Determine if suit is the one specified in the Site Health and Safety Plan (HASP)
- Before donning, inspect suit for holes or tears; check to see that zippers are operable and look for signs of suit degradation.
- When wearing, avoid contact with contaminated material where possible; be aware of sharp objects that can tear suit; periodically look over suit to check for major rips or tears.
- While decontaminating, remove gross excess of material from suit; remove suit so that material does not contact inner suit; place clothing in properly labeled disposal containers.

3.2.2 Inner/Outer Gloves (Levels D+ through B)

- Determine if gloves meet the specifications in the site HASP.
- Look for rips, tears, or degradation of material. Replace as necessary or at the direction of the SHSO.

3.2.3 Chemically Resistant Boots (Levels D+ through B)

- Determine if boots meet the specifications in the site HASP.
- Nondisposable boots are to be examined on a daily basis before and after use. Disposable boots should be examined prior to donning and while in use, and disposed according to site procedures.

3.2.4 Safety (Steel Toe and/or Shank) Boots (Levels D through B)

- Examine daily for gouges, open seams, etc., anything that would lessen the integrity of the boot. Replace as boot becomes worn.

3.2.5 Hard Hats (Levels D through B)

- Should be visually inspected before donning for fit, cracks, and overall condition.

3.2.6 Safety Glasses/Goggles (Levels D through C)

- Should be visually inspected before donning for cracks, deteriorated parts, and overall condition. Replace as necessary.

3.2.7 Respirators (Levels D+ through B)

- Procedures for care of respiratory protective equipment are covered in Baker's SOP for Respiratory Protection.

3.2.8 Hearing Protection (Levels D through B)

- Disposable - Replace daily, or as material becomes worn or dirty.
- Reusable - Inspect before use, clean regularly, replace parts as necessary.

3.3 EQUIPMENT CLEANING

General procedures for cleaning of equipment are listed below. Site-specific concerns will be addressed by the SHSO prior to and during site activities. Cleaning of respiratory equipment is covered under the "Respiratory Protection Program" SOP.

3.3.1 Gross Physical Removal

Remove large amounts of contaminated soil or sediment by scraping off with a tongue depressor or other suitable instrument, then wipe off using a disposable wipe/paper towel.

3.3.2 Physical/Chemical Removal

Remove residual contamination with a soft-bristled, long-handled brush or equivalent using a nonphosphate detergent solution.

3.3.3 Rinsing/Dilution

The detergent solution and residual contaminants will be rinsed with distilled/tap water using a pressurized sprayer, a tub filled with clean wash water, or equivalent.

3.4 EQUIPMENT STORAGE

Storage of PPE is an important aspect to the daily care and cleaning therefore, the following considerations should be observed:

- Different types of PPE shall be stored in a clean and dry environment, free from elements that could damage PPE.
- PPE shall be stored and labeled so that site personnel can readily select the specified PPE.
- Contaminated, nondisposable PPE shall be decontaminated before returning to the storage area.
- Contaminated, disposable PPE shall not be returned to the storage trailer, but disposed according to the provisions identified in the Site Work Plans.

Baker
Baker Environmental, Inc.

4.0 - BLOODBORNE PATHOGENS
(Safe Handling of First Aid Incidents)

4.1 PURPOSE

The purpose of the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard, Title 29 CFR Part 1910.1030, is to protect workers from bloodborne pathogens such as the (HIV) and (HBV) by reducing or eliminating workers' exposure to blood and other potentially infectious materials. Although HIV and HBV are specifically mentioned by OSHA, the standard includes any bloodborne pathogen, such as Hepatitis C, malaria, and syphilis. The standard requires the employer to develop a written exposure control plan that will reduce or eliminate employee exposure, thus reducing their risk of infection.

The purpose of the Baker Environmental (Baker) exposure control plan is to minimize the possibility of transmission of bloodborne pathogens in the workplace by establishing procedures for the safe handling of first aid incidents that may expose personnel to blood or other potentially infectious materials.

4.2 SCOPE

All Baker SRN personnel who may be exposed to blood or other potentially infectious materials as part of their job duties (e.g., those certified in Standard First Aid) are required to follow the guidelines set forth in this SOP. The exposure control plan shall be reviewed and updated at least annually, to reflect new or modified tasks and procedures that affect occupational exposure, and to reflect new or revised employee positions with occupational exposure.

4.3 RESPONSIBILITY

The Baker Project Health and Safety Office (PHSO) and Project Manager are responsible for providing support and administering this exposure control plan as necessary, from the corporate office. The Baker Site Health and Safety Officer and Site Manager are responsible for implementing this exposure control plan at project sites for their employees.

4.4 DEFINITIONS

Bloodborne Pathogens - Pathogenic microorganisms that may be present in human blood, having the potential to cause disease in humans. Two examples of bloodborne pathogens include, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Contaminated - Means the presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

Decontamination - Physically or chemically removing, inactivating, or destroying bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles, so that the surface or item is rendered safe for handling, use, or disposal.

Exposure Incident - A specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that result from the performance of an employee's duties.

Occupational Exposure - Reasonably anticipated skin, eye, mouth, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties.

Other Potentially Infectious Materials - Includes the following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; any unfixed tissue or organ (other than intact skin) from a human; and HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Parenteral - Piercing of the mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions.

Regulated Waste - OSHA defines a regulated waste as a liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid state if compressed; items caked with dried blood or other potentially infectious materials that are capable of release of these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials.

4.5 PROCEDURES FOR EXPOSURE TO BLOODBORNE PATHOGENS

The sections below will discuss the means by which Baker personnel can determine exposure potential, modes of transmission, methods of compliance, medical monitoring, and post exposure procedures.

4.5.1 Exposure Determination

The exposure determination is based upon the job classifications with occupational exposure potential, and the activities in which these exposures can occur, as follows.

Job Classifications

- Site Manager/Site Safety and Health Officer
- Environmental Scientists
- Geologists
- Other Baker Field Personnel

Exposure Activities

- Response to first aid incidents involving site personnel
- Decontamination of personnel, personal protective equipment, work surfaces, and equipment potentially exposed to blood or other potentially infectious materials

4.5.2 Modes of Virus Transmission in the Workplace

Modes of virus transmission are similar for the viruses of concern. Primarily, virus transmission occurs as the result of direct blood contact from percutaneous inoculation, contact with an open wound, non-intact skin (e.g. chapped, abraded, or dermatitis), or mucous membranes to blood, blood-contaminated body fluids, or concentrated virus. Protective measures for workers will focus on preventing exposure to blood and other body fluids that can result from an injury or sudden illness.

4.5.3 Methods of Compliance

4.5.3.1 Universal Precautions

The unpredictable and emergent nature of exposures likely to be encountered on a site may make differentiation between hazardous body fluids and those that are not hazardous very difficult. Thus, all employees will observe "Universal Precautions" to prevent contact with blood or other potentially infectious materials. These "Universal Precautions" stress that all blood or other potentially infectious materials will be treated as if they are known to be infectious.

The universal precautions will include:

(1) Cover the skin, especially open cuts, scrapes, skin rashes, or other broken skin.

(2) Don't touch objects that could be contaminated, such as blood-covered surfaces, clothing or linens.

(3) Cover mucous membranes (i.e., mouth, nose, and eyes).

(4) Prevent direct contact with sharps, such as needles, scalpels, or broken glass that could pierce or puncture your skin.

(5) Clean and decontaminate surfaces, containers, and equipment that may have been exposed to blood or other body fluids.

4.5.3.2 Standard Work Practices

Standard work practices are to be implemented at all times by all employees who may be exposed to blood or other potentially infectious materials. Work practices are defined as specific policies or procedures whose purpose is to reduce the potential for employee exposure to bloodborne pathogens. Work practices for use by site personnel are described in the balance of this section.

Personal Hygiene

All exposed employees will observe the following hygienic practices:

- During or immediately after exposure to blood or other potentially infectious materials; do not eat, drink, chew gum, chew tobacco, smoke, apply cosmetics, balms or medications, or any other activity that increases the potential for hand-to-mouth, mucous membrane, or skin contact.

- Following exposure to blood or other potentially infectious materials, personnel will wash their hands and any other exposed skin with a disinfectant soap and water after removal of chemical-protective gloves or other personal protective equipment (PPE). This will be performed before eating, urinating, defecating, applying make-up, smoking or undertaking any activity that may result in increased potential for hand to mouth, mucous membrane, or skin contact.

Personal Protective Equipment

The basic premise for wearing the appropriate PPE is that site personnel must be protected from exposure to blood and other potentially infectious materials. Appropriate PPE is available to all site personnel.

Responders to a medical emergencies will have access to the appropriate PPE. The PPE will be present in the site trailer and field vehicles. The PPE should be used in accordance with the level of exposure encountered. Minor lacerations or small amounts of blood do not merit the same extent of PPE use as required for massive arterial bleeding. Management of the patient who is not bleeding, and has no bloody body fluids, should not routinely require the use of PPE.

The following PPE will be present in each Baker Field Vehicle and/or the Baker Site Trailer.

1. Disposable chemical-protective gloves (i.e, nitrile or latex)
2. Resuscitation equipment*
3. Safety glasses, goggles, or faceshields
4. Tyvek® coveralls

* Resuscitation Equipment - Because the risk of salivary transmission of infectious disease during artificial ventilation of trauma victims, pocket mouth-to-mouth resuscitation masks will be present in the first aid kits. The pocket mouth-to-mouth resuscitation masks are designed to isolate response personnel from contact with the victims' blood and blood-contaminated saliva, respiratory secretions, and vomitus.

Decontamination procedures will follow those outlined in each site HASP.

Handling Regulated Wastes

With the exception of contaminated sharps, all other regulated wastes must be placed in closable, color-coded, labeled containers that prevent leakage of fluids. All applicable federal and state regulations must be followed for transporting and disposing of the wastes.

Training and Education

All employees with the potential for occupational exposure will receive initial training on the safe handling of first aid incidents during first aid/CPR Instruction, and subsequently during HASP briefings. See Appendix A for the suggested Bloodborne Pathogens Training Outline.

4.5.4 Medical Monitoring

All Baker personnel will follow the guidelines established by Baker's Board Certified Occupational Health Physician in association with EMR, Inc.

