03.07-07/09/92-01487

FINAL

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY HEALTH AND SAFETY PLAN FOR SITES 6, 9, 48, AND 69 MARINE CORPS BASE CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA

CONTRACT TASK ORDER 0024

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared By:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

JULY 9, 1992

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1.0 INTRODUCTION

1.1 Background

Baker Environmental, Inc. (Baker) will perform a Remedial Investigation/Feasibility Study (RI/FS) to investigate potentially contaminated groundwater, surface water, sediments, and soil associated with burial or disposal of potential hazardous materials at Sites 6 (Lots 201 and 203), 9, 48, and 69 at the Marine Corps Base, Camp Lejeune, North Carolina. This study will include soil borings, drum sampling, well installations, aquatic/ecological surveys at adjacent rivers and streams, and associated sampling and analyses. Specific activities associated with Sites 6, 9, 48, and 69 can be found in the corresponding Final RI/FS Work Plan (Baker, May 1992). The site locations are shown on Figure 1 .

1.2 Policy

It is the policy of Baker that all on-site hazardous waste management activities be performed in conformance with a Site-Specific Health and Safety Plan (HASP). The HASP applies to activities performed by both Baker and Subcontractor personnel including compliance with the surveillance and training requirements as outlined in the following sections. However, the Subcontractor personnel are required to provide their own personal protective equipment (PPE) that meets or exceeds the level of protection as outlined in this HASP. The Site Health and Safety Officer (SHSO) will audit subcontractor records to verify compliance with surveillance and training requirements.

The SHSO, or qualified designee, will be responsible for continually evaluating safety at the site and ensuring adherence to the HASP. The SHSO or designee, in addition to the Site Manager, is directly responsible for safety issues relevant to the site, and the SHSO has the immediate authority to modify the existing HASP as site conditions warrant. Modifications are to be documented and changes made to the HASP after review with the Project Manager and the Navy's Engineer-in-Charge (EIC). The SHSO, or designee, will be responsible for the preparation of a daily report (in the field log book) as necessary which may include all relevant health and safety events; recordkeeping of all personnel and site monitoring information; accident investigation and reporting; daily safety talks and inspections; and any other relevant health and safety issues. 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 Navy EIC when such changes to the plan are implemented.

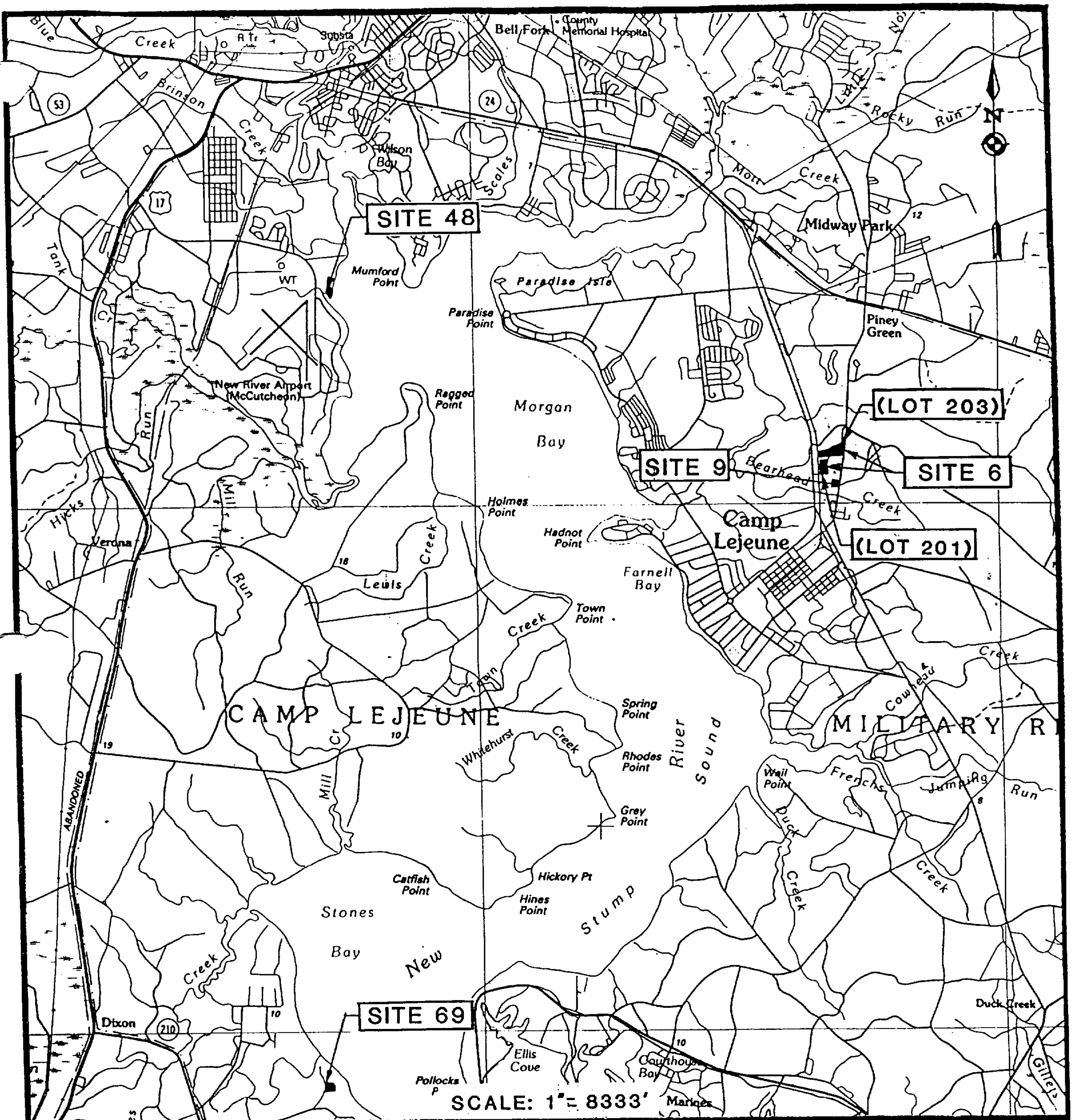

FIGURE I
SITE LOCATION MAP
MCB CAMP LEJEUNE
SITES 6, 9, 48 and 69

1.3 Medical Surveillance Requirements

This site-specific HASP will require that project personnel, who may be exposed to materials having potentially adverse and deleterious health effects, are deemed medically fit by a qualified physician to perform the tasks required prior to entry onto the site. Baker's corporate medical surveillance program has been developed to establish a medical baseline and to monitor 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, Occupational Safety and Health Administration (OSHA), Hazardous Waste Operations and Emergency Response Standard, 29 CFR 1910.120. Additionally, the program is intended to determine the individual's capability for performing on-site work, including wearing respiratory protective equipment.

All Baker employees that will be engaged in site activities covered by the 1910.120 standard receive a Group III physical examination by a licensed physician. This exam is received initially, then once every twelve months thereafter. A Group III medical exam includes standard parameters such as height, weight, vision, temperature, blood pressure, and a complete review of occupational and medical histories in addition to chest x-rays, electrocardiogram, spirometry, urinalysis, and blood tests. Baker's company physician will then review the results of the testing and determine the employee's ability to perform the work required. Attachment A describes the medical surveillance testing parameters performed annually on Baker employees.

Prior to entry onto the site, all personnel, including subcontractors, will be required to provide information from their company physician stating that they are physically capable of performing the activities required.

1.4 Training Requirements

Baker assures that all personnel who work on site will be initially trained at a health and safety training course, meeting the requirements outlined in 29CFR 1910.120. These requirements state: "General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor." These are generally 5-day (40-hour) courses. 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 (which include 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, OSHA requires general site workers to receive an annual 8-hour refresher training course on the items specified by the 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.

OSHA also requires that personnel involved with on-site management and supervisors directly responsible for, or who supervise employees engaged in hazardous waste operations, shall 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 on such topics as, but 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. Attachment B provides the appropriate "OSHA" Health and Safety Training History for Baker Project Personnel. Training records for Subcontractor personnel will be accumulated prior to site startup and maintained at the on-site command post.

1.5 Pre-Entry Requirements

During the initiation of site activities (site mobilization), the SHSO will perform a reconnaissance of the on-site and off-site sampling areas, establish or confirm emergency points of contact and procedures, and review any other issues deemed necessary to address site safety and health. At this point, the SHSO will call a meeting with Baker on-site personnel and the subcontractor's personnel. Site-specific safety and health hazards, data obtained from a previous site reconnaissance, provisions outlined in this HASP, and appropriate safety and health related procedures/protocols will be reviewed by the SHSO.

After this initial briefing with all site personnel, information will be provided and discussed with personnel specifically designated to use monitoring equipment on site. Information discussed may include equipment maintenance, calibration, response time and troubleshooting procedures, and the review of definitions for breathing zone, point source, etc., with respect to the use of each piece of monitoring equipment. Other pertinent information may also be discussed at this time.

Prior to each phase of site operation (new sampling task, new site operation), the SHSO will brief the appropriate site workers on the health and safety hazards and protection strategies. The SHSO will be available to address potential emergencies, unforeseen circumstances, and implement appropriate changes to the HASP.

All Baker employees and subcontractor personnel will be responsible for familiarity with the requirements and provisions of the HASP including modifications. Any modifications that affect site personnel or site operations will be discussed with site personnel via daily or weekly briefings or sooner, if necessary.

Baker believes that the development of a HASP is necessary to ensure adequate protection for on-site personnel. The following HASP has been based on an outline developed by the U.S. Coast Guard for responding to hazardous chemical releases (U.S.C.G. Pollution Response COMDTINST-ML6456-30) and by NIOSH, OSHA, USCG, and EPA's recommended health and safety procedures (Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities). This plan, at a minimum, meets the requirements under OSHA Standard 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response). This plan has been designed as a Site-Specific HASP for activities to be conducted at Sites 6, 9, 48, and 69 at the Marine Corps Base, Camp Lejeune, North Carolina.

2.0 SITE DESCRIPTION

S.O.# 19024-50-SRN

Submittal Date: July 9, 1992 Location: Camp Lejeune, North Carolina

Hazards:

- Potentially contaminated soils [(chemical wastes, mercury wastes, and Unexploded Ordnance (UXO)].
- Potentially contaminated groundwater (chemical wastes).
- Potentially contaminated surface water and sediment (chemical wastes).
- Potential hazards associated with drilling around utilities and potentially contaminated soil and water.
- Inhalation of vapors and/or particulates.
- Ingestion of particulates via a hand to mouth pathway.
- Dermal contact and eye contact via hand to mouth and absorption pathways, respectively.

Area affected:

- Site 6 - Lots 201 and 203
- Site 9 - Fire Fighting Training Pit
- Site 48 - Building 804 lawn to edge of New River
- Site 69 - Rifle Range Chemical Dump

Surrounding population:

- Site 6 - One Military Building at Lot 201 (approximately 25 acres) and at Lot 203 (approximately 46 acres), no buildings. Site is fenced.
- Site 9 - Two-acre site bordered by local streets to the east and west. Several buildings within the immediate area but none within the site boundaries. Site is fenced.
- Site 48 - One Military Building - Site area is approximately 20,000 square feet.
- Site 69 - Indigenous vegetation - no structures - Site area is approximately 6 acres. Site is fenced.

Topography:

- Most study areas are flat. The wooded portions of Site 6 and Site 69 slope slightly.

Anticipated weather conditions:

- Hot temperatures ranging from 70° to 85°F (work expected to take place in July or August 1992 for a period up to three months).

Additional information:

- Site 6 is located on Holcomb Boulevard between Wallace and Bear Head Creeks; previously used to dispose or store hazardous waste. Lot 201 is actively used to store materials and vehicles. Lot 203 is inactive and is littered with construction debris and drums.

- Site 9 is located between Piney Green Road and Holcomb Boulevard along the southern border of Site 6. Bear Head Creek is located approximately 500 feet to the north of the site. This two-acre site is bordered by local streets to the east and west. An asphalt-lined pit on the site is currently used to conduct training exercises for extinguishing fires. An oil/water separator is located just south of the pit. Three aboveground storage tanks are located just west northwest of the training pit that could potentially contain jet fuel (JP-4 and JP-5) based on markings noted on these tanks.

- Site 48 is located on Longstaff Road next to Building 804 (former Photolab). The area extends from Building 804 to the New River. Mercury from radar units were reportedly disposed behind building.

- Site 69 - Rifle Range Chemical Dump is located approximately 9,000 feet east of the intersection of Range Road and Sneads Ferry Road, north of Everett Creek (approximately 6 acres). The site was reportedly utilized as a disposal area for chemical wastes and other hazardous materials. Wastes included various pesticides, PCBs, gas cylinders, drums containing training chemical warfare agents, chemical agent test kits for chemical warfare agents, and miscellaneous hazardous materials generated/used on base.

3.0 SITE ENTRY OBJECTIVES

The long-term objective of the initial entry is to characterize the degree, type and extent (vertical and areal) of soil, groundwater, sediment, and surface water contamination (where applicable) for each site. This study will include the following activities:

- Site 6 (Lot 201) - Sediment and surface water sampling, Aquatic/Ecological Survey at Bear Head Creek, surface and subsurface (borings) soil sampling, monitoring well installations, groundwater sampling, aquifer testing, and surveying.
- Site 6 (Lot 203) - Geophysics, sediment and surface water sampling, Aquatic/Ecological Survey at Wallace Creek, surface and subsurface (borings) soil sampling, monitoring well installations, groundwater sampling, surveying, test pits, aquifer testing, drum sampling, and Ordnance Survey.
- Site 6 (Wooded Areas) - Surface and subsurface (borings) soil sampling, surveying, groundwater sampling, and monitoring well installations.
- Site 9 - Surface and subsurface (borings) soil sampling, groundwater sampling, aquifer testing, monitoring well installations, and surveying.
- Site 48 - Geophysics, surface and subsurface (borings) soil sampling, monitoring well installations, groundwater sampling, sediment and surface water sampling, surveying, aquifer testing, and an Aquatic/Ecological Survey in the adjacent New River area.
- Site 69 - Surveying, geophysics, groundwater sampling, hydropunch groundwater sampling (off-site - downgradient), surface and subsurface (borings) soil sampling (off-site-downgradient), sediment and surface water sampling, monitoring well installation (off-site-downgradient), and Aquatic/Ecological Survey in the adjacent New River and Everett Creek area.

4.0 SITE ORGANIZATION AND COORDINATION

The following personnel are designated to carry out the stated job functions for both on- and off-site activities. (Note: One person may carry out more than one job function.)

PROJECT MANAGER Raymond Wattras
PROJECT HEALTH AND SAFETY OFFICER Barbara Cummings/Ronald Krivan
SITE MANAGER Donald Shields
SITE HEALTH AND SAFETY OFFICER Peter Monday
FIELD TEAM LEADER Peter Monday

FIELD TEAM MEMBERS

Richard Dabal
Mathew Bartman
Michael Smith
Ken Martin
Thomas Trebilcock

NAVFACENGCOM REPRESENTATIVES

Mr. Byron Brant, P.E., (EIC) (804) 445-2931

ACTIVITY/BASE REPRESENTATIVES

Mr. George Radford (CLEJ EMD) (919) 451-5872

FEDERAL/STATE/LOCAL REPRESENTATIVES

Ms. Michele Glenn (EPA)
Mr. Jack Butler (N.C. DEHNR)

CONTRACTOR(S)

Driller:	(to be determined per Baker's Basic Ordering Agreements)
Surveyor:	(to be determined per Baker's Basic Ordering Agreements)
Geophysics:	(to be determined per Baker's Basic Ordering Agreements)
UXO:	Environmental Hazards Specialist International, Inc. (EHS)

All personnel arriving or departing the site will be documented in the field log. All activities on site must be cleared through the Site Manager.

5.0 SITE CONTROL

5.1 General Requirements

The Field Team Leader is designated to coordinate access control and security on Sites 6, 9, 48, and 69. A safe perimeter will be established for all planned sampling sites requiring Level C and higher protection levels, according to Site Boundary procedures identified in Section 5.3. **Unauthorized personnel are not permitted within these areas.**

5.2 Site Conditions

The prevailing wind conditions for Sites 6, 9, 48, and 69 are from the south, southwest. The Command Post for Sites 6, 9, 48, and 69 has been established at the Baker field trailer, which will be located off site, near the Hadnot Point Industrial Area (HPIA).

5.3 Work Zones

Work Zones shall be established utilizing control boundaries between the Exclusion Zone (Work Area) the Contamination Reduction Zone (CRZ), and the Support Zone (clean area). These boundaries shall be defined as follows:

- Exclusion Zone (Work Area) - A radius of at least 25 feet (barring obstructions) from Site Investigative Activities.
- Hotline - The boundary between the Exclusion Zone and CRZ.*
- CRZ* - The area between the Exclusion Zone and the Support Zone (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.

*** Note: A CRZ is required for activities in Level C protection and higher protection levels.**

Refer to Figure 2 for a "Typical Contamination Reduction Zone Layout."

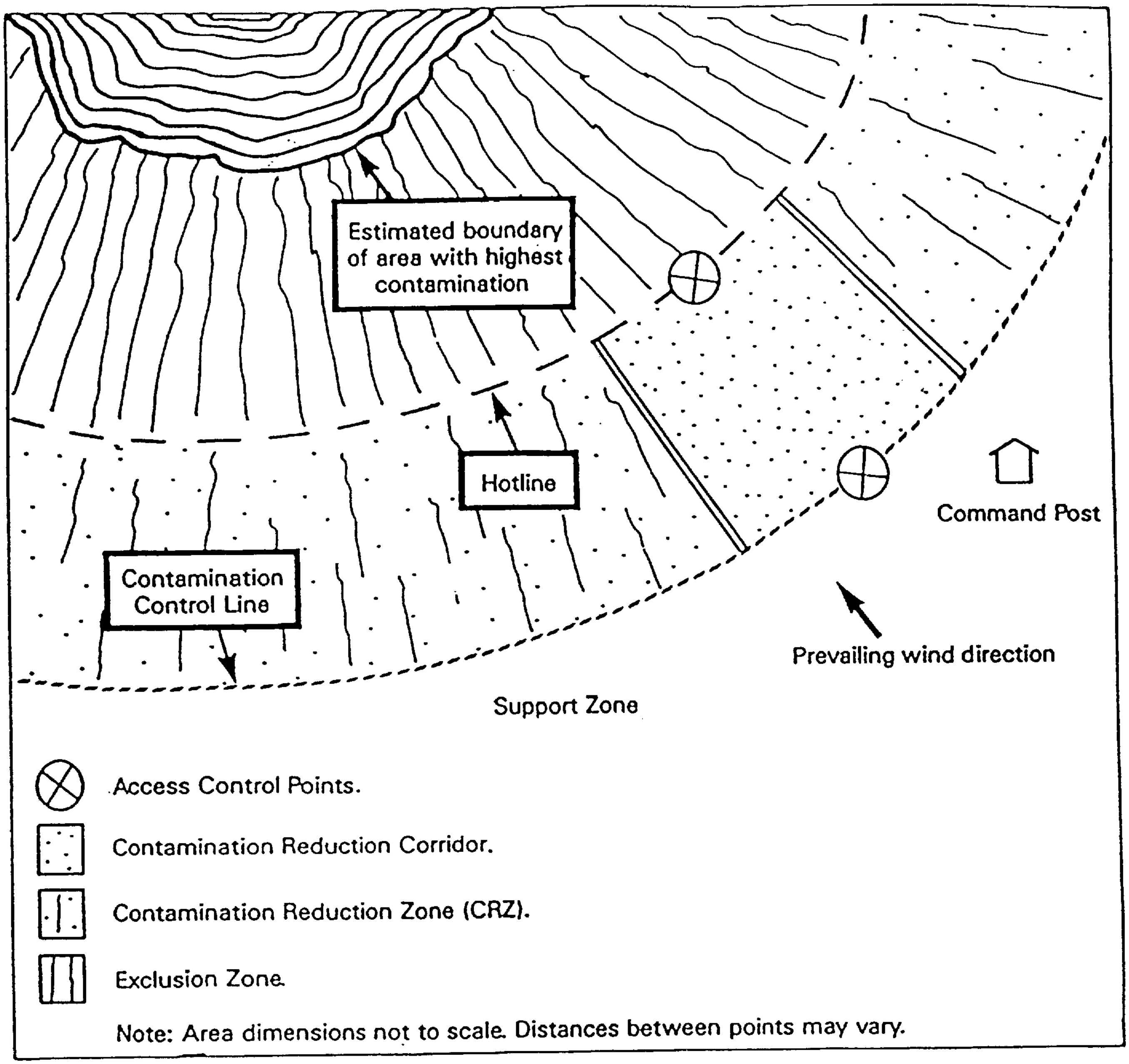

FIGURE 2
TYPICAL CONTAMINATION
REDUCTION ZONE LAYOUT

These boundaries will be demarcated using:

- Colored Boundary Tape, Cones, or equivalent for the Hotline.
- Colored Boundary Tape, Cones, or equivalent for the Decontamination Corridor of the CRZ.
- Colored Boundary Tape, barriers for the Contamination Control Line including posted signs indicating "Work Area," "Authorized Personnel Only", or equivalent.