4.5.5 Post-Exposure Procedures and Follow-Up management

The following subsections presents the procedures to follow when a first aid incident occurs involving the presence of blood or other potentially infectious material; specific steps need to be taken to safeguard the health of Baker site personnel.

4.5.5.1 First Aid Incident Report

If there is a reasonable cause to believe that a potential exposure to blood or other potentially infectious materials has been experienced, the employee must complete the steps listed below. These steps are required when non-HBV vaccinated first aid responders participate and regardless of whether an actual "exposure incident" occurred.

1. Immediately notify the SHSO. The SHSO will determine whether an "exposure incident" occurred.

2. Wash area of contamination and remove contaminated clothing to ensure that no further contamination will occur.

3. All parties involved will complete the Supervisors Incident Report Form and the incident will be reported to Baker's Human Resources office.

Baker employees who render first aid where blood or other potentially infectious materials are present must be seen by a designated EMR physician within 24 hours of the incident. The employee must take a copy of the Supervisors Incident Report Form and a copy of OSHA Standard 1910.1030 to the physician.

Employees who respond to first aid incidents involving the presence of blood or other potentially infectious materials where the determination was made that an "exposure incident" occurred, have 90 days following baseline blood level collection to decide if they wish to have their blood tested for HIV.

The confidential medical evaluation and follow-up will include:

1. The circumstances of the exposure.

2. If consent has been obtained testing of the source individual's blood in order to determine HIV and/or HBV infectivity. If consent is not obtained this will be documented in writing.

3. If consent has been obtained, the exposed employee's blood will be tested.

The occupational health physician will provide the employer with a confidential written opinion that includes verification that the employee has been informed of the results of the evaluation and also includes a recommendation for further evaluation or treatment. A copy of this written opinion will be provided within 15 days following the medical evaluation.

4.5.5.2 "Good Samaritan" Behavior

The OSHA standard does not cover "good samaritan" behavior. However, employees who provide first aid as "good samaritans" should receive the same post incident evaluation either through an EMR designated physician or their personal physician.

4.6 REFERENCES

OSHA Title 29 CFR Part 1910.1030

U.S. Department of Labor, U.S. Department of Health and Human Services. Joint Advisory Notice: protection against occupational exposure to Hepatitis B virus and human immunodeficiency virus. Federal Register 1987; 52:41818-24.

Centers for Disease Control. Update on hepatitis B prevention. MMWR 1987; 36:353-360,366.

Centers for Disease Control. Update: Acquired immunodeficiency syndrome and human immunodeficiency virus infection among health- care workers. MMWR 1988; 37:229-34, 239.

OSHA Instruction CPL 2-2.44, February 13, 1992, Enforcement Procedures for the Occupational Exposure to Bloodborne Pathogens Standard.

Appendix A

SUGGESTED BLOODBORNE PATHOGENS TRAINING OUTLINE

I. **Introduction**

- A. Purpose of the training program
- B. Overview: Bloodborne Pathogen Standard 29 CFR 1910.1030
  - 1. Applicability to Site Personnel
  - 2. General requirements
  - 3. Overview of Baker exposure control plan

II. **Bloodborne Diseases**

- A. Types
- B. Modes of Transmission

III. **Baker Exposure Control Plan**

- A. Purpose
- B. Plan availability
- C. Bloodborne pathogen hazard recognition steps
  - 1. Concept of universal precautions
  - 2. Blood and other potentially infectious materials
- D. Potential exposure minimization
  - 1. Work practices
  - 2. Personal protective equipment
  - 3. Hygienic practices
- E. Procedures for decontamination
  - 1. Personnel
  - 2. Personal protective equipment (PPE)
    - a. Tasks and procedures requiring PPE
    - b. Location of PPE
    - c. Disposal of PPE
  - 3. Equipment
  - 4. Work surfaces
- F. Medical monitoring
  - 1. Baker medical monitoring program
  - 2. Post exposure evaluation procedures
    - a. First aid incident report
    - b. HBV and non-HBV vaccinated responders
    - c. Exposure incidents (defined)
    - e. Confidential medical evaluation
- G. Emergency Preparedness
  - 1. First aid kits
  - 2. Personal injury

5.1 INTRODUCTION

Heat stress in the hazardous waste industry usually is a result of protective clothing decreasing natural body ventilation, although it may occur at any time work is being performed at elevated temperatures. If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physiological reactions can occur, ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal.

5.2 CAUSES AND SYMPTOMS

The following heat stress causes and symptoms are provided for buddy monitoring purposes. Site personnel must realize that monitoring the physical condition of fellow personnel in Levels D+ through B protective ensembles will be more difficult.

1. *Heat rash* results from continuous exposure to heat or humid air and chafing clothes. The condition decreases the ability to tolerate heat. Symptoms include a mild red rash.

2. *Heat cramps* are caused by heavy sweating and inadequate fluid intake. Symptoms include muscle spasms and pain in the hands, feet, and abdomen.

3. *Heat exhaustion* occurs when body organs attempt to keep the body cool, due to inadequate fluid intake and personnel not acclimated to the environment. Symptoms include pale, cool, moist skin; heavy sweating; dizziness, headaches, and vomiting.

4. *Heat stroke* is the most serious form of heat stress. It is a MEDICAL EMERGENCY. Symptoms are red, hot, dry skin; lack of perspiration; nausea; dizziness and confusion; strong, rapid pulse rate; and coma.

The need to seek medical attention and the urgency in seeking medical attention depends on the symptoms and the severity of the symptoms displayed by the affected individual. If *heat stroke* is noted or suspected, medical attention must be sought IMMEDIATELY. Efforts should be taken to cool the body to prevent serious injury or death.

5.3 PREVENTION

Because heat stress is one of the most common and potentially serious illnesses at hazardous waste sites, regular monitoring and other preventive measures are vital. Site workers must learn to recognize and treat the various forms of heat stress. The best approach is preventive heat stress management. In general:

- Monitor for signs of heat stress.

- Fluid intake should be increased during rest schedules to prevent dehydration. Drinking cool water (maintained at 50 to 60°F) is satisfactory when light sweating occurs and temperatures are moderate to cool; however, diluted electrolyte solutions (i.e., Gatorade, Sqwincher, or equivalent) must be used in addition to water under one or all of the following conditions: continued or heavy sweating, moderate to high ambient temperatures, or heavy work loads. The intake of coffee during working hours is discouraged.

- Acclimate workers to site work conditions by slowly increasing workloads (i.e., do not begin site work activities with extremely demanding activities).

- Use cooling devices to aid natural body ventilation. These devices, however, add weight and their use should be balanced against worker efficiency. An example of a cooling aid is a cooling vest that can be worn under clothing, but not against the skin.

- In extremely hot weather, conduct field activities in the early morning and evening.

- Ensure that adequate shelter is available to protect personnel against heat that can decrease physical efficiency and increase the threat of heat stress. If possible, set up the command post in a shaded area, and encourage breaks in shaded areas.

- In hot weather, rotate shifts of workers wearing impervious clothing.

- Good hygienic standards must be maintained by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult the SHSO.

5.4 MONITORING

Provisions for monitoring for heat stress will be determined by the SHSO and performed as outlined below. Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

5.4.1 Monitoring for Permeable Clothing

For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress. If the actual clothing work differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly.

The guidelines to follow for workers above as determined by the SHSO are as follows:

1. Increased awareness of heat stress symptoms and buddy monitoring.

2. Fluid intake discipline.

3. Self monitoring of urine output quantities to prevent dehydration.

4. Attention to work-rest intervals.

5. Calculate the Heat Exposure Threshold Limit Value (TLV) for work-rest intervals using the following steps:

   a. Determine the Wet Bulb Globe Temperature (WBGT) Index using the Quest® Heat Stress Monitor.

   b. Estimate the work load using the following guidelines:

      (1) Light work = sitting or standing to control machines, performing light hand or arm work.

      (2) Moderate work = walking about with moderated lifting and pushing.

      (3) Heavy work = pick and shovel work.

   c. Evaluate the calculations against the following Heat Exposure TLVs* in °C or (°F).

Work - Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous work	30.0 (86)	26.7 (80)	25.0 (77)
75% work - 25% rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% work - 50% rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% work - 75% rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

Special Considerations

- Acclimatization - After approximately one to two weeks, workers should be acclimated to their environment.

- Fitness - Physically fit workers will adjust more readily to a change in environment.

- Medication - Some medications can predispose individuals to heat-induced illnesses.

5.4.2 Semipermeable/Impermeable Clothing Monitoring

For workers wearing semipermeable or impermeable clothing encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C).

To monitor the worker, use one or more of the following methods:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.
  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
  - If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
  - If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
  - If oral temperatures still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
  - Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).
- Body water loss. Measure weight on a scale accurate to ±0.25 pound at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or preferably in underwear only. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

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

5.5 CARING FOR HEAT-RELATED ILLNESS

To care for heat-related illness provide the following:

- Remove victim from heat.
- Loosen tight clothing.

- Apply cool, wet cloths to the skin.
- Fan the victim.
- If victim is conscious, give cool water to drink.
- Call for an ambulance or transport to hospital if heat stroke is suspected, victim refuses water, vomits, or starts to lose consciousness.

6.0 - COLD STRESS

6.1 INTRODUCTION

The potential exists for either frostbite or hypothermia to occur when conducting work activities in an environment where air temperatures may fall below freezing or where wind-chill factors lower air temperatures below freezing. A brief description of the exposure symptoms (for both hypothermia and frostbite) and methods of prevention are listed in the sections below:

6.2 CAUSES AND SYMPTOMS

The following cold stress causes and symptoms are provided for buddy monitoring purposes. Site personnel must realize that monitoring the physical condition of fellow personnel in Levels D+ through B protective ensembles will be more difficult.

6.2.1 Frostbite

Frostbite is a condition in which there is a freezing or partial freezing of some part of the body. Individuals previously exposed to frostbite are more susceptible to contracting it again. Vasoconstrictors, which include tobacco products, constrict blood vessels, and can accelerate frostbite. The three stages of frostbite include: (1) frostnip- the beginnings of frostbite whereby the skin begins to turn white; (2) superficial - similar to frostnip except the skin begins to turn numb; and (3) deep - the affected area is frozen to the bone, cold, numb, and very hard.

DO NOT:

- Rub the frostbitten part.
- Use ice, snow, gasoline, or anything cold on the frostbitten area.
- Use heat lamps or hot water bottles to rewarm the frostbitten area.
- Place the frostbitten area near a hot stove.

6.2.2 Hypothermia

Hypothermia is a condition in which the body loses heat faster than it is produced. At a body temperature of 95°F, an average man is considered to be hypothermia. Vasodilators, which include alcohol and drugs, allow the body to lose heat faster which can accelerate hypothermia. The five stages of hypothermia include:

(1) shivering
(2) apathy, listlessness, or sleepiness
(3) unconsciousness, glassy stare, slow pulse or slow respiratory rate
(4) freezing of the extremities
(5) death

The need to seek medical attention and the urgency in seeking medical attention depends on the symptoms and the severity of the symptoms displayed by the affected individual. If the latent

conditions of hypothermia or frostbite are noted or suspected, medical attention must be sought IMMEDIATELY to prevent permanent injury or death.

6.3 PREVENTION

To prevent conditions from occurring have personnel:

- Dress in a minimum of three layers:

  (1) a skin layer to absorb moisture and keep skin dry
  (2) an insulating layer
  (3) an outer layer of nylon/wind-breaking material or chemical-protective layer

- Avoid touching cold surfaces (especially metal) with bare skin, minimize exposed skin surfaces.

- Keep active, use warm and dry shelter areas during rest cycles; use wind breaks whenever possible.

- Maintain body fluids by consuming warm, sweet, caffeine-free, non-alcoholic drinks.

- Avoid alcohol and medications that interfere with normal body regulation or reduces tolerance to cold.

6.4 CARING FOR COLD-RELATED ILLNESS

The following lists the general guidelines to care for cold-related injuries:

- Start by treating any life-threatening problems.

- Call the local emergency number for help or transport the victim to the nearest hospital.

- Move the victim to a warm place, if possible.

- Remove any wet clothing and dry the victim.

- Warm the victim slowly by wrapping in blankets or putting on dry clothing.

6.5 MONITORING

In cold weather, monitor the outdoor temperature and wind speed to determine wind chill conditions, with work periods adjusted accordingly. The following table details the wind chill effects and relative danger of combined cold and wind conditions. It is important to note that the wearing of PPE in cold environments may introduce the possibility of heat stress; therefore, symptoms of heat stress should also be considered during monitoring.

WIND CHILL INDEX[1]
(under calm conditions)

Wind Speed	*Actual Thermometer Reading (°F)*									
	50	40	30	20	10	0	-10	-20	-30	-40
(in mph)	*Equivalent Chill Temperature (°F)*									
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40 mph (little added effect)	LITTLE DANGER (for properly clothed person)				INCREASING DANGER (Danger from freezing of exposed flesh)			GREAT DANGER (Danger from freezing of exposed flesh)		

[1] Source: Fundamentals of Industrial Hygiene, Third Edition. Plog, B.A., G. S. Benjamin, M. A. Kerwin, National Safety Council, 1988.

8.0 - CUTTING AND WELDING

Cutting and welding operations are performed routinely. Personnel engaged in these operations must be highly skilled and understand the importance of using safe work practices to minimize potential exposure to fire, explosion, or health hazards. No work involving a flame or spark-producing operation is to be conducted without preparing a Hot Work Permit (attached) and following the provisions of this procedure.

8.1 SAFETY RESPONSIBILITY

Both welder and Baker personnel must work together to ensure safe cutting and welding operations.

All personnel, including subcontractors, should understand the potential hazards of the work site, required use of personal protective equipment, and other safety aspects prior to initiation of cutting and welding procedures.

Under no circumstances should work be done in front of or around the open end of piping that has not been cleaned/purged, then checked using the Oxygen/Lower Explosive Limit Meter.

8.2 EQUIPMENT

It is necessary to keep equipment in good working condition and inspect regularly for defects. Equipment shall be approved and operated as specified by the manufacturer.

8.2.1 Welding Machines

Carelessness around welding machines can lead to serious injury or death. The inspector should be particularly aware of the following:

- Never touch live metal parts with bare skin or wet clothing; electrocution can result.
- Do not attempt to refuel a welding machine while it is in operation.
- Inspect all machine connections and grounding prior to use.
- Prevent electrode holders from coming in contact with people, metal objects, fuel sources, water, or compressed gas cylinders.
- The welder should not loop or coil the electrode cable around parts of the body.

8.2.2 Compressed Gas Cylinders

- Handling and storage of cylinders should be in accordance with approved governmental practices.
- Cylinders must always be secured and oxygen cylinders must be stored at least 20 feet from combustible gas cylinders.

8.2.3 Oxygen Use

- Do not confuse oxygen with air or use it as a substitute because it supports and accelerates combustion causing flammable materials to burn violently.
- Oil or grease in the presence of oxygen may ignite or explode spontaneously.
- Ensure that regulators used in oxygen service are free of dirt, oil or grease.
- Never use oxygen to blow out or purge vessels or pipelines previously containing flammables or to dust off clothing.

8.3 FIRE AND EXPLOSION PREVENTION

8.3.1 Location of Combustibles

- Cutting and welding operations shall be conducted in a designated location free from combustibles.
- Use care when welding metal partitions or piping which are adjacent to immovable combustibles because of the possibility of ignition by conduction.

8.3.2 Fire Watch

- Fire watchers with fire extinguishers or charged hoselines shall be posted.
- These individuals should be prepared to extinguish fires in the incipient stage or sound an alarm and should have no other duties at the job site.
- The fire watch should continue for at least a half hour after completion of the cutting or welding operation.

8.3.3 Fire Extinguishers

- Welding machines must have a fire extinguisher mounted in an easily accessible location either on the machine or nearby.

8.3.4 Prohibited Areas

Cutting and welding operations shall not be conducted when any of the following conditions exist:

- The area may contain flammable vapors in excess of 10% of the L.E.L.
- Large quantities of exposed, readily ignitable materials such as bulk sulfur are stored in the area.

8.4 PERSONAL PROTECTION

The following sections present the personal protective equipment such as clothing, eye and face protection, respiratory protection, and noise protection.

8.4.1 Clothing

- To protect the skin during cutting or welding operations, wear gauntlet type gloves and protective aprons. Depending on the job, it may be necessary to also wear leggings, cape sleeves or shoulder covers, and skull caps under helmets.

- Sleeves and collars should be buttoned, pockets should be removed from the front of clothing or buttoned with a flap, and pants should be uncuffed to prevent the retention of sparks.

- To prevent patter from getting into shoes, use spats or have pants overlap shoes.

- Woolen clothing is preferred but cotton material, preferably flame retardant, is acceptable.

- Keep outer clothing free from oil or grease.

8.4.2 Eye and Face Protection

- Approved eye protection must be worn at all times by welders and their assistants to protect against flying sparks, radiant energy, ultraviolet, visible and infrared radiation.

- Helmets must be designed to protect the face, forehead, neck and ears from radiant heat.

- Where exposure to flash exists for the other personnel, a screen should be used.

8.4.3 Respiratory Protection

Adequate ventilation (natural or mechanical) is necessary in all cutting and welding operations. Respiratory protection may also be necessary to prevent unacceptable exposure levels to toxic fumes and gases. Avoid breathing the fume plume.

8.4.4 Noise Protection

Engine driven generators, plasma arc cutting, and other processes may expose personnel to excessive noise. If excessive noise cannot be controlled at the source, the use of ear plugs or muffs is required.

8.5 HOT WORK PERMIT

No employee is to begin hot work unless a Hot Work Permit has been obtained. It is the responsibility of the Site Manager to request this permit. The Hot Work Permit shall be signed by the Site Manager and Site Health and Safety Officer and explained to each affected employee.

Note: It is the responsibility of the Site Manager to see that workers comply with all safety practices of the Hot Work Permit.

The Hot Work Permit will be valid for a single work shift only. On projects requiring more than a single work shift, a new permit shall be completed at the start of each shift. The permit shall be displayed at the project site.

At the conclusion of the project, the Hot Work Permits will be forwarded to the Site Manager and placed in the project file.

ATTACHMENT B
MATERIAL SAFETY DATA SHEETS

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(518) 377-8854

Section 1. Material Identification 32

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.

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

NFPA
3 / 2 / 0 / -

HMIS
H 3
F 3
R 0
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.

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Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).
Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.
Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.
Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).
Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.
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. Immediately 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. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. 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
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019
Listed 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]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

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 skin contact.
Ventilation: 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]
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: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.
Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."
Other 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)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
ID No.: UN1114
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT 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

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

DDD **MSDS No. 939**

Date of Preparation: 12/94

Section 1 - Chemical Product and Company Identification 45

Product/Chemical Name: DDD
Chemical Formula: $(ClC_6H_4)_2CHCHCl_2$
CAS No.: 72-54-8
Synonyms: benzene, 1,1'-(2,2-dichloroethylidene) bis (4-chlorobenzene); 1,1-dichloro-2,2-bis (*p*-chlorophenyl) ethane; dichlorodiphenyldichloroethane; Dilene; Rothane; TDE; tetrachlorodiphenylethane
Derivation: DDD is no longer produced or sold commercially in the USA. Prepared by chlorination of ethanol and subsequent condensation with chlorobenzene. DDD also occurs naturally as a degradation product of DDT.
General Use: Formerly used as a pesticide (dusts, emulsions, and wettable powders) for control of leaf rollers and other insects.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Ingredient, ca >90 % wt (*p, p'* isomer)
Trace Impurities: ≤ 10% *o, p'* isomer

OSHA PEL	NIOSH REL	DFG (Germany) MAK
None established	None established	None established

ACGIH TLV
None established

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

DDD exists as odorless, colorless crystals. It is irritating to the skin, eyes, and respiratory tract. Systemic toxicity is similar to that caused by DDT (*Genium MSDS* #155), but to a slightly lesser extent. The central nervous system and liver appear to be most affected. Skin absorption can occur. Although combustible, DDD does not burn readily. Banned from US production because of its ability to bioconcentrate and its persistency in the environment.