As site investigation locations vary throughout the project, adjustments will be made accordingly.

Note: Due to the large number of sampling locations (over 100) a site map has not been included in the HASP. However, site maps are provided in the Work Plan.

5.4 Sanitation/Site Precautions

Standard provisions for sanitation and other precautions to be followed on site are located in Attachment D - Baker Safety SOPs. Specific sanitation facilities for each site will consist of: Building 804 facilities for Site 48, portable facilities for Site 69, and portable facilities near the Baker Field Trailer (within the HPIA) for Sites 6 and 9. Responsibility for compliance with these provisions lies with the Site Manager, Field Team Leader, and SHSO.

6.0 HAZARD EVALUATION

6.1 Preliminary Evaluation

Research into the history of each of the four sites under investigation (Sites 6, 9, 48, and 69) indicates potential site hazards. A summary of the potential chemical and physical hazards at each site can be found in Sections 6.2 and 6.3, respectively.

6.2 Chemical Hazards

- The toxicological properties of chemicals/substances detected during preliminary sampling investigations at Sites 6, 9, 48, and 69 are identified in Table 6-1.
- Exposure Symptoms for substances detected during preliminary sampling at Sites, 6, 9, 48, and 69 are identified in Table 6-2.
- The toxicological properties of potentially hazardous materials visible at Sites 6 (Lot 203) and 9 are identified in Table 6-3.
- A supplemental list of chemicals suspected of being disposed at sites 6 and 69 are identified in Table 6-4.
- Chemical/Material Safety Data Sheets for the contaminants identified in Tables 6-3 and 6-4 are included as Attachment C.

6.3 Physical Hazards

6.3.1 Confined Space Entry

It is not anticipated that there will be a need for a confined space entry procedure during the Remedial Investigation activities. However, should this condition occur, procedures for entering a confined space are outlined in Attachment D - Baker Safety SOPs.

TABLE 6-1

TOXICOLOGICAL PROPERTIES OF CHEMCIALS/SUBSTANCES DETECTED DURING PRELIMINARY SAMPLING

Detected Analytes	Location	Source	TLV (ACGIH)	PEL (OSHA)	IDLH	Routes of Exposure	Ionization Potential
Acetone	Site 6	GW and SW	750 ppm	750 ppm	20,000 ppm	Inhalation, Ingestion, Skin/Eye Contact	9.69 eV
Barium (as Barium)	Site 6	GW	0.5 mg/m^3	0.5 mg/m^3	1,100 mg/m^3	Inhalation, Ingestion, Skin/Eye Contact	NA
Benzene	Site 6 Site 69	GW GW and SW	10 ppm (A2)	1 ppm	3,000 ppm (CA)	Inhalation, Absorption, Ingestion, Skin/Eye Contact	9.24 eV
BHC,B* BHC,D (as BHC, G)	Site 69	GW and SW	0.5 mg/m^3 (skin)	0.5 mg/m^3 (skin)	1,000 mg/m^3	Inhalation, Absorption, Ingestion, Skin/Eye Contact	NG
Cadmium (as dust)	Site 6 Site 48 Site 69	GW SD SD	0.05 mg/m^3	0.2 mg/m^3 C - 0.6 mg/m^3	50 mg/m^3	Inhalation, Ingestion	NA
Carbon Disulfide	Site 6 Site 69	GW GW	10 ppm (skin)	4 ppm (skin)	500 ppm	Inhalation, Absorption, Ingestion, Skin/Eye Contact	10.08 eV
Chlorobenzene	Site 69	GW and SW	10 ppm	75 ppm	2,400 ppm	Inhalation, Ingestion, Skin/Eye Contact	9.07 eV
Chloroform	Site 69	GW and SW	10 ppm	2 ppm	1,000 ppm (CA)	Inhalation, Ingestion, Skin/Eye Contact	11.42 eV
Chloromethane (methyl chloride)	Site 6	GW	50 ppm (skin)	50 ppm	10,000 ppm (CA)	Inhalation, Skin/Eye Contact	11.28 eV
Chromium (as metal)	Site 6 Site 9 Site 48 Site 69	GW and SD GW SD GW and SD	0.5 mg/m^3	1 mg/m^3	NG	Inhalation, Ingestion	NA

* Assumes original chemical to be a technical grade of benzene hexachloride (64.0% alpha, 10.0% beta, 13.0% gamma, and 9.0% delta). The gamma isomer of BHC is the only regulated isomer and has a PEL of 0.5 mg/m^3.

TABLE 6-1 (Continued)

TOXICOLOGICAL PROPERTIES OF CHEMICALS/SUBSTANCES DETECTED DURING PRELIMINARY SAMPLING

Detected Analytes	Location	Source	TLV (ACGIH)	PEL (OSHA)	IDLH	Routes of Exposure	Ionization Potential
DDD (op' & pp') (1)	Site 6 Site 69	SL SD	1 mg/m^3	1 mg/m^3 (skin)	(CA)	Inhalation,Absorption, Ingestion, Skin/Eye Contact	NA
DDE (TDE) (op' & pp') (1)	Site 6 Site 69	SD and SL SD	1 mg/m^3	1 mg/m^3 (skin)	(CA)	Inhalation,Absorption, Ingestion, Skin/Eye Contact	NA
DDT (op' & pp')	Site 6	SD and SL	1 mg/m^3	1 mg/m^3 (skin)	(CA)	Inhalation,Absorption, Ingestion, Skin/Eye Contact	NA
1,2-Dibromoethane (ethylene dibromide)	Site 9 Site 69	GW GW	(A2) (skin)	20 ppm C - 30 ppm	400 ppm	Inhalation, Absorption, Ingestion, Skin/Eye Contact	9.45 eV
1,2-Dichloroethane (ethylene dichloride)	Site 69	GW and SW	10 ppm	1 ppm	4,000 ppm	Inhalation, Ingestion, Skin/Eye Contact	11.05 eV
1,1-Dichloroethylene (vinylidene chloride)	Site 69	GW	5 ppm	1 ppm	Unknown	Inhalation, Ingestion, Skin/Eye Contact	Unknown
Ethyl benzene	Site 69	SW	100 ppm	100 ppm	2,000 ppm	Inhalation, Ingestion, Skin/Eye Contact	8.76 eV
Lead (as lead)	Site 6 Site 9 Site 69	GW and SW GW GW and SD	0.05 mg/m^3	0.05 mg/m^3	700 mg/m^3	Inhalation, Ingestion, Skin/Eye Contact	NA
Manganese	Site 6 Site 48 Site 69	GW, SW & SD SD GW, SW, & SD	5 mg/m^3	5 mg/m^3	NG	Inhalation, Ingestion	NA
Mercury (as mercury vapor)	Site 48 Site 69	SL and SD GW and SW	0.01 mg/m^3 (skin)	0.05 mg/m^3 (skin)	28 mg/m^3	Inhalation, Absorption, Skin/Eye Contact	NG
Pentachlorophenol	Site 69	SW and SD	0.5 mg/m^3 (skin)	0.5 mg/m^3	150 mg/m^3	Inhalation, Absorption, Ingestion, Skin/Eye Contact	NA

TABLE 6-1 (Continued)

TOXICOLOGICAL PROPERTIES OF CHEMICALS/SUBSTANCES DETECTED DURING PRELIMINARY SAMPLING

Detected Analytes	Location	Source	TLV (ACGIH)	PEL (OSHA)	IDLH	Routes of Exposure	Ionization Potential
Phenols	Site 9	GW	5 ppm (skin)	5 ppm (skin)	250 ppm	Inhalation, Absorption, Ingestion, Skin/Eye Contact	8.50 eV
Tetrachloroethene (Perchloroethylene)	Site 6 Site 69	GW GW	50 ppm	25 ppm	500 ppm (CA)	Inhalation, Ingestion, Skin/Eye Contact	9.32 eV
1,1,2,2-Tetrachloroethane	Site 6 Site 69	GW GW and SW	1 ppm (skin)	1 ppm (skin)	150 ppm (CA)	Inhalation, Absorption, Ingestion, Skin/Eye Contact	11.10 eV
1,1,2-Trichloroethane	Site 69	SW	10 ppm (skin)	10 ppm	500 ppm (CA)	Inhalation, Absorption, Ingestion, Skin/Eye Contact	11.00 eV
Trichloroethene (trichloroethylene)	Site 6 Site 69	GW and SW GW and SW	50 ppm	50 ppm	1,000 ppm (CA)	Inhalation, Ingestion, Skin/Eye Contact	9.45 eV
Trans-1,2-dichloroethene (1,2-dichloroethylene)	Site 6 Site 69	GW and SW GW and SW	200 ppm	200 ppm	4,000 ppm	Inhalation, Ingestion, Skin/Eye Contact	9.65 eV
Toluene	Site 69	GW and SW	100 ppm	100 ppm	2,000 ppm	Inhalation, Absorption, Ingestion, Skin/Eye Contact	8.82 eV
Vinyl chloride	Site 6 Site 69	GW and SW GW and SW	5 ppm (A1)	1 ppm	(CA) unknown	Inhalation	9.99 eV

(1) TLVs and PELs for DDD and DDE were not published; therefore, the levels and subsequent information provided for DDT was substituted.