Wilson Risk Scale
R 1
I –
S 2*
K 1
*Skin absorption

HMIS
H 2*
F 1
R 0
* Chronic effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion, skin absorption.
Target Organs: Eyes, skin, respiratory tract, central nervous system, liver.
Acute Effects
Inhalation: Symptoms include irritation of the respiratory tract, nausea, vomiting, and excitement followed by lethargy (general tiredness). Exposure to DDD appears to result in less severe symptoms than exposure to its higher analogue, DDT.
Eye: Contact causes minor irritation.
Skin: Contact causes minor irritation. Absorption can cause systemic effects.
Ingestion: Ingestion causes CNS effects (see inhalation). The estimated fatal dose is 5g/kg.
Medical Conditions Aggravated by Long-Term Exposure: Liver disorders.
Chronic Effects: Repeated exposure can lead to liver damage and atrophy (deterioration) of the adrenal cortex.
Carcinogenicity: Listed by IARC (Class 2B carcinogen, possibly carcinogenic in humans) and the EPA (Class B2 carcinogen, inadequate human and adequate animal data) as a carcinogen. Although the NTP reports DDD to have produced cancer in animals, it has only given a formal designation to DDT.
Other: In general, exposure to organochlorine pesticides have been indicated in spontaneous abortions and premature delivery.

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. Consult an ophthalmologist if pain or irritation persist.
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water followed by a soap and water wash. Consult a physician if pain or irritation persist.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Vomiting may be spontaneous.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treatment is symptomatic and supportive.

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Section 5 - Fire-Fighting Measures

Genium

Flash Point: None reported. DDD is combustible, but does not ignite readily.
Autoignition Temperature: None reported.
LEL: None reported.
UEL: None reported.
Flammability Classification: Combustible solid
Extinguishing Media: Use dry chemical, carbon dioxide, regular foam, or water spray.
Unusual Fire or Explosion Hazards: None reported.
Hazardous Combustion Products: Include chlorine and hydrogen chloride gas.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind.
Small Spills: Carefully scoop or vacuum (with appropriate filter) and place in suitable container for disposal.
Large Spills: Flush spill with water to containment area. Absorb with activated carbon. Do not release into sewers or waterways.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Wear appropriate PPE to prevent inhalation, eye contact, and skin absorption.
Storage Requirements: Store in a cool, dry, well-ventilated area away from alkalis.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Since DDD is no longer produced in the USA, engineering controls are not normally applicable. However, when DDD is encountered through analysis and disposal procedures, it is important that processes are enclosed to prevent dispersion of DDD dusts or contaminated (DDD) soil through the work area.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Administrative Controls: Consider preplacement and periodic medical exams of all workers potentially exposed to DDD. Emphasis should be placed on liver function.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse or plan for disposal. Remove DDD from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after potential exposure to DDD, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: Odorless, colorless crystals
Vapor Pressure: 10.2×10^{-7} mm Hg at 86 °F (30 °C)
Formula Weight: 320.05
Density (H_2O=1, at 4 °C): 1.385 g/cm^3
Water Solubility: 0.005 ppm
Other Solubilities: Soluble in organic solvents
Boiling Point: 379.4 °F (193 °C) at 1 mm Hg
Melting Point: 228.2 to 230 °F (109 to 110 °C)
Octanol/Water Partition Coefficient: log Kow = 6.02

Section 10 - Stability and Reactivity

Stability: DDD is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization does not occur.
Chemical Incompatibilities: Alkalis.
Conditions to Avoid: Exposure to ignition sources and alkalis.
Hazardous Decomposition Products: Thermal oxidative decomposition of DDD can produce chlorine gas.

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Section 11- Toxicological Information

Toxicity Data:*

Acute Dermal Effects:
Rabbit, skin, LD_{50}: 1200 mg/kg caused primary irritation, excitement and convulsions or effect on seizure threshold, and death in 50% of test animals.

Mutagenicity:
Mouse embryo: 28,400 nmol/L caused oncogenic transformation.

Acute Oral Effects:
Rat, oral, LD_{50}: 113 mg/kg

Tumorigenicity:
Rat, oral: 54 g/kg/78 continuous weeks caused thyroid tumors.

* See NIOSH, *RTECS* (KI0700000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Japanese quail, LC_{50} = 3165 ppm ; mallard duck, LC_{50} = 4814 ppm; rainbow trout, LC_{50} = 70 µg/L/96 hr.
Environmental Transport: If released to soil, DDD will absorb strongly with very little leaching to groundwater. In water, DDD will absorb strongly to sediment and bioconcentrate in aquatic animals. Hydrolysis is not appreciable; est. half-life is 570 days (pH 9) and 190 days (pH 5). Evaporation will be slow; est. half-life from a model river 1 m deep, flowing 1 m/sec with a wind velocity of 3 m/sec is 1.82 days.
Environmental Degradation: Biodegrades very slowly.
Soil Absorption/Mobility: Absorbs strongly to soil, sediment, and particulates.

Section 13 - Disposal Considerations

Disposal: DDD is a potential candidate for rotary kiln incineration. Activated carbon can be used to remove most DDD from wastewater (to levels < 1 mg/L). Contact a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
Container Cleaning and Disposal: Triple rinse containers before disposal or shipment to scrap metal facility.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Organochlorine pesticides, solid toxic, n.o.s.
Shipping Symbols: –
Hazard Class: 6.1
ID No.: UN2761
Packing Group: III
Label: Keep Away From Food
Special Provisions (172.102): –

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 100 kg
b) Cargo Aircraft Only: 200 kg

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33): U060
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001, CWA, Sec. 311 (b)(4), and CWA, Sec. 307(a).
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

Section 16 - Other Information

References: 73, 103, 124, 184, 189, 197, 198
Prepared By.....M Gannon, BA
Industrial Hygiene Review.....DJ Wilson, CIH
Medical Review .....T Thoburn, MD, MPH

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Section 1. Material Identification

1,1-Dichloroethane (CH_3CHCl_2) Description: Derived by various methods; by direct chlorination of ethane, as a side product of chloral manufacture, by treating ethylene and chlorine with calcium chloride, by action of phosphorus chloride on acetaldehyde, and the reaction of hydrogen chloride and vinyl chloride at 20 to 55 °C in the presence of an aluminum, ferric, or zinc chloride catalyst. Found as an air contaminant in submarines and space craft. Its largest industrial use is in the production of 1,1,1-trichloroethane. Also used as a cleansing agent, degreaser, solvent for plastics, oils, and fats, grain fumigant, chemical intermediate; in insecticide sprays, rubber cementing, fabric spreading, paint and varnish removers, in ore flotation, vinyl chloride production, and as a coupling agent in anti-knock gasoline. Formerly used as an anesthetic.
Other Designations: CAS No. 75-34-3; assymetrical dichloroethane; chlorinated hydrochloric ether; ethylidene chloride; ethylidene dichloride.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.
Cautions: 1,1-Dichloroethane is volatile and highly flammable. It is irritating to the eyes and respiratory tract and inhalation of high concentrations causes an anesthetic effect.

R	1
I	3
S	2
K	4

NFPA

HMIS
H 2
F 3
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

1,1-Dichloroethane, reagent grade (99.7%). Impurities consist of ethyl chloride (0.02%), trichloroethylene (0.08%), butylene oxide (0.08%), ethylene dichloride (0.01%), and unknown (0.14%).

1991 OSHA PEL
8-hr TWA: 100 ppm (400 mg/m^3)

1990 IDLH Level
4000 ppm

1990 NIOSH REL
8-hr TWA: 100 ppm (400 mg/m^3)

1991-92 ACGIH TLVs*
TWA: 200 ppm (810 mg/m^3)
STEL: 250 ppm (1010 mg/m^3)

1990 DFG (Germany) MAK
100 ppm (400 mg/m^3)
Half-life: < 2hr
Peak Exposure Limit: 200 ppm/30 min. average value/maximum of 4 peaks per shift

1985-86 Toxicity Data†
Mouse, oral, TD_{Lo}: 185 g/kg administered intermittently for 78 wk produced uterine tumors.
Rat, oral, LD_{50}: 725 mg/kg; toxic effects not yet reviewed.‡
Rat, inhalation, TC_{Lo}: 6000 ppm/7 hr administered during 6 to 15 days of pregnancy caused developmental abnormalities of the musculoskeletal system.

* Notice of intended change to 100 ppm/405 mg/m^3.
†See NIOSH, *RTECS* (KI0175000), for additional reproductive, tumorigenic and toxicity data.
‡ Considered a possible error since subsequent studies at higher concentrations failed to produce comparative results.[133]

Section 3. Physical Data

Boiling Point: 135 °F (57.3 °C)
Melting Point: -143 °F (-96.98 °C)
Vapor Pressure: 230 mm Hg at 77 °F (25 °C)
Saturated Vapor Density (air = 1.2 kg/m^3 or 0.075 lbs/ft^3): 2.076 kg/m^3 or 0.129 lbs/ft^3
Refraction Index: 1.4166 at 68 °F (20 °C)
Surface Tension: 24.75 dyne/cm at 68 °F (20 °C)

Molecular Weight: 98.97
Specific Gravity: 1.174 at 68 °F (20/4 °C)
Water Solubility: Slightly, 0.5%
Other Solubilities: Very soluble in alcohol and ether, soluble in acetone, benzene, and fixed and volatile oils.
Relative Evaporation Rate (BuAc=1): 11.6
Odor Threshold: 49 to 1359 ppm; odor is not sufficient to warn against overexposure

Appearance and Odor: Colorless, mobile, oily liquid with a chloroform odor and a saccharin taste.

Section 4. Fire and Explosion Data

Flash Point: 17 °F (-8.33 °C) CC*	Autoignition Temperature: 856 °F (493 °C)	LEL: 5.6% v/v	UEL: 11.4% v/v

Extinguishing Media: A Class 1B Flammable Liquid. For small fires, use dry chemical, carbon dioxide (CO_2), or "alcohol-resistant" foam. For large fires, use fog or "alcohol-resistant" foam. Water may be ineffective unless used as a "blanket".
Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Container may explode in heat of fire.
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 only limited protection. If possible without risk, move container from fire area. Apply cooling water to sides of containers 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 this is impossible, withdraw from area and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers (explosion) or waterways.

* 22 °F (-5.5 °C), OC[148]

Section 5. Reactivity Data

Stability/Polymerization: 1,1-Dichloroethane is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Incompatible with strong oxidizers and forms acetaldehyde in contact with caustics. 1,1-Dichloroethane will attack some forms of plastics, rubber, and coatings.
Conditions to Avoid: Exposure to heat and ignition sources and contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of 1,1-dichloroethane can produce carbon dioxide (CO_2), irritating hydrogen chloride (HCl) and toxic phosgene ($COCl_2$) fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list 1,1-dichloroethane as a carcinogen. However, the National Cancer Institute has recommended caution due to analogy to other chloroethanes such as 1,2-dichlorothane which are shown to cause cancer in animals.
Summary of Risks: 1,1-Dichloroethane is irritating to the eyes and respiratory system. It causes varying degrees of central nervous system (CNS) disturbance depending on the concentration and duration of exposure. Liver and kidney toxicity is controversial.