SD - Sediment Sample
SW - Surface Water Sample
GW - Groundwater Sample
NA - Not Applicable
TLV - Time-weighted average (TWA) concentration published by the ACGIH

SL - Soil Sample
Skin - Potential for dermal absorption
CA - Potential human carcinogen
A1 - Confirmed human carcinogen
PEL - TWA concentration published by OSHA
ppm - parts per million (in air)

Unknown - IDLH is unknown
C - Ceiling concentration, not to be exceeded
NG - Not Given
A2 - Suspected human carcinogen
IDLH - Immediately Dangerous to Life or Health
mg/m^3 - milligrams per cubic meter (in air)

TABLE 6-2

EXPOSURE SYMPTOMS FOR SUBSTANCES DETECTED DURING PRELIMINARY SAMPLING AT SITES 6, 9, 48, AND 69

Detected Analytes	Exposure Symptoms
Acetone	Eye, nose and throat irritation; dizziness; dermatitis
Barium (as Barium)	Upper respiratory irritation; gastroenteritis; muscle spasms; slow pulse; eye and skin irritation and burning
Benzene	Eye, nose and respiratory irritation; nausea and staggered walk; dermatitis; bone marrow depressant; (carcinogen)
BHC,B BHC,D (as BHC, G)	Eye, nose and throat irritant; headache; nausea; respiratory difficulty; skin irritation ; muscle spasms
Cadmium (as dust)	Pulmonary edema; dyspnea; cough; headache; chills, muscle aches, nausea, vomiting, diarrhea, mild anemia; (carcinogen)
Carbon Disulfide	Dizziness, headache, poor sleep, anorexia/low weight; eye and skin burns, dermatitis
Chlorobenzene	Skin, eye and nose irritation; drowsiness; uncoordination
Chloroform	Dizziness, mental dullness, nausea, disorientation, headache, fatigue, anesthesia; skin and eye irritant; (carcinogen)
Chloromethane (methyl chloride)	Dizziness, nausea, vomiting, visual disturbance, stagger, slurred speech, convulsions, frostbite (carcinogen)
Chromium (as metal)	Histologic fibrosis of lungs
DDD (op' & pp') (1)	Lips, tongue and face paresthesia; tremors, apprehension, dizziness, confusion, malaise, headache, fatigue, vomiting, eye and skin irritant. (carcinogen)
DDE (TDE) (op' & pp') (1)	Lips, tongue and face paresthesia; tremors, apprehension, dizziness, confusion, malaise, headache, fatigue, vomiting, eye and skin irritant. (carcinogen)
DDT (op' & pp')	Lips, tongue and face paresthesia; tremors, apprehension, dizziness, confusion, malaise, headache, fatigue, vomiting, eye and skin irritant. (carcinogen)
1,2-Dibromoethane (ethylene dibromide)	Eye and respiratory irritant; dermatitis with vesiculation
1,2-Dichloroethane (ethylene dichloride)	CNS depression; nausea, vomiting, dermatitis, irritated eyes with corneal opacity (carcinogen)
1,1-Dichloroethylene (vinylidene chloride)	CNS depression
Ethyl benzene	Eye and mucus membrane irritant; dermatitis, narcosis, coma

(1) Symptoms of Exposure and First Aid Instructions for DDD and DDE were copied from the information provided for DDT.

TABLE 6-2 (Continued)

EXPOSURE SYMPTOMS FOR SUBSTANCES DETECTED DURING PRELIMINARY SAMPLING AT SITES 6, 9, 48, AND 69

Detected Analytes	Symptoms of Exposure
Lead (as lead)	Weakness, lassitude, insomnia. Facial pallor, malnutrition, constipation, abdomen pain. wrist and ankle paralysis, eye irritant, hypotension
Manganese	Parkinson's, insomnia, mental confusion, metal fume fever, dry throat, cough, tight chest, flu-like fever, low back pain, vomiting, malaise, fatigue
Mercury (as mercury vapor)	Cough, chest pain, tremor, insomnia, irritability, indecision, headache, fatigue, anorexia, eye and skin irritant
Pentachlorophenol	Eye, nose and throat irritation; sneezing, coughing, weakness, anorexia, sweating, headache, dizziness, nausea, vomiting, chest pain, high fever, dermatitis
Phenols	Eye, nose and throat irritation; weakness; muscle aches; dark urine; cyanosis; skin burns; dermatitis; convulsions
Tetrachloroethene (Pentachloroethylene)	Eye, nose and throat irritant; flushing of face and neck; vertigo, dizziness, incoordination, headache (carcinogen)
1,1,2,2-Tetrachloroethane	Nausea, vomiting, abdomen pain, tremor in fingers, jaundice, dermatitis
1,1,2-Trichloroethane	Eye and nose irritant, CNS depression (carcinogen)
Trichloroethene (trichloroethylene)	Headache, vertigo, visual disturbance, tremors, nausea, vomiting, eye irritation, dermatitis (carcinogen)
Trans-1,2-dichloro-ethene (1,2-dichloroethylene)	Eye and respiratory irritant, CNS depression
Toluene	Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, muscle fatigue, dermatitis
Vinyl chloride	Weakness, abdomen pain, GI bleeding, cyanosis of extremities (carcinogen)

TABLE 6-3

TOXICOLOGICAL PROPERTIES OF POTENTIALLY HAZARDOUS MATERIALS VISIBLE AT SITES 6 AND 9

Chemical	Location	Source	TLV (ACGIH)	PEL (OSHA)	IDLH	Routes of Exposure	Ionization Potential
Tricresyl-phosphate (Triorthocrespylphosphate)	Site 6 (Lot 203)	Drums	0.1 mg/m^3 (skin)	0.1 mg/m^3 (skin)	40 mg/m^3	Inhalation, Absorption, Ingestion, Skin/Eye Contact	NG
Diesel Fuel Oil (Fuel Oil No. 2)	Site 6 (Lot 203)	Above Ground Tank	NG	NG	NG	Ingestion, Skin/Eye Contact	NG
Gasoline	Site 6 (Lot 203)	Above Ground Tank	300 ppm	300 ppm	NG	Inhalation, Ingestion, Skin/Eye Contact	NG
Kerosene (Fuel Oil No. 1)	Site 6 (Lot 203)	Above Ground Tank	NG	NG	NG	Ingestion, Skin/Eye Contact	NG
Lubricants	Site 6 (Lot 203)	Drums	NG	NG	NG	Ingestion, Skin/Eye Contact	NG
Freon (as Freon 10 - carbon tetrachloride)	Site 6 (Lot 203)	Drums	5 ppm (skin) A2	2 ppm	300 ppm (CA)	Inhalation, Absorption, Ingestion, Skin/Eye Contact	11.47 eV
Jet Fuels (JP-4 and JP-5)	Site 9	Above Ground Tank	NG	NG	NG	Inhalation, Absorption, Skin/Eye Contact	NG

NG - Not Given
Skin - Potential for dermal absorption
CA - Potential human carcinogen
A2 - Suspected human carcinogen
TLV - Time-weighted Average (TWA) concentration published by the ACGIH
PEL - TWA concentration published by OSHA
IDLH - Immediately Dangerous to Life or Health
ppm - parts per million (in air)
mg/m^3 - milligrams per cubic meter (in air)

TABLE 6-4

SUPPLEMENTAL LIST OF CHEMICALS
(not otherwise mentioned)

Chemicals suspected as being disposed at Sites 6 and 69: (1)

Chemical	Site Location(s)
Polychlorinated biphenyls (PCBs)	6 (Lot 201) and 69
Pentachlorophenol	69
Malathion	69
Parathion	69
Diazinon	69
HTH (calcium hypochlorite)	69
Chloroacetophenone (CN)	69
Chemical Warfare Agent Training Kits (contain surety agent simulants)	69
*HD (Mustard Gas)	69
*GB (Sarin)	69
*VX	69
*HT (Vesicant)	69

(1) The possibility for direct contact with the pure form of chemicals identified at Site 69 is not anticipated since only offsite investigations are being conducted at this time.

* Low probability for these chemicals to be found on site however, "MSDS's" are provided in Attachment C.

6.3.2 Heat Stress

Monitoring

Provisions for monitoring for heat stress will be determined by the SHSO and performed as outlined below.

Heat stress monitoring is required for personnel wearing semipermeable or impermeable protective outerwear when there is an ambient air temperature greater than 70°F. One or more of the following procedures will be implemented when this condition exists:

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. Work-rest intervals.
5. Calculate the Heat Exposure Threshold Limit Value (TLV) for work-rest intervals using the following steps:
   a. Calculate the WBGT (Wet Bulb Globe Temperature) 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)

* For unacclimatized workers, the permissible heat exposure TLV should be reduced by 2.5°C.

Special considerations

- Clothing - Subtract 2 from the TLV to compensate for the use of semipermeable clothing.
- Acclimatization - After approximately a week, workers should have acclimated themselves 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.

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 Level B and C protective ensembles will be difficult.

1. *Heat rash* results from continuous exposure to heat or humid air.
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; and dizziness.
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. Excessive cooling can cause hypothermia and should be avoided.

Prevention

Fluid intake should be increased during rest schedules to prevent dehydration. Drinking cool water is best; however, diluted electrolyte solutions (i.e., Gatorade or equivalent) can be substituted for water. Each individual should monitor their urine output and adjust their fluid intake to ensure that urine output and urine color are close to normal. Additional means for preventing heat-induced illnesses may include providing shelter or cooling devices, such as vests and showers.

6.3.3 Explosion and Fire

In general, the following items present potential physical hazards and will be monitored closely:

- Explosion and fire resulting from:
    - heavy equipment malfunction.
    - penetration into underground utility/service lines (gas, electric, fuel).
    - ignition of trapped flammable vapors.
    - vehicular accidents
    - puncturing of drums during test pitting

Provisions for monitoring for potential fire/explosive conditions will include the use of a combustible gas meter (as indicated in Section 11.2.1) and the performance of utility checks and geophysical surveys prior to conducting intrusive activities. As additional concerns are identified, provisions for making changes to the HASP will be presented by the SHSO, as needed.

6.3.4 Site-Specific Safety Hazards

It is expected that the following additional safety hazards may be present at each of the respective sites.