Continue on next page

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Section 6. Health Hazard Data, *continued*

Some sources report that severe, acute exposures can cause damage, some quote recent detailed chronic studies which indicate little capacity for damage; still others refute the possibility of acute damage even from very high exposures. In reviewing the data it appears likely that chronic exposure will not cause kidney or liver damage but acute exposures to high concentrations may. There is definite evidence that 1,1-dichloroethane produces liver damage in monkeys, dogs, and rats when exposed to 98 ppm/90 days. It is also unclear whether or not 1,1-dichloroethane is absorbed through the skin. There are reports of absorption (although not in toxic amounts) and others claiming there is no absorption. Given this controversial data it is best to take precautions as if skin absorption, and liver and kidney damage were proven to occur. **Medical Conditions Aggravated by Long-term Exposure:** Chronic respiratory and skin disease, neurological damage, and liver or kidney disorders. **Target Organs:** Skin, CNS, liver, kidney. **Primary Entry Routes:** Inhalation and skin contact. **Acute Effects:** Inhalation symptoms include eye, nose, and throat irritation, headache, dizziness, coughing, staggering, disturbed vision, irregular heartbeat (can result in sudden death), unconsciousness, narcosis, coma, and death due to cardiac or respiratory failure. There is the risk of pulmonary edema (fluid in lungs). Skin contact is irritating and causes defatting, redness and swelling. Vapor contact with the eyes causes irritation, watering eyes and lid inflammation. Splashes to the eyes produces a burning sensation, watering, and lid inflammation. **Chronic Effects:** Repeated skin contact can cause a rash and scaliness. Repeated inhalation may have neurological effects.

FIRST AID *Emergency personnel should protect against contamination.*

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do *not* allow victim to rub or keep eyes tightly shut. Immediately consult an ophthamlologist. **Skin:** 1,1-Dichloroethane vaporizes easily and poses an inhalation hazard as well. *Quickly and carefully* remove contaminated clothing; *1,1-dichloroethane is flammable!* 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. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. After vomiting, give 2 tbsp activated charcoal in 8 oz water to drink.

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

Note to Physicians: Proper ventilation is the main treatment for acute exposure. Be prepared to support respiration if needed. Monitor liver function studies, urine analysis, and creatinine with acute and chronic exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against inhalation and skin contact. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and using nonsparking tools, place in a suitable container. For large spills, dike far ahead of liquid spill for disposal or reclamation. Do not allow 1,1-dichloroethane to enter confined areas such as a sewer because of potential explosion. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Degradation:** In soil, 1,1-dichloroethane volatilizes rapidly but may leach into groundwater. In water it will volatilize from a pond, lake, or river with a half-life of 6 to 9 days, 5 to 8 days, and 24 to 32 hr, respectively. In the atmosphere it will degrade by reaction with photochemically produced hydroxyl radicals with a 62 day half-life. It may also be carried back to soil via rain.

Ecotoxicity Values: *Artemia salina*, brine shrimp, TLm 320 mg/L/24 hr; *Lagodon rhomboides*, pinperch, TLm 160 mg/L/24 hr; *Poecilia reticulata*, guppies, LC_{50} 202 ppm/7 days.

Disposal: 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
SARA Toxic Chemical (40 CFR 372.65): Not listed
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U076
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001 & 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 respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH/MSHA-approved respirator. For < 1000 ppm, use any supplied-air respirator or SCBA. For < 2500 ppm, use any supplied-air respirator operated in a continuous flow mode. For < 4000 ppm, use any supplied-air respirator 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: 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 repeated or prolonged skin contact. Polyvinyl alcohol is recommended as suitable material for PPG. **Ventilation:** Provide general and 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] **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. Thoroughly decontaminate 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. 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 (Sec. 5). Label containers to indicate the contents' high flammability. Periodically inspect containers for cracks and leaks. To prevent static sparks, electrically ground and bond all equipment used in 1,1-dichloroethane manufacture, use, storage, transfer, and shipping.

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: Consider preplacement and periodic medical exams of exposed workers emphasizing the skin, CNS, liver, and kidney. Educate workers about the hazards of 1,1-dichloroethane and the necessary precautions to reduce or prevent exposure.

Transportation Data (49 CFR 172.102)

IMO Shipping Name: 1,1-Dichloroethane
IMO Hazard Class: 3.2
ID No.: UN2362
IMO Label: Flammable Liquid
IMDG Packaging Group: II

MSDS Collection **References:** 73, 89, 101, 103, 126, 127, 131, 132, 133, 136, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD

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Material Safety Data Sheets Collection:

Sheet No. 385
Ethylbenzene

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

Section 1. Material Identification

39

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
3 / 2 / 0 / -

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

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Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive airway 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 rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was intolerable 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 absorbed 118 & 215.7 µg/cm^2/hr, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation 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 to 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 tension 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, test 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 material 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 1508 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 (450 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
UN 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

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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

33

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.

R	1
I	-
S	2
K	2

NFPA

HMIS
H 0
F 2
R 0
PPG*
* 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)
Appearance and Odor: Brown, slightly viscous liquid.
Water Solubility: Insoluble
Pour Point:* <21 °F (-6 °C)

*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.

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Section 6. Health Hazard Data

Carcinogenicity: 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.
Disposal: 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): 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

DOT Hazard Class: Combustible liquid

ID 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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Sheet No. 474
Fuel Oil No. 6

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

Section 1. Material Identification 33

Fuel Oil No. 6 Description: A high-viscosity residual oil. Used to power heavy units such as ships, trucks, and trains. A thick paste, fuel oil No. 6 is not usually used unless preheated to decrease its viscosity.
Other Designations: CAS No. 68553-00-4, bunker C.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R	1
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S	2
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* Sec. 8

Cautions: Fuel oil No. 6 is a respiratory irritant and central nervous system (CNS) depressant. It is a moderate fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 6*

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

* A complex mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, including polycyclic aromatic hydrocarbons. Sulfur content is <2.8%. A fuel oil No. 6 with low sulfur (0.2 and 1.2%) is commercially available.
† Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point: 500 °F (>260 °C)
Vapor Pressure: 0.2 mm Hg at 70 °F (21 °C)
Viscosity: 36,000 centistoke at 100 °F (37.8 °C)
Specific Gravity: ~0.966
Water Solubility: Insoluble
Appearance and Odor: Black liquid to heavy paste with a petroleum odor.

Section 4. Fire and Explosion Data

Flash Point: 150 to 270 °F (66 to 132 °C)	Autoignition Temperature: 765 °F (407 °C)	LEL: 3.9% v/v	UEL: 20.1% 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. Cool fire-exposed containers with water spray.
Unusual Fire or Explosion Hazards: Fuel oil No. 6 is an OSHA Class IIIA combustible liquid that exhibits "boil-over" characteristics.
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 hazard area. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Fuel oil No. 6 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. 6 can produce various hydrocarbons and hydrocarbon derivatives and partial oxidation products including carbon dioxide, carbon monoxide, and sulfur dioxide.

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Section 6. Health Hazard Data

Carcinogenicity: The IARC lists fuel oils, residual (heavy) as possible human carcinogen (Group 2B); animal evidence-limited.
Summary of Risks: Residual oils are generally more viscous and less toxic than kerosene due to their low volatility and limited absorption through the intestinal tract. Inhalation of heated or misted fuel oil No. 6 can cause the same systemic and local pulmonary effects seen with lighter grade fuel oils, respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and time of exposure. When removed from exposure area, affected persons usually experience complete recovery. The residual (heavy) oils have a lower aspiration hazard since heavy oils are more viscous. Aspiration is limited to inhalation from vomiting after ingestion and dilution with gastric contents. Significant ingestion is unlikely. In addition, intestinal absorption of long-chain hydrocarbons is low. Its primary toxicities, then, are its laxative effect, mild gastrointestinal (GI) irritation, and skin irritation. After prolonged skin contact, changes in rabbit bladder linings are reported. Prolonged or repeated skin contact may cause irritation and block the sebaceous glands, with a rash of acne-like pimples and spots, usually on the arms and legs. Repeated prolonged dermal contact may also have systemic effects. Heavy repeated application of fuel oil No. 6 to rabbit skin gave severe skin changes and systemic toxicity including an increased incidence of hyperplasia of the urinary bladder epithelium.*
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 oxygentation of the blood).
Chronic Effects: Repeated skin contact causes dermatitis and possible systemic toxicity.
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*. Consulting 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.

* EPA (TOSCA) document 8EHQ-0181-0377, December, 1980.

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 a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclaim 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). Report large oil spills.
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
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 IIIA 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 area 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
DOT Hazard Class: Combustible liquid
ID 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, 131, 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. 311
Methyl Chloroform

Issued: 11/75 Revision: F, 3/92 Errata: 6/92

Section 1. Material Identification

Methyl Chloroform ($C_2H_3Cl_3$) Description: Derived by catalytic addition of hydrogen chloride to 1,1-dichloroethylene or by re-fluxing chlorine monoxide with carbon tetrachloride and chloroethane. Available in technical and solvent grades which differ only in the amount of stabilizer added to prevent metal parts corrosion. Used as a solvent for oils, waxes, tars, cleaning precision instruments, and pesticides; as a component of inks and drain cleaners; in degreasing metals, and textile processing. In recent years, methyl chloroform has found widespread use as a substitute for carbon tetrachloride.

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Other Designations: CAS No. 71-55-6, α-trichloroethane; Inhibisol; 1,1,1-trichloroethane; Strobane.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.
Cautions: Methyl chloroform is a skin, eye, and respiratory tract irritant and can become narcotic with an anesthetic effect at high concentrations.
* Data on skin absorption via methyl chloroform is conflicting.[133] Some studies show definite absorption where others don't.