Site 6 (Lot 201)

- Military vehicular traffic

Site 6 (Lot 203)*

- Exposure to deteriorating debris such as:
    - Empty drums
    - Sheet metal
    - Above ground tanks
    - Shredded tires
    - Cables
    - Barbed wire
    - Empty crates/disposal bins
    - Wooden pallets
    - Glass
    - Spent ammunition
- Unsecured compressed gas cylinders

Sites 9 and 48

- None apparent

Site 69*

- Unsecured compressed gas cylinders
- Fired and unfired rifle cartridges

* All identification/management of ammunition, UXO, etc. will be controlled by the subcontractor (EHS). Removal of live UXO will be handled by military personnel at Camp Lejeune. Baker personnel are not to be directly involved with these types of hazards. Applicable EHS Standard Operating Procedures are provided in Attachment E.

Provisions for the monitoring of hazards particular to the specific site activities (such as slippery ground, uneven terrain, overhead equipment, electrical lines, etc.) shall be addressed at the pre-entry briefing by the SHSO and Site Manager. All personnel are expected to adhere to all applicable compliance regulations such as, but not limited to, OSHA standards 29 CFR 1910 and 1926.

6.4 Radiation Hazards

Although the presence of a radiological wastes or radioisotopes at Sites 6, 9, 48 and 69 is not anticipated, a radiation survey meter will be used as a standard operating procedure (Section 11.4 identifies the monitoring requirements).

Monitoring at the work site with a radiation survey meter (Victoreen Model 450 ionization chamber) will determine gamma ray exposure rates and serve as an indicator for the presence of beta and alpha particles. If the monitoring shows a level greater than 1 mR/hr, work will stop and not resume until the SHSO and PHSO have been notified and additional protective measures are instituted such as, retreating a safe distance from the source and employing shielding measures (if necessary).

A brief discussion of the different types of ionizing radiation, for the benefit of site personnel, is as follows:

- Alpha particles, because of their relatively large mass, have the highest ionizing potential but the lowest penetrating quality of all forms of ionizing radiation. Alpha particles travel no more than 10 centimeters in air and can be shielded completely with paper. Adverse health affects from alpha particles are caused by absorption via inhalation, ingestion, or a break in the skin.

- Beta particles have a lower ionizing potential than alpha particles but are more penetrating. Beta particles can be shielded with aluminum or Lucite. They can be absorbed into the human body via inhalation, ingestion, or skin penetration.

- Gamma rays are the most penetrating form of ionizing radiation. Shielding can reduce gamma rays but not completely eliminate them. They can be absorbed via inhalation and ingestion of radioactive material, or can penetrate intact skin.

Any questions regarding the different types of ionizing radiation, should be directed to the SHSO.

6.5 Environmental Hazards

Hazardous Flora

Incidence of contact by individuals to poisonous/thorny plants is a real threat. Bare skin should be covered as much as practical when working in forested areas (i.e., long pants and shirt, steel toe boots, leather or cotton gloves, safety glasses, and head protection). Personnel should avoid entering an area in the direct path of known poisonous flora (i.e., poison ivy/oak), 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.

While attempting to cut into dense underbrush, hazards exist from the sharp machete, gas-powered weed eater, etc. Care should be taken when using such devices. All rashes and other injuries will be reported to the SHSO.

Hazardous Fauna

All animal life must be treated with respect. Without proper training, personnel may not be able to differentiate between dangerous and nondangerous varieties. Working in wet or swampy areas unprotected will not be allowed. Contact with surface water will be kept to a minimum.

Mosquitoes pose a nuisance and physical hazard to field personnel. As a nuisance, they distract workers, leading to accidents. Mosquitoes also pose a physical threat by injecting live microorganisms into their victim. Perfumes and scented deodorants should be avoided. Donning light colored clothing is preferable, as mosquitoes are not attracted to lighter colors.

There is a potential to come in contact with other dangerous insects. These include fire ants, chiggers, bees, wasps, hornets, mites, fleas, spiders, and ticks.* All personnel should perform "checks" on each other periodically and at the end of the work shift. All insect bites must be reported to the SHSO.

Poisonous snakes such as the rattlesnake, copperhead, and cottonmouth (water moccasin), all known as pit vipers, are common to the United States. Snakes, as a general rule, are timid creatures. They typically do not attack people but will bite when provoked, angered, or accidentally injured (as when stepped on). When encountering a snake(s), avoid quick/jerky motions, loud noises, and retreat slowly; do not provoke the snake(s). Cover bare skin as much as practical (i.e., long pants and shirt, steel toe boots, leather gloves, safety glasses and head protection) when working in forested/swampy areas. If bitten, follow procedures outlined in Section 12.6, Emergency Medical Treatment.

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

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* *Site personnel have been provided with a copy of Baker's policy (per our medical consultant) regarding the signs and symptoms of exposure for Lyme Disease.*

7.0 PERSONAL PROTECTIVE EQUIPMENT

7.1 Levels of Protection

Based on an evaluation of potential site hazards, the following levels of personal protection have been designated for the applicable work areas or tasks. Upgrading or downgrading the level of protection will be based on real time monitoring and working conditions. Changes in the Levels of Protection will be the responsibility of the SHSO.

Location	Job Task	Level of Protection				
		A	B	C	D	Other
Sites 6, 48 & 69	Sediment/ Surface Water Sampling(3)					D+
Sites 6, 9, 48 & 69	Surveying				X	
Sites 6 (Lot 203), 48 & 69	Non-intrusive Geophysics				X	
Sites 6, 9, 48 & 69	Surface Soil Sampling (3)				X	D+ (2)(7)
Sites 6, 9, 48 & 69	Monitoring Well Installation (3)			X(2)	X(6)	D+
Sites 6, 9, 48 & 69	Groundwater Sampling (Monitoring Well)(3)					D+
Site 69	Groundwater Sampling (Hydropunch) (3)				X	
Site 6 (Lot 203)	Drum Sampling (4)		X			
Site 6 (Lot 203)	Test Pits		X			
Sites 6, 48 & 69	Aquatic/Ecological Survey					D+
Sites 6 (Lot 203) & 69	Ordnance Survey (5)					X(1)
Sites 6, 9, 48 & 69	Soil Boring Sampling (3)			X(2)	X(6)	D+
Sites 6, 9 & 48	Aquifer Test				X	

(1) The identification of unexploded ordnance (UXO) will be performed solely by Baker's subcontractor (EHS) per the subcontractor's standard operating procedures (SOPs). Additional levels of protection specific to this type of work beyond the levels specified for the aforementioned tasks, are to be determined by the subcontractor. Should the subcontractor be present during the performance of the other job tasks listed above, he/she shall be required to meet the level of protection specified for that task.

(2) For Site 48 only. Respiratory protection to include an MSA half-face cartridge respirator with approved Mercury Vapor/HEPA Cartridge and goggles, if a proper fit can be achieved. Otherwise, Level B protection.

(3) Only offsite soil and groundwater sampling are proposed at Site 69.

(4) Drum sampling will be performed according to Drum Sampling Procedures outlined in Attachment D.

(5) Removal of live UXO will be performed by Camp Lejeune military personnel.

(6) For Site 9 only.

(7) For Site 6 (Lot 203 only).

Based on the known or suspected contaminants at each site, protection Levels B through D, as indicated in Section 7-1, are believed to be the appropriate levels of protection. Continuous and/or periodic monitoring in the breathing zone with OVAs/HNus and detector tubes (Tables 11-1 through 11-4) will be conducted to evaluate this level of protection. Levels greater than those discussed in Section 11.2.1 will require investigation by the SHSO, including the likelihood of protection upgrades.

Specific protective equipment for each level of protection is as follows:

Level B

Chemical Resistant Clothing (1)
Air Line Respirator (ALR) with 5-minute escape pack (SCBAE)
SCBA

Chemical Resistant Gloves (2)
(Inner-Disposable)
Chemical Resistant Gloves (Outer) (3)
Safety Shoes/Boots
Boots (Chemical Resistant - Overboots)
Hard Hat
2-Way Communications
Hearing Protection (Optional)*

Level C

Chemical Resistant Clothing (1)
Full-Face Cartridge Respirator

Chemical-Resistant Gloves (2)
(Inner-Disposable)
Two-way Communications

Chemical-Resistant Gloves (Outer) (3)
Hearing Protection (Optional)*
Safety Shoes/Boots
Boots (Chemical Resistant - Overboots)
Hard Hat

Level D+

Chemical Resistant Clothing (1) or uncoated Tyvek® Coveralls
Safety Shoes/Boots with Chemical Resistant Overboots

Two-way Communications
Hard Hat (Optional)*
Chemical-Resistant Gloves (2)
(Inner-Disposable)
Chemical-Resistant Gloves (Outer) (3)
Hearing Protection (Optional)*
Safety Glasses/Goggles
Full-face Cartridge Respirator on Standby

Level D

Normal Work Clothes with Long Sleeve Shirt or Coveralls
Safety Shoes/Boots
Boots (Chemical Resistant Overboots) (Optional)
Two-way Communications
Hard Hat (Optional)*

Gloves (Outer)
Hearing Protection (Optional)*
Safety Glasses/Goggles

(1) Polyethylene-coated Tyvek® or Saranex®
(2) Nitrile or Latex
(3) Neoprene or Nitrile

* The need for hearing protection and hard hat protection will be determined by the SHSO, however, hearing protection and hard hat protection is required during drilling operations.

CHANGES TO THE SPECIFIED LEVELS OF PROTECTION SHALL ONLY BE MADE WITH THE APPROVAL OF THE SITE HEALTH AND SAFETY OFFICER AND THE SITE MANAGER. APPROPRIATE NOTIFICATION WILL BE MADE TO THE NAVY EIC, AS NECESSARY.

7.2 Respiratory Protection

Level B

Respiratory Protection will include a combination (4-person manifold) "North" Brand Air Line Respirator (ALR) System with 5-minute escape pack. The rescue worker(s) will be equipped with a "North" Brand Self-Contained Breathing Apparatus (SCBA) for emergency purposes. This individual may also be responsible for monitoring the supplied air system as long as there is clear visibility between the workers and the ALR system.

Level C

A "North or MSA" Brand full-face NIOSH certified air-purifying cartridge respirator equipped with a combination organic vapor, acid gases, and highly toxic particulates cartridge*, is the appropriate cartridge for use with the detected hazardous materials and the measured contaminant concentrations. Upgrade/downgrade in the level of respiratory protection will be based on measured "realtime" air contaminant concentrations (see Section 11.2). Cartridge changeover or protection upgrade will occur when one or more of the following warning properties have been observed: PID/FID concentrations in the breathing zone greater than or equal to 100 ppm for vapor/gas cartridges; exposure duration greater than eight hours for vapor/gas cartridges; breathing resistance due to overloaded particulate filters; odor breakthrough due to overloaded vapor/gas cartridges; and other warning properties, where appropriate, for specialty filter cartridges (i.e., end of service life indicators).