Section 2. Ingredients and Occupational Exposure Limits

Methyl chloroform, ca 92 to 97%*

1990 OSHA PELs
8-hr TWA: 350 ppm (1900 mg/m^3)
15-min STEL: 450 ppm (2450 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
15-min Ceiling: 350 ppm (1900 mg/m^3)

1991-92 ACGIH TLVs
TWA: 350 ppm (1910 mg/m^3)
STEL: 450 ppm (2460 mg/m^3)

1990 DFG (Germany) MAKs
TWA: 200 ppm (1080 mg/m^3)
Half-life: 2 hr to shift length
Peak Exposure Limit: 1000 ppm/30 min (average value)/2 per shift

1985-86 Toxicity Data†
Human, oral, TD_{Lo}: 670 mg/kg produced diarrhea, nausea, and vomiting
Human, inhalation, LC_{Lo}: 27 g/m^3/10 min; toxic effects not yet reviewed
Man, eye: 450 ppm/8 hr produced irritation
Rat, inhalation, TC_{Lo}: 2100 ppm/24 hr for 14 days prior to mating and from 1 to 20 days of pregnancy produced specific developmental abnormalities of the musculoskelatal system

* Methyl chloroform usually contains inhibitors (3 to 8%) to prevent corrosion of aluminum and some other metals. Typical inhibitors are nitromethane, butylene oxide, secondary butyl alcohols, ketones, and glycol diesters.
† See NIOSH, *RTECS* (KJ2975000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 165 °F (75 °C)
Freezing Point: -22 °F (-30 °C)
Vapor Pressure: 100 mm Hg at 68 °F (20 °C)
Vapor Density (air = 1): 4.55
Corrosivity: Readily corrodes aluminum and its alloys
Refraction Index: 1.43765 at 69.8 °F (21 °C)
Viscosity: 0.858 cP at 68 °F (20 °C)
Molecular Weight: 133.42
Density: 1.3376 at 68/39.8 °F (20/4 °C)
Water Solubility: Insoluble
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, carbon tetrachloride, and carbon disulfide
% in Saturated Air: 16.7% at 77 °F (25 °C)
Relative Evaporation Rate (butyl acetate = 1): 12.8
Appearance and Odor: Colorless liquid with a sweetish, chloroform-like odor. The odor threshold is 44 ppm.

Section 4. Fire and Explosion Data

Flash Point: None (in conventional CC tests)	Autoignition Temperature: 932 °F (500 °C)	LEL: 7% v/v	UEL: 16% v/v

Extinguishing Media: ***Noncombustible liquid*** whose ***vapor*** burns in the presence of excess oxygen or a strong ignition source. For small fires, use dry chemical or carbon dioxide (CO_2). For large fires use fog or regular foam. If these materials are unavailable, a water spray may be used but be aware that water reacts slowly with methyl chloroform to release hydrochloric acid.
Unusual Fire or Explosion Hazards: Vapors are heavier than air and may travel to a strong ignition source and flash back. Air/vapor mixtures may explode when heated. Container may explode in heat of fire. Exposure to open flames or arc welding can produce hydrogen chloride and phosgene.
Special Fire-fighting Procedures: Methyl chloroform's burning rate is 2.9 mm/min. 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 firefighters' protective clothing provides limited protection. Wear clothing specifically recommended by the manufacturer for use in fires involving methyl chloroform. Apply cooling water to container sides until after fire is extinguished. Stay away from ends of tanks. Isolate area for 1/2 mile if fire involves tank, truck, or rail car. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Methyl chloroform is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can occur in contact with aluminum trichloride.
Chemical Incompatibilities: Methyl chloroform is incompatible with sodium hydroxide, nitrogen tetroxide, oxygen (liquid or gas), strong oxidizers, and chemically active metals like aluminum, zinc, and magnesium powders; reacts violently with caustics to form dichloroacetylene; reacts slowly with water to form hydrochloric acid; forms shock sensitive mixtures with potassium; and polymerizes in contact with aluminum trichloride.
Conditions to Avoid: Exposure to moisture, strong ignition sources, and arc-welding units, and contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition (temperatures >500 °F, contact with hot metals, or under UV rays) of methyl chloroform can produce carbon dioxide (CO_2) and toxic dichloroacetylene, hydrogen chloride, and phosgene gases.

Section 6. Health Hazard Data

Carcinogenicity: The IARC (Class 3, inadequate evidence),[164] NTP,[142] and OSHA[164] do not list methyl chloroform as a carcinogen.
Summary of Risks: Methyl chloroform is considered one of the least toxic of the liquid chlorinated hydrocarbons. It is irritating to eyes, skin, and respiratory tract. Although low in systemic toxicity, methyl chloroform is an anesthetic capable of causing death at high concentrations (>15,000 ppm), generally in poorly ventilated, enclosed areas. Quick and complete recovery is observed after prompt removal of unconscious persons from area of exposure. Like many other solvents, methyl chloroform sensitizes the heart to epinephrine (blood pressure-raising hormone) and may induce cardiac arrhythmias and arrest.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eyes, central nervous (CNS) and cardiovascular (CVS) systems.

Continue on next page

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Section 6. Health Hazard Data, *continued*

Primary Entry Routes: Inhalation, skin contact. **Acute Effects:** Methyl chloroform defats the skin causing irritation, redness, dryness, and scaling. Contact with eyes produces irritation and mild conjunctivitis. Vapor inhalation can cause headache, dizziness, equilibrium disturbances, and in high concentrations may lead to CNS depression, unconsciousness, and coma. During a 60-min exposure period these effects are observed: 100 ppm is the observed odor threshold, at 500 ppm there is obvious odor and decreased reaction time, 1000 ppm causes slight equilibrium loss, at 5000 ppm there is definite incoordination, and 20,000 ppm produces surgical strength anesthesia with possible death. Mild liver and kidney dysfunction may occur after CNS depression recovery. Although unlikely, if ingestion occurs, symptoms include nausea, vomiting, diarrhea, and possible esophageal burns. The acute lethal human dose is ~500 to 5000 mg/kg. **Chronic Effects:** None reported.

FIRST AID

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to rub or keep eyes tightly shut. 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 to dilute. When deciding whether to induce vomiting, carefully consider amount ingested, time since ingestion, and availability of medical help. If large amounts are recently ingested (absorption into the body is not yet likely to have occurred), and medical help or transportation to a medical facility is not readily available, induce vomiting. Otherwise, vomiting is not recommended since aspiration of vomitus can produce chemical pneumonitis.

Note to Physicians: Do not use adrenaline or sympathomimetic amines in treatment because of the increased cardiac sensitivity involved.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources. If possible without risk, shut off leak. Cleanup personnel should wear fully encapsulating vapor-protective clothing. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material. Using nonsparking tools, place in suitable containers for disposal or reclamation. For large spills, dike far ahead of liquid spill for later disposal or reclamation. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120).

Environmental Transport: In water, methyl chloroform's half-life is hours to weeks depending on wind and mixing conditions. It is very persistent in groundwater. On land it volatilizes due to its high vapor pressure and leaches extensively. When released to the atmosphere, methyl chloroform can be transported long distances and returned to earth via rain. It is slowly degraded by reaction with hydroxyl radicals and has a half-life of 6 months to 25 years. The Natural Resources Defenses Council reported recently that methyl chloroform depletes ozone.

Ecotoxicity Values: *Pimephales promelas* (fathead minnow), LC_{50}: 52.8 mg/L/96 hr; *Poecilia reticulata* (guppy), LC_{50}: 133 ppm/7 day.

Disposal: 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 261.33): No. U226

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Reportable Quantity (RQ), 1000 lb (454 kg) [* per RCRA, Sec. 3001, CWA, Sec. 307(a), and CAA, Sec. 112]

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

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

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

Section 8. Special Protection Data

Goggles: Wear splash-proof, protective chemical safety goggles or faceshields, 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. 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 respiratory protection program that includes at least: 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 repeated or prolonged skin contact. Viton and butyl rubber [with breakthrough times (BTs) of >8 hr and 4 to 7.9 hr, respectively] are recommended materials for protective gear. *Do not use* neoprene, polyvinyl chloride (PVC), natural rubber, or polyethylene because these materials have a BT of <1 hr.

Ventilation: Provide general and local exhaust (in some cases, explosion-proof) ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into 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 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. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in cool, dry, well-ventilated (use pressure-vacuum ventilation) area away from ignition sources, arc-welding operations, and incompatibles (Sec. 5). Regularly monitor inhibitor levels. *Do not* store in aluminum containers or use pressure-spraying equipment when methyl chloroform is involved.

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. To prevent static sparks, electrically ground and bond all equipment used in methyl chloroform manufacturing, use, storage, transfer, and shipping.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers that emphasize CNS, CVS, liver and skin.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: 1,1,1-Trichloroethane
DOT Hazard Class: ORM-A
ID No.: UN2831
DOT Label: None
DOT Packaging Exceptions: 173.505
DOT Packaging Requirements: 173.605

IMO Shipping Name: 1,1,1-Trichloroethane
IMO Hazard Class: 6.1
ID No.: UN2831
IMO Label: St. Andrews Cross
IMDG Packaging Group: III

MSDS Collection **References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 148, 153, 159, 162, 163, 164

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MPH, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheet

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No. 677

1,1,2,2-TETRACHLOROETHANE

Issued: November 1988

SECTION 1. MATERIAL IDENTIFICATION 27

Material Name: 1,1,2,2-TETRACHLOROETHANE

Description (Origin/Uses): Used as a solvent primarily for cleaning and extraction procedures and as a chemical intermediate in the manufacture of trichloroethylene and tetrachloroethylene; and as an analytic reagent by textile manufacturers in polymer characterization tests.

Other Designations: Acetylene Tetrachloride; *sym*-Tetrachloroethane; $CHCl_2CHCl_2$; CAS No. 0079-34-5

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

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

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
1,1,2,2-Tetrachloroethane, CAS No. 0079-34-5	Ca 100	**OSHA PEL (Skin*)** 8-Hr TWA: 1 ppm, 7 mg/m³ **ACGIH TLV (Skin*), 1988-89** TLV-TWA: 1 ppm, 7 mg/m³ **Toxicity Data**** Human, Oral, TD_{Lo}: 30 mg/kg Human, Inhalation, TC_{Lo}: 1000 mg/m³ (30 Mins) Rat, Oral, LD_{50}: 800 mg/kg

*This material can be absorbed through intact skin, which contributes to overall exposure.
**See NIOSH, *RTECS* (KI8575000), for additional data with references to reproductive, tumorigenic, and irritative effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 295°F (146°C)
Melting Point: -47°F (-44°C)
% Volatile by Volume: Ca 100
Vapor Pressure: 6 Torrs at 77°F (25°C)*
Molecular Weight: 168 Grams/Mole
Solubility in Water (%): Insoluble
Specific Gravity (H_2O = 1): 1.58658 at 77°F (25°C)

Appearance and Odor: A colorless, nonflammable, heavy, mobile liquid; sweetish, suffocating, characteristic chloroform odor. The odor recognition threshold is reported to be less than 3 ppm.

*At 77°F (25°C) the concentration of 1,1,2,2-tetrachloroethane in saturated air is approximately 7900 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature*	LEL*	UEL*

Extinguishing Media: *1,1,2,2-Tetrachloroethane does not burn. Use extinguishing agents that will put out the surrounding fire. **Unusual Fire or Explosion Hazards:** None reported. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode to protect against the effects of the nearby fire.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: 1,1,2,2-Tetrachloroethane is stable in closed containers during routine operations at room temperature. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Hazardous reactions between 1,1,2,2-tetrachloroethane and 2,4-dinitrophenyl disulfide, nitrogen tetroxide, chemically active metals such as potassium; and strong caustics such as potassium hydroxide, sodium, sodium-potassium alloy, hot iron, aluminum, and zinc in the presence of steam are reported. **Conditions to Avoid:** Prevent exposure to the incompatible chemicals listed above. Contact with water causes appreciable hydrolysis that will degrade and decompose this liquid. **Hazardous Products of Decomposition:** Thermal-oxidative degradation of 1,1,2,2-tetrachloroethane can produce highly toxic gases such as carbon monoxide (CO) and oxides of chlorine (ClO_x).

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: NIOSH lists 1,1,2,2-tetrachloroethane as a carcinogen.
Summary of Risks: 1,1,2,2-Tetrachloroethane is absorbed through intact skin in significant amounts; one human fatality has been attributed to this route of exposure. This liquid is considered to be one of the most toxic of the common chlorinated hydrocarbons, particularly with respect to the liver. Severely acute exposure causes depression of the central nervous system (CNS), which can cause death within 12 hours. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, CNS, gastrointestinal system, liver, and kidneys. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** The initial symptoms of exposure are lacrimation, salivation, and irritation of the nose and throat; continued exposure can lead to nausea, vomiting, and narcosis. Also, low blood pressure and cardiac rhythm abnormalities; respiratory depression; nausea, vomiting, burns of the esophagus, and diarrhea; and anesthesia with dizziness leading to loss of consciousness and coma; plus possible transient liver and kidney changes. **Chronic Effects:** The two sets of manifestations are (1) malaise, drowsiness, decreased appetite, then nausea and retching, a bad taste in the throat, constipation, headache, pale stools, jaundice, and dark urine, as well as mental confusion, stupor, and coma; and (2) hand

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SECTION 6. HEALTH HAZARD INFORMATION, cont.

tremors, sensation of deafness, numbness in hands and feet, a decrease in reflexes, headache, and nausea. 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. Rinse the affected areas with flooding amounts of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Keep the exposed person warm and at rest until medical help is available. **Ingestion.** Unlikely. Should this type of exposure occur, give the exposed person 3 glasses of water to drink and induce vomiting, then repeat this procedure. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Workers exposed to this liquid should be evaluated with a full battery of tests for the liver, kidneys, and CNS systems, as well as the blood.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, and provide adequate ventilation. Cleanup personnel must be properly clothed and equipped to protect the skin and eyes against any contact with the liquid as well as inhalation of its vapor (see sect. 8). Vacuum the spilled 1,1,2,2-tetrachloroethane and pump it into suitable 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 (40 CFR 302.4)
RCRA Waste, No. U209
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per the Clean Water Act (CWA), § 307 (a); and the Resource Conservation and Recovery Act (RCRA), § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of this liquid is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills 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, gauntlets, etc., to prevent skin contact with this liquid. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels 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:** 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 any work area. Do not inhale 1,1,2,2-tetrachloroethane vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store 1,1,2,2-tetrachloroethane in closed, airtight containers in a cool, dry, well-ventilated area away from incompatible chemicals (see sect. 5). **Special Handling/Storage:** Provide storage areas with adequate ventilation to prevent concentrations of the vapor from building up beyond the occupational exposure limits cited in section 2.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Tetrachloroethane
DOT Hazard Class: ORM-A
ID No. UN1702
DOT Packaging Requirements: 49 CFR 173.620
DOT Packaging Exceptions: 49 CFR 173.505

IMO Shipping Name: 1,1,2,2-Tetrachloroethane
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II

References: 1, 38, 84-94, 100, 116, 117, 120, 122.

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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.

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

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 causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

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Section 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, transient 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.

EPA Designations
Listed 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 < 1000 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 2000 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 and 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)

DOT Shipping Name: Toluene
DOT Hazard Class: 3
No.: UN1294
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 150
b) Non-bulk Packaging: 202
c) Bulk Packaging: 242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
Vessel Stowage: B
Other: --

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.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, CIH, MPH; **Medical Review:** AC Darlington, MD, MPH

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Section 1. Material Identification

Trichloroethylene (C_2HCl_3) Description: Derived by treating tetrachloroethane with lime or other alkali in the presence of water, or by thermal decomposition of tetrachloroethane followed by steam distillation. Stabilizers such as epichlorohydrin, isobutanol, carbon tetrachloride, chloroform, benzene, or pentanol-2-triethanolamine are then added. Used as a degreasing solvent in electronics and dry cleaning, a chemical intermediate, a refrigerant and heat-exchange liquid, and a diluent in paint and adhesives; in oil, fat, and wax extraction and in aerospace operations (flushing liquid oxygen). Formerly used as a fumigant (food) and anesthetic (replaced due to its hazardous decomposition in closed-circuit apparatus).
Other Designations: CAS No. 79-01-6; acetylene trichloride; Algylen; Anamenth; Benzinol; Cecolene; Chlorylen; Dow-Tri; ethylene trichloride; Germalgene; Narcogen; Triasol; trichloroethene; TCE; 1,1,3-trichloroethylene.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

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

NFPA
2 / 2 / 0 / -

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

Cautions: TCE is irritating and toxic to the central nervous system (CNS). Inhalation of high concentrations have lead to death due to ventricular fibrillation. Chronic exposure may lead to heart, liver, and kidney damage. The liquid is absorbed through the skin. Although it has a relatively low flash point, TCE burns with difficulty.

Section 2. Ingredients and Occupational Exposure Limits

Trichloroethylene, < 100% [contains stabilizers (Sec. 1)].

1991 OSHA PELs
8-hr TWA: 50 ppm (270 mg/m^3)
15-min STEL: 200 ppm (1080 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
10-hr TWA: 25 ppm (~135 mg/m^3)

1992-93 ACGIH TLVs
TWA: 50 ppm (269 mg/m^3)
STEL: 200 ppm (1070 mg/m^3)

1990 DFG (Germany) MAK
Ceiling: 50 ppm (270 mg/m^3)
Category II: Substances with systemic effects
Half-life: 2 hr to shift length
Peak Exposure Limit: 250 ppm, 30 min average value; 2 peaks/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 160 ppm/83 min caused hallucinations and distorted perceptions.
Human, lymphocyte: 5 mL/L caused DNA inhibition.
Rabbit, skin: 500 mg/24 hr caused severe irritation.
Rabbit, eye: 20 mg/24 hr caused moderate irritation.
Mouse, oral, TD_{Lo}: 455 mg/kg administered intermittently for 78 weeks produced liver tumors.

* See NIOSH, *RTECS* (KX4550000), for additional irritation, mutation, reproductive, tumorigenic and toxicity data.

Section 3. Physical Data

Boiling Point: 189 °F (87 °C)
Freezing Point: -121 °F (-85 °C)
Viscosity: 0.0055 Poise at 77 °F (25 °C)
Molecular Weight: 131.38
Density: 1.4649 at 20/4 °C
Refraction Index: 1.477 at 68 °F (20 °C/D)
Odor Threshold: 82 to 108 ppm (*not an effective warning*)

Vapor Pressure: 58 mm Hg at 68 °F (20 °C); 100 mm Hg at 32 °F (0 °C)
Saturated Vapor Density (Air = 0.075 lbs/ft^3; 1.2 kg/m^3): 0.0956 lbs/ft^3; 1.53 kg/m^3
Water Solubility: Very slightly soluble; 0.1% at 77 °F (25 °C)
Other Solubilities: Highly soluble in organic solvents (alcohol, acetone, ether, carbon tetrachloride, & chloroform) and lipids.
Surface Tension: 29.3 dyne/cm

Appearance and Odor: Clear, colorless (sometimes dyed blue), mobile liquid with a sweet chloroform odor.

Section 4. Fire and Explosion Data

Flash Point: 90 °F (32 °C) CC	Autoignition Temperature: 788 °F (420 °C)	LEL: 8% (25 °C); 12.5% (100 °C)	UEL: 10% (25 °C); 90% (100 °C)

Extinguishing Media: A Class 1C Flammable Liquid. Although it has a flash point of 90 °F, TCE burns with difficulty. For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Vapor/air mixtures may explode when ignited. Container may explode in heat of fire. **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 firefighters' protective clothing provides only limited protection against TCE. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: TCE slowly decomposes in the presence of light and moisture to form corrosive hydrochloric acid. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include alkalis (sodium hydroxide), chemically active metals (aluminum, beryllium, lithium, magnesium, sodium, potassium, and titanium), epoxides, and oxidants (nitrogen tetraoxide, perchloric acid). Contact with 1-chloro-2,3-epoxy propane or the mono and di 2,3-epoxypropyl ethers of 1,4-butanediol + 2,2-bis-4(2',3'-epoxypropoxy)-phenylpropane can, in the presence of catalytic quantities of halide ions, cause dehydrochlorination of TCE to explosive dichloroacetylene. **Conditions to Avoid:** Exposure to light, moisture, ignition sources, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of TCE (above 300 °C) or exposure to ultraviolet light can produce carbon dioxide (CO_2) and toxic dichloro acetylene (explosive), chlorine, hydrogen chloride, and phosgene gas.