* For Site 48, a half-face NIOSH approved MSA cartridge respirator equipped with a mercury vapor/HEPA cartridge, with end of service life indicator, is the only air-purifying cartridge respirator system allowed for this site.

Level D+

A NIOSH certified air-purifying cartridge respirator meeting all the requirements identified under Level C, on standby.

Criteria for using this type of respiratory protection has been determined by qualified Baker personnel in compliance with Attachment D - Baker Safety SOPs.

7.3 Care and Cleaning of Personal Protective Equipment

Provisions for the care and cleaning of personal protective equipment used on site can be found in Attachment D - Baker Safety SOPs. Responsibility for compliance with these provisions lies with the Site Manager and/or Field Team Leader.

8.0 SITE WORK PLANS/SITE PERSONNEL

A Work Plan, Field Sampling and Analysis Plan, and Quality Assurance Project Plan detailing the tasks to be performed at each of the four sites have been bound separately, due to their size. However, copies of these documents will accompany the HASP.

Work party(s) consisting of two to six personnel will perform the following functions:

Name*	Function
Donald Shields	Site Manager/Project Geologist
Peter Monday	Site Health and Safety Officer/Field Team Leader
Richard Dabal	Environmental Scientist
Michael Smith	Environmental Scientist
Thomas Trebilcock	Environmental Scientist
Mathew Bartman	Environmental Scientist
Ken Martin	Environmental Scientist
Drilling Contractor	Drilling Activities
Geophysics Contractor	Geophysics Activities
Survey Contractor	Site Survey Activities
EHS	UXO and Surety Identification

* Note: At the time of the Health and Safety Plan Publication, specific-site personnel and contractors had not been fully determined. Personnel identification to be provided prior to beginning site activities.

9.0 COMMUNICATION PROCEDURES

The "Buddy System" (two-person teams) will be employed during all site activities. Personnel in the Exclusion Zone (Work Zone) should remain in constant communication or within sight of the Site Manager, or his/her representative. Any failure of communication requires an evaluation of whether personnel should discontinue Activities.

Radio communications will be employed by site teams to remain in constant contact with the Site Manager, SHSO, and other field teams.

Air horns will be used for communication during emergency evacuation of site personnel during Level C or B operations. One long (3 second) or continuous air horn blast is the emergency signal to indicate that emergency assistance is required.

The following standard hand signals will be used in case of failure of radio communications or when radio communications are ineffective during Level C or B operations:

Hand gripping throat	- Out of air, can't breathe
Grip partner's wrist or both hands around waist	- Leave area immediately
Hands on top of head	- Need assistance
Thumbs up	- OK, I am all right, I understand
Thumbs down	- No, negative

Coordination between Baker and Contractor Personnel is the responsibility of the Site Manager. The best means for securing the lines of communication will be determined prior to start-up by on-site project personnel.

Telephone communication at the Baker Site Trailer (Command Post) will be established during mobilization activities. The phone number is* ____________________.

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* *To be determined just prior to site arrival.*

10.0 DECONTAMINATION PROCEDURES

10.1 Site Decontamination

Personnel and equipment leaving the Exclusion Zone (Work Area) shall be thoroughly decontaminated. The following protocol shall be used for the decontamination stations according to levels of protection:

Level D	Level D+	Level C	Level B
1. Equipment drop	1. Equipment drop	1. Equipment drop	1. Equipment drop
2. Boot and glove gross contamination removal*	2. Outer boot and glove wash	2. Outer boot and glove wash	2. Outer boot and glove wash
3. Boot and glove wash*	3. Outer boot and glove rinse	3. Outer boot and glove rinse	3. Outer boot and glove rinse
4. Boot and glove rinse*	4. Outer boot and glove removal	4. Outer boot and glove removal	4. Outer boot and glove removal
5. Boot and glove removal*	5. Coverall removal/disposal	5. Coverall removal/disposal	5. SCBA or air line removal
6. Coverall removal*	6. Inner glove removal/disposal	6. Respirator removal	6. Coverall removal/disposal
7. Hand/Face wash	7. Hand/face wash	7. Inner glove removal/disposal	7. SCBA or ALR face piece removal
8. Equipment wipe down	8. Equipment cleaning	8. Hand/face wash	8. Inner glove removal/disposal
		9. Respirator cleaning/sanitizing	9. Hand/face wash
		10. Equipment cleaning	10. Respiratory 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 and higher protection levels and recommended for Levels D and D+ protection:

- Two small tubs (one set of wash and rinse water)
- Scrub brush
- Towels
- Disposable wipes
- Pressurized sprayers for rinsing
- Contaminated clothing disposal bag or drum
- Respirator cleaning solution
- Liquinox and water as the decontamination solution.

The decontamination liquids and clothing will be contained and disposed according to the policy defined in the Field Sampling and Analysis Plan (FSAP)(Baker, 1992).

10.2 Emergency Decontamination Stations

Emergency personnel decontamination will include the following stations*:

Level D	Level D+	Level C	Level B
Equipment drop, boot and glove removal*, and coverall removal*.	Equipment drop, outer boot and glove removal, coverall removal/disposal. and inner glove removal/ disposal.	Equipment drop, outer boot and glove removal, coverall removal/disposal, respirator removal, and inner glove removal/ disposal.	Equipment drop, outer boot and glove removal, SCBA or escape tank removal, coverall removal/ disposal, SCBA or ALR face shield removal, and inner glove removal/ disposal.

* If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination and wrap injured personnel with clean garments/blankets, to avoid contaminating other personnel or transporting equipment.

All emergency medical personnel are to be immediately informed of the injured person's condition and potential contaminants and provided with all pertinent chemical data.

10.3 Equipment Decontamination

Provisions for the decontamination of equipment will be based on the size and type of equipment used. Specific decontamination procedures for Sites 6, 9, 48, and 69 can be found in the Final Field Sampling and Analysis Plan (FSAP)(Baker, 1992).

11.0 SITE SAFETY AND HEALTH

11.1 Responsibilities

The SHSO, as identified in Section 4.0, is directly responsible for safety and health requirements on site.

11.2 Environmental Monitoring

The following environmental monitoring instruments shall be used on site at the specified intervals.

11.2.1 Point Source

Point source monitoring is defined by this HASP as monitoring performed at the source of the activity. However, the action levels presented below are based on levels detected in the breathing zone (bz) of the work party personnel. Monitoring required for the tasks being performed at each site has been outlined in Tables 11-1 through 11-4. Dräger tubes are required when air concentrations reach a certain level according to an HNu/OVA response. In certain situations, however, Dräger tubes are specified for use in the same manner as other real time instrumentation. Refer to Tables 11-1 through 11-4 for frequencies of use.

The action levels, given the concentration measured by real time instruments, are as follows:

*HNu/OVA

- Background to 5 ppm - Level D protection
- >5 ppm to 7 ppm for greater than 5 continuous minutes = Level C plus Dräger tube monitoring
- >7 ppm for up to 15 continuous minutes = Level B or stop work and consult SHSO
- Instantaneous peak concentrations >70 ppm = Level B or stop work and consult SHSO

*HNu with 11.7 eV probe or Foxboro OVA 128.

Dräger Tubes

- Below limits of detection (BLD) to less than the PEL/TLV* - Level D
- ≥PEL to 5 times the PEL/TLV = Level C (if adequate NIOSH certified air-purifying cartridge is available -- otherwise Level B -- or stop work and consult SHSO)
- >5 times the PEL/TLV = Level B or stop work and consult SHSO

*Whichever is lower.

TABLE 11-1
MONITORING EQUIPMENT AND FREQUENCY FOR SITE 6

Job Task	HNu or OVA +	Dräger Colorimetric Tubes(1)		Combustible Gas Meter(2)	Radiation Survey Meter(3)
		(67 28061) Vinyl Chloride	(67 28561) Benzene		
Sediment/Surface Water Sampling	I&P	▨	▨	▨	▨
Surveying	I&D	▨	▨	▨	I
Non-intrusive Geophysics	I&D	▨	▨	▨	I
Surface Soil Sampling	I&P	▨	▨	I&P	I&D
Monitoring Well Installation	C	▨	▨	C	C
Groundwater Sampling	I&P	▨	▨	I&P	I&D
Drum Sampling (Lot 203 only)	I&P	▨	▨	I&P	I
Aquatic/Ecological Survey	I&D	▨	▨	▨	▨
UXO Identification* (Lot 203 only)		▨	▨	▨	▨
Subsurface (Boring) Soil Sampling	C	▨	▨	C	C
Test Pitting (Lot 203 only)	C	▨	▨	C	C
Aquifer Test	I&D	▨	▨	I	▨

* This task is performed by the subcontractor prior to Baker personnel entering the site and then on a standby basis as other tasks are performed. The subcontractor is solely responsible for Identifying UXO according to their SOPs (refer to Attachment E) and informing Baker and other contractor personnel of the appropriate measures to be taken. Live UXO will be handled by military personnel at Camp Lejeune.

I = Initially - At start of job task to confirm level of protection
P = Periodically - When site condition or set-up changes or when a new area is entered
C = Continuously - Monitor levels continuously
D = Discretionary - At the discretion of the SHSO

Note: As air concentrations are measured, they should be documented. In the case of continuous monitoring every 15 to 30 minutes.

(1) Dräger tubes to be used at this site are subject to change, based on site concerns.
(2) Continuous Monitoring is required when combustible gas readings are between 10% and 20%.
(3) The Victoreen Model 450 Radiation Survey Meter measures gamma radiation and detects the presence of beta and alpha particles when the mylar screen is exposed. Alpha particle detection is possible only when the mylar screen is very close (<3 mm) to the surface being tested. The meter will be held at the survey location for 9 seconds for a complete response.