Section 6. Health Hazard Data

Carcinogenicity: The following agencies have rated TCE's carcinogenicity: IARC (Class 3, limited animal evidence & insufficient human data), Germany MAK (Class B, justifiably suspected of having carcinogenic potential), & NIOSH (Class X, carcinogen defined with no further categorization). **Summary of Risks:** TCE vapor is irritating to the eyes, nose, and respiratory tract and inhalation of high concentrations can lead to severe CNS effects such as unconsciousness, ventricular arrythmias, and death due to cardiac arrest. Mild liver dysfunction was also seen at levels high enough to produce CNS effects. Contact with the liquid is irritating to the skin and can lead to dermatitis by defatting the skin. Chronic toxicity is observed in the victims increasing intolerance to alcohol characterized by 'degreasers flush', a transient redness of the face, trunk, and arms. The euphoric effect of TCE has led to craving, and habitual sniffing of its vapors.

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Section 6. Health Hazard Data, *Continued*

TCE crosses the placental barrier and thus exposes the fetus (any effects are yet unknown). There are increased reports of menstrual disorders in women workers and decreased libido in males at exposures high enough to cause CNS effects. TCE is eliminated unchanged in expired air and as metabolites (trichloroacetic acid & trichloroethanol) in blood and urine. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of the nervous system, skin, heart, liver, and kidney. **Target Organs:** Respiratory, central & peripheral nervous, and cardiovascular (heart) systems, er, kidney, and skin. **Primary Entry Routes:** Inhalation, skin and eye contact, and ingestion (rarely). **Acute Effects:** Vapor inhalation can ıse eye, nose, and throat irritation, nausea, blurred vision, overexcitement, headache, drunkenness, memory loss, irregular heartbeat (resulting in sudden death), unconsciousness, and death due to cardiac failure. Skin contact with the liquid can cause dryness and cracking and prolonged exposure (generally if the victim is unconscious) can cause blistering. Eye contact can cause irritation and watering, with corneal epithelium injury in some cases. Ingestion of the liquid can cause lip, mouth, and gastrointestinal irritation, irregular heartbeat, nausea and vomiting, diarrhea (possibly blood-stained), drowsiness, and risk of pulmonary edema (fluid in lungs). **Chronic Effects:** Effects may persist for several weeks or months after repeated exposure. Symptoms include giddiness, irritability, headache, digestive disturbances, mental confusion, intolerance to alcohol (degreasers flush), altered color perception, loss or impairment of sense of smell, double vision, and peripheral nervous system function impairment including persistent neuritis, temporary loss of sense of touch, and paralysis of the fingers from direct contact with TCE liquid.

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. **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, then induce vomiting. Do not give milk, as its fat content (TCE is lipid soluble) may inhance gastrointestinal absorption of TCE. **Note to Physicians:** TCE elimination seems to be triphasic with half lives at 20 min, 3 hr, and 30 hr. Some success is seen in treating patients with propranolol, atropine, and disulfiram. Monitor urine and blood (lethal level = 3 to 110 μg/mL) metabolites. BEI = 100 mg/g creatinine (trichloroacetic acid) in urine, *sample at end of workweek.* BEI = 4 mg/L (trichloroethanol) in blood, *sample at end of shift at end of the workweek.* These tests are not 100% accurate indicators of exposure; monitor TCE in expired air as a confirmatory test.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container for later disposal. For large spills, flush to containment area where density stratification will form a bottom TCE layer which can be pumped and containerized. Report any release in excess of 1000 lbs. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Bluegill sunfish, LC_{50} = 44,700 μg/L/ 96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 40.7 mg/L/96 hr. **Environmental Degradation:** In air, TCE is photooxidized with a half-life of 5 days and reported to form phosgene, dichloroacetyl chloride, and formyl chloride. In water it evaporates rapidly in minutes to hours. TCE rapidly evaporates and may leach since it does not absorb to sediment. **Soil Absorption/Mobility:** TCE has a Log K_{oc} of 2, indicating high soil mobility. **Disposal:** Waste TCE can be poured on dry sand and allowed to vaporize in isolated location, purified by distillation, or returned to supplier. A potential candidate for rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) with an acid scrubber to remove halo acids. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

ARA Extremely Hazardous Substance (40 CFR 355): Not listed
ted as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

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

Listed as a RCRA Hazardous Waste (40 CFR 261.33 & 261.31): No. U228 & F002 (*spent solvent*)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001, CWA Sec. 311 (b)(4), & CWA Sec. 307 (a)]

Section 8. Special Protection Data

Goggles: Wear chemical safety goggles (cup-type or rubber framed, equipped with impact-resistant glass), 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. At any detectable concentration, wear a SCBA with a full facepiece 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 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 from Viton or Neoprene to prevent skin contact. *Do not* use natural rubber or polyvinyl chloride (PVC). **Ventilation:** Provide general and 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] **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 personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene 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 steel drums, in a cool, dry, well-ventilated area away from sunlight, heat, ignition sources, and incompatibles (Sec. 5). Store large quantities in galvanized iron, black iron, or steel containers; small amounts in dark (amber) colored glass bottles. **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. Design processes so that the operator is not directly exposed to the solvent or its vapor. Do not use open electric heaters, high-temperature processes, arc-welding or open flames in TCE atmospheres. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on skin, respiratory, cardiac, central and peripheral nervous systems, and liver and kidney function. Employ air and biological monitoring (BEIs). Instruct employees on safe handling of TCE.

Transportation Data (49 CFR 172.101)

OT Shipping Name: Trichloroethylene
OT Hazard Class: 6.1
No.: UN1710
DOT Packing Group: III
DOT Label: Keep Away From Food
DOT Special Provisions (172.102): N36, T1

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 60L
b) Cargo Aircraft Only: 220L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MD

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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

45

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.

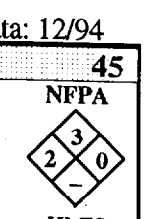
Other Designations: CAS No. 1330-20-7 [95-47-6; 108-38-3; 106-42-3 (*o*-, *m*-, *p*-isomers)], dimethylbenzene, methyltoluene, NCI-C55232, Violet 3, xylol.

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
I	2
S	2
K	3

NFPA



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

Flash Point	Autoignition Temperature	LEL	UEL
63 to 77 °F (17 to 25 °C) CC	982 °F (527 °C) (*m*-)	1.1 (*m*-, *p*-); 0.9 (*o*-)	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 counts as well as increases in platelet counts.

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Section 6. Health Hazard Data, *continued*

Menstrual 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 ɜe dizziness; nausea, vomiting, and abdominal pain; eye, nose, and throat irritation; respiratory tract irritation leading to pulmonary edema (fluid ıng); drowsiness; and unconsciousness. Direct eye contact can result in conjunctivitis and corneal burns. Ingestion may cause a burning sensa- uon 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% per day. Xylenes are resistant to hydrolysis. **Soil Absorption/Mobility:** Xylenes have low to moderate adsorption to soil and when spilled on land, will 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

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

.ed 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)

	Packaging Authorizations	Quantity Limitations	Vessel Stowage Requirements
DOT Shipping Name: Xylenes	a) Exceptions: 173.150	a) Passenger, Aircraft, or Railcar: 5L	a) Vessel Stowage: B
DOT Hazard Class: 3	b) Nonbulk Packaging : 173.202	b) Cargo Aircraft Only: 60L	b) Other: –
No.: UN1307	c) Bulk Packaging: 173.242		
T Packing Group: II			
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

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ATTACHMENT C
GEOPROBE SAFETY INSTRUCTIONS

3.0 SAFETY INSTRUCTIONS

Operator safety is a chief consideration in the design and testing of all Geoprobe machines. While deliberate measures have been taken to remove the possibility of operator injury, care should be exercised whenever working with our machines. This section lists some important safety cautions.

IMPORTANT: **Read all Safety Precautions before attempting to operate any Geoprobe Soil Probing Machine.**

IMPORTANT: **Untrained personnel should operate Geoprobe machines only when assisted by a qualified instructor.**

IMPORTANT: **The location of buried or underground utilities and services must be known before starting to drill or probe.**

3.1 Operators should wear OSHA-approved steel-toed shoes and keep feet clear of probe foot.

3.2 Operators should wear OSHA-approved safety glasses at all times during the operation of this machine.

3.3 Operators must wear hearing protection. OSHA-approved hearing protection for sound levels exceeding 85 dba is recommended.

3.4 Only one person should operate a Geoprobe machine at one time. This ensures that one person will not accidentally engage the machine controls while another person's hands, fingers, or other appendages are on or around any moving parts.

3.5 Never place hands on top of probe rod while the rod is under probing machine.

3.6 Turn off the hydraulic system at the control panel while changing probe rods, inserting the hammer anvil, or attaching any accessories.

3.7 Never exert downward pressure on the probe rod so as to lift the probe foot over six inches off the ground (two inches with the 4220).

3.8 Always take the Geoprobe carrier vehicle out of gear and set emergency brake before engaging remote ignition.

3.9 Always extend the probe unit out from the vehicle and deploy the foot to clear the vehicle roof line before folding the probe unit out.

3.10 Operators must stand to the control side of the probe machine, clear of the probe foot and derrick, while operating controls.

3.11 Never exert down pressure on the probe rod so as to lift the rear tires of the carrier vehicle off the ground.

3.12 The vehicle catalytic converter is hot and may present a fire hazard when operating over dry grass or combustibles.

3.13 Shut down the hydraulic system and stop the vehicle before attempting to clean or service the equipment.

3.14 Accidental engagement of this machine may cause injury.

3.15 Use caution when carrier vehicle is parked on a loose or soft surface. Do not apply enough force to the probe foot to lighten the load on the carrier vehicle suspension. Reduced weight on the vehicle tires may allow the vehicle to shift or slide on the loose surface.

3.16 Do not wear loose clothing while operating this machine. Severe injury will result if clothing becomes entangled in moving parts.

3.17 Avoid hydraulic fluid leaks. Pressurized fluid may be injected into the skin resulting in serious bodily injury. In the event of an accident seek medical attention immediately.

3.18 In the event of a problem, the operator should release all control levers. The spring-loaded levers will automatically return to the neutral position and machine operation will cease.

3.19 Geoprobe machines are equipped with a remote starting system. Ensure that everyone is clear of all moving parts before starting the engine.

3.20 Do not make modifications or add attachments to this machine which are not approved by Geoprobe Systems.