\+ An OVA will be used during all intrusive activities where methane gas is anticipated (i.e., landfills)

TABLE 11-2

MONITORING EQUIPMENT AND FREQUENCY FOR SITE 9

Job Task	HNu or OVA +	Dräger Colorimetric Tubes[1]	Combustible Gas Meter[2]	Radiation Survey Meter[3]
		(67 28561) Benzene		
Surface Soil Sampling	I&P			I&D
Monitoring Well Installation	C		C	C
Groundwater Sampling	I&P		I&D	I&D
Subsurface (Boring) Soil Sampling	C		C	C
Surveying	I&D			I
Aquifer Test	I&D		I	

I = Initially - Immediately prior to start of job task to establish levels, confirming level of protection
P = Periodically - When site condition or set-up changes or when a new area is entered
C = Continuously - Monitor levels continuously
D = Discretionary - At the discretion of the SHSO

Note: As air concentrations are measured, they should be documented. In the case of continuous monitoring every 15 to 30 minutes.

(1) Dräger tubes to be used at this site are subject to change, based on site concerns.
(2) Continuous monitoring is required when combustible gas readings are between 10% and 20%
(3) The Victoreen Model 450 Radiation Survey Meter measures gamma radiation and detects the presence of beta and alpha particles when the mylar screen is exposed. Alpha particle detection is possible only when the mylar screen is very close (<3 mm) to the surface being tested. The meter will be held at the survey location for 9 seconds for a complete response.

\+ An OVA will be used during all intrusive activities where methane gas is anticipated (i.e., landfills)

TABLE 11-3

MONITORING EQUIPMENT AND FREQUENCY FOR SITE 48

Job Task	HNu or OVA +	Mercury Vapor		Combustible Gas Meter(1)	Radiation Survey Meter(2)
		(CH 23181) Dräger Tube	Badge		
Sediment/Surface Water Sampling	I	I	C	▨	▨
Surface Soil Sampling	I&P	I	C	I	I&D
Monitoring Well Installation	C	I & P	▨	C	C
Aquatic/Ecological Survey	I&D	▨	C	▨	▨
Subsurface (Boring) Soil Sampling	C	I & P	▨	C	C
Groundwater Sampling	I&P	I	C	I	I&D
Non-intrusive Geophysics	I&D	I	C	▨	I
Surveying	I&D	I	C	▨	I
Aquifer Test	I&D	I & D	C	I	▨

I = Initially - Immediately prior to start of job task to establish levels, confirming level of protection
P = Periodically - When site condition or set-up changes or when a new area is entered
C = Continuously - Monitor levels continuously
D = Discretionary - At the discretion of the SHSO

Note: As air concentrations are measured, they should be documented. In the case of continuous monitoring every 15 to 30 minutes.

(1) Continuous monitoring is required when combustible gas readings are between 10% and 20%.

(2) The Victoreen Model 450 Radiation Survey Meter measures gamma radiation and detects the presence of beta and alpha particles when the mylar screen is exposed. Alpha particle detection is possible only when the mylar screen is very close (<3 mm) to the surface being tested. The meter will be held at the survey location for 9 seconds until the instrument responds.

\+ An OVA will be used during all intrusive activities where methane gas is anticipated (i.e., landfills)

TABLE 11-4

MONITORING EQUIPMENT AND FREQUENCY FOR SITE 69

Job Task	HNu or OVA +	Dräger Colorimetric Tubes[1]				Radiation Survey Meter[2]	Combustible Gas Meter[3]
		(67 28061) Vinyl Chloride	(67 28561) Benzene	(67 28461) (Phosphoric) Acid Ester	(CH 23101) Mercury Vapor		
Sediment/Surface Water Sampling	I&P	▨	▨	▨	▨	▨	▨
Surveying	I&D	▨	▨	▨	▨	I	▨
Non-intrusive Geophysics	I&D	▨	▨	▨	▨	I	▨
Aquatic/Ecological Survey	I&D	▨	▨	▨	▨	▨	▨
Groundwater Sampling (Hydropunch)	I&P	▨	▨	I	I	I&P	I&P
Surface Soil Sampling	I&P	▨	▨	I	I	I&P	I&P
Monitoring Well Installation (offsite)	C	▨	▨	I	I	C	C
Soil Boring Sampling (offsite)	C	▨	▨	I	I	C	C

C = Continuously - Monitor levels continuously
I = Initially - Immediately prior to start of job task to establish levels, confirming level of protection
P = Periodically - When site condition or set-up changes or when a new area is entered
D = Discretionary - At the discretion of the SHSO

Note: As air concentrations are measured, they should be documented. In the case of continuous monitoring every 15 to 30 minutes.

(1) Dräger tubes to be used at this site are subject to change, based on site concerns.
(2) The Victoreen Model 450 Radiation Survey Meter measures gamma radiation and detects the presence of beta and alpha particles when the mylar screen is exposed. Alpha particle detection is possible only when the mylar screen is very close (<3 mm) to the surface being tested. The meter will be held at the survey location for 9 seconds until the instrument responds.
(3) Continuous monitoring required when combustible gas readings are between 10% and 20%.

+ An OVA will be used during all intrusive activites where methane gas is anticipated (i.e., landfills)

Combustible Gas Meter

- <10% of the Lower Explosive Limit (LEL) = continue work
- 10% to 20% of the LEL* = continue work with extreme caution, and use non-sparking tools
- >20% of the LEL* = stop work immediately and consult PHSO

*Continuous monitoring is required until levels drop below this range.

Radiation Survey Meter (Victoreen Model 450)

- Background (typically 0.02 to 0.04 mR/hr) to 0.5 mR/hr = Continue work
- 0.5 mR/hr to 1 mR/hr = Continue work, monitor levels closely
- >1 mR/hr = Leave work area and consult PHSO

Vapor Badge (Mercury)

- The mercury vapor badge indicator works as a color change from tan to grey. A dark grey indicates levels at or above the PEL, while a medium grey indicates levels at or below the PEL. No color change should be interpreted as a low concentration of mercury vapor. Interferences include carbon monoxide; therefore, when conditions indicate above normal levels of CO, the badge is rendered useless. Hence, smoking or combustion equipment will not be permitted within 25 feet of a vapor badge in use, at any time.

- Vapor badge is to be worn by personnel in the breathing zone (bz) at all times while working at Site 48. Vapor badge is to be replaced daily, at a minimum.

11.2.2 Perimeter Monitoring

Perimeter monitoring is defined as monitoring performed at borders beyond the Support Zone and often at the "fenceline". Releases occurring during these types of investigative activities are expected to be minimal. Therefore, it is anticipated that the type and frequency of monitoring required for each of the three sites will be as follows:

- The OVA/HNu may be used periodically to scan the downwind perimeter as a means of documenting any volatile releases that may extend past the work zone when volatile concentrations exceeding 5 ppm are detected at the breathing zone.

- Dräger Colorimetric Tubes may be used periodically to measure any potential releases when concentrations exceeding the PEL/TLV are detected at the breathing zone. Refer to Tables 11-1 through 11-4 to determine the specific tubes required for each task by site.

- The Radiation Survey Meter will be used to determine a safe distance from the source, if a radiation level exceeding 1mR/hr is detected.

It is not anticipated that there will be a need for any additional monitoring. However, as work progresses, additions to the scope of monitoring will be investigated by the SHSO.

11.3 Personal Monitoring

The following personal monitoring will be in effect on site:

- Personal exposure monitoring, as outlined in Section 11.2.1, should be sufficient according to the work activities and hazards already presented. However, as work progresses, additions to the scope of monitoring may be extended based on monitoring results, odor detection, changing work conditions and signs or symptoms of exposure. Any or all of these conditions will be immediately investigated and acted upon by the SHSO.

11.4 Equipment Maintenance and Calibration

Procedures for the return of equipment to inventory and for maintenance of the equipment shall be followed in order to assure that the optimum level of operation is maintained for the item. Personnel using equipment shall complete a field equipment usage form which will be reviewed by the PHSO. Equipment calibration under the direction of the SHSO will be completed daily and entered into the equipment calibration log. Procedures for equipment maintenance and calibration can be 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.

11.5 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. At the end of each day, these values will be entered onto an air monitoring log sheet. The log sheets will be placed in a binder and remain on site till the end of the field activities, whereby the log sheets will become part of the permanent file. A complete copy of the log sheets will also be filed with the Project Health and Safety Officer.

12.0 EMERGENCY PROCEDURES

12.1 Pre-Emergency Planning

All Navy/local emergency response contacts (On-Scene Coordinator (Fire Chief), Fire Department, Security, Ambulance, Hospital, etc.) at Camp Lejeune will be contacted 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 to be used on site.
- Expected length of time on site.
- Specific requirements the emergency response facilities may require.
- Confirmation of emergency phone numbers.

Specific points of contact, where applicable, will be established and added to the HASP. If requested, Chemical/Material Safety Data Sheets will be provided at this time.

12.2 Emergency Coordinator

The SHSO acting as the Emergency Coordinator is responsible for field implementation of the Emergency Plan. 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 a backup/alternate Emergency Coordinator.

- Controlling activities of subcontractors and contacting the Navy On-Scene Coordinator (Fire Chief) and Environmental Management Department (EMD).

- Anticipating, identifying and assessing, fires, explosions, chemical releases, and other emergency situations to the best of his/her abilities.

12.3 Communications

The primary internal communication system will rely on direct communication (via verbal or two-way radios) between site personnel. External communications will employ a telephone located in the site trailer. Refer to section 9.0 for an outline of the Communication Procedures.

Emergency telephone numbers will be place at strategic locations (i.e., Baker Field Trailer, Baker Field Vehicles, etc.) throughout the site. The list of emergency phone numbers is presented below.

Agency/Facility	Phone Number	Contact*
Security (Police)	911 or (919) 451-4555	
Fire	911	Emergency Services Operator
Ambulance (On-Base)	911	Emergency Services Operator
Ambulance (Off-Base)	(919) 455-9119	
Hospital (On-Base)	911 or (919) 451-4551	
Hospital (Off-Base) (Emergency Room)	(919) 577-2240	
Hospital (Off-Base) (Information)	(919) 577-2345	Onslow County Hospital Information
Hazardous Materials Team	911	Emergency Services Operator
Emergency	911	Emergency Services Operator
On-Scene Coordinator	911	Fire Chief
Public Works Department (Underground Utilities via EMR Contact)	(919)451-5872	George Radford
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
Agency for Toxic Substances and Disease Registry	1-404-639-0615	Response Operator

* Remaining points of contact will be identified prior to the start of activities.

Note: When calling 911 on a non-base phone, ask emergency services operator to transfer call to Base 911 system and report emergency.

12.4 Assembly Area

In the event of an emergency, personnel will meet at the Baker Site Trailer. If possible, personnel will exit the work area through the decontamination zone. If the trailer is inappropriate, an alternate assembly area will be designated by the Emergency Coordinator in an upwind location from the site before the start of operations. At this location, emergency needs will be provided, such as:

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

12.5 Emergency Hospital Route

An emergency hospital route map showing the location of the local hospitals will be posted at strategic locations throughout the site. Personnel will be informed of the location of the map and directions to the hospital.

The following are directions to the Base Naval Hospital (Building NH100) from Sites 6 and 9 (refer to Figure 3):

1. Proceed up Holcomb Boulevard (north) approximately 2.25 miles.
2. Turn left on to Brewster Boulevard (west).
3. Continue on Brewster Boulevard until intersecting with driveway to Naval Hospital on right (approximately 0.75 miles).
4. Proceed on driveway until intersecting with the Naval Hospital.

The following are directions to Onslow County Memorial Hospital (317 Western Boulevard) from Sites 48 and 69 (refer to Figure 3):

1. Leave Base through Main Gate.
2. Take Highway 24 east to Western Boulevard and turn left (north).
3. Continue on Western Boulevard to the fifth stop light and Hospital will be on the left.

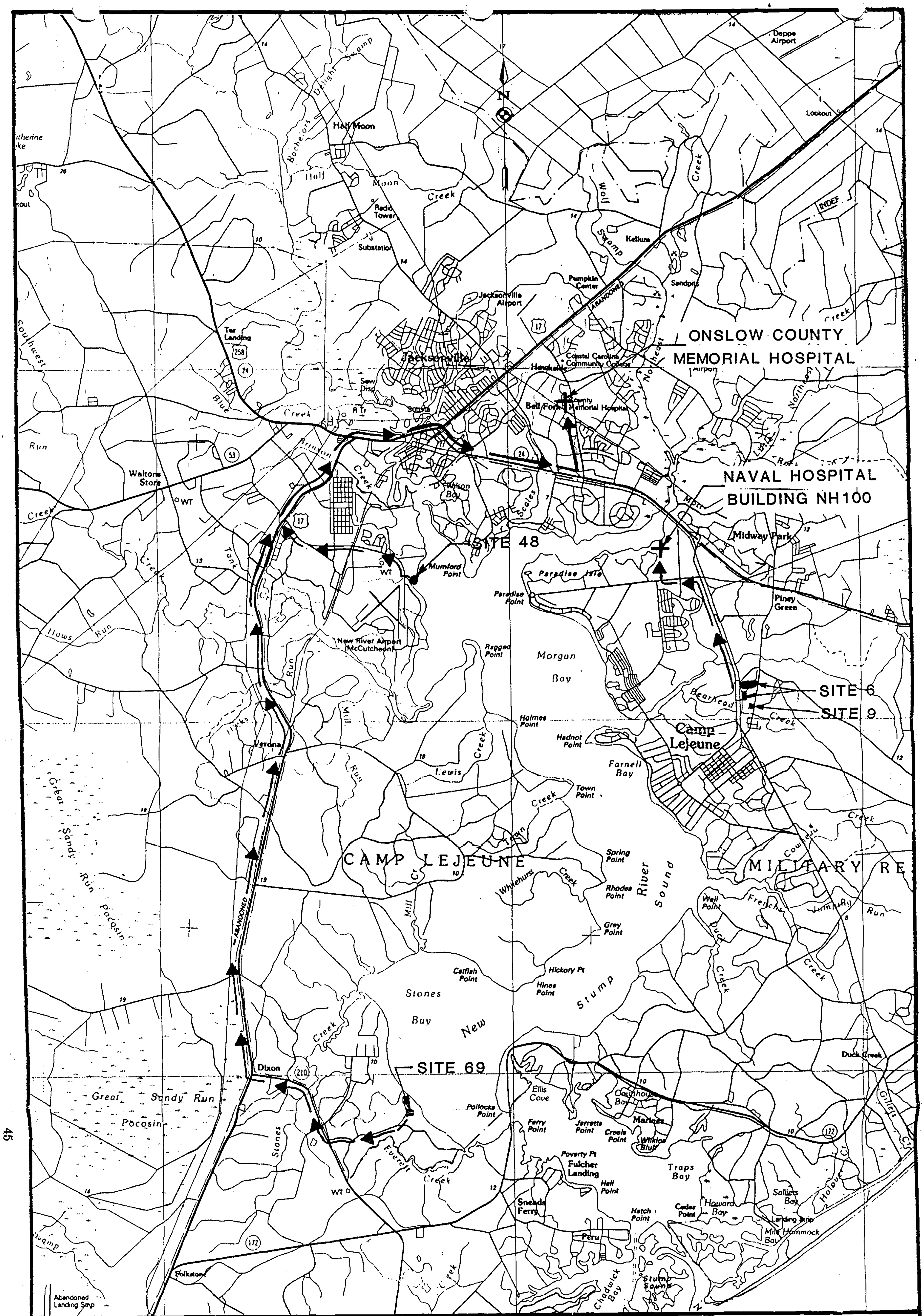

FIGURE 3
EMERGENCY HOSPITAL ROUTE
SITES 6,9,48 and 69
MCB CAMP LEJEUNE

12.6 Emergency Medical Treatment

Emergency Services

The emergency hospital is the Naval Base Hospital, located in Building NH100, phone no.: (919) 451-4551 (or 911) for Sites 6 and 9; and, Onslow County Memorial located at 317 Western Boulevard in Jacksonville, North Carolina at phone no.: (919) 577-2240 for Sites 48 and 69.

Local ambulance service is available in emergency situations from the Base Ambulance Service (at 911) or from the City of Jacksonville at phone no.: (919) 455-9119. Contact will be made with emergency personnel prior to the start of activities (See Section 12.1).

Physical Injury

If an employee working in a contaminated area is physically injured, first-aid procedures are to be followed. Depending on the severity of the injury, emergency medical response from base personnel may be sought to stabilize victims for transport to public hospitals. 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 10.2). Then, if circumstances permit, administered emergency first aid and transported to an awaiting ambulance, or to a local emergency medical facility.

Chemical Injury

If the injury to a worker is chemical in nature (e.g., overexposure), 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 emergency eyewash station using large amounts of water and lifting the lower and upper lids occasionally. Obtain medical attention immediately. Contact lenses will not be worn when working.

- 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 North Carolina Duke Regional Poison Control Center at 1-800-672-1697. Do not make an unconscious person vomit.

- Breathing - If a person has difficulty breathing, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.

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. Systematic signs (which may or may not occur) including weakness, sweating, faintness, and signs of shock.

Provide treatment as follows:

1. Calm and reassure the victim; have the victim sit in a comfortable position and remain quiet.

2. Keep the affected area below the level of the heart.

3. Cool the bite area using an ice pack or similar device. Take care not to induce frostbite.

4. Transport victim to the nearest medical facility or contact an ambulance to transport the victim.

5. 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.

Inform the SHSO immediately if a snakebite has occurred. The SHSO will in turn, inform the PHSO, as soon as possible.

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 and chemicals involved.

Decontamination

If on-site decontamination of injured employee(s) is not possible, the Emergency Coordinator will provide polyethylene sheeting for a stretcher, and ambulance. If necessary, a site employee equipped with appropriate protective equipment and clothing will accompany the injured employee and will perform decontamination under the supervision of emergency medical personnel.

Instances requiring treatment beyond "first aid" will be handled at appropriate facilities and reported to the Project Manager and PHSO within 24 hours.

12.7 Emergency Decontamination Procedures

In the event of a medical emergency, patients are to be adequately decontaminated before transfer, if possible. This is to prevent contamination of the medical transport vehicle and medical facility.

At a minimum, the patient should have the following removed before transport:

- Protective outer clothing
- Protective boots
- Protective gloves
- Other protective equipment.

If necessary, one of the site personnel equipped with appropriate PPE may accompany the injured worker and perform decontamination with supervision of medical personnel.

12.8 Personal Protection and First-Aid Equipment

PPE available for emergency response will include the following:

- Polyvinyl chloride and neoprene boots
- Saranex® suits
- Tyvek® suits, polyethylene coated and uncoated
- Nitrile gloves (inner and outer)
- Neoprene and nitrile gloves (outer)
- Face shields and goggles
- SCBA

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

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

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

12.9 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, he/she will report their findings to the Fire Chief (Navy On-Scene Coordinator) and Environmental Management Department (EMR). The Fire Chief will then respond to the incident and determine the appropriate action to be taken. If necessary the Fire Chief may contact EMR to provide additional services.

The notification report will be made from the Baker Field Trailer or other base locations and 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.
- The extent of injuries, and number of casualties.
- The possible hazards to human health or the environment and cleanup procedures.
- Assistance that is requested.

12.10 Hazard Assessment

The Emergency Coordinator will assess possible hazards to human health or the environment that may result from a chemical release, fire, explosion, or severe weather conditions to the best of his/her abilities, incorporating the following steps, as appropriate:

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

- Identify the materials involved in the incident.

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

- Determine the potential effects of the exposure/release and appropriate safety precautions.

- Determine if release of materials meets EPA requirements for reportable quantities for spills under the RCRA or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

- Inform appropriate personnel as identified in Section 12.9.

This assessment will 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 generated or the effects of any hazardous surface water runoff from water or chemical agents used to control fire and heat-induced explosions).

12.11 Security

During activation of the Emergency Plan, the Emergency Coordinator or his designated representative will control access to the site and maintain an incident log until the Fire Chief (Navy On-Scene Coordinator) arrives. The incident log will include:

- Time of entry.
- Expected exit time.
- Use of team or "buddy" system.
- Task being performed.
- Location of task.
- Rescue and response equipment used.
- Protective equipment being used.

12.12 Emergency Alerting

Personnel Injury in the Exclusion Zone (Work Area): Upon notification of an injury in the Exclusion Zone, the designated emergency signal (verbal) warning and/or one long airhorn blast shall be sounded. All site personnel shall assemble at the decontamination control line (for Level D or D+) or the CRZ (for Level C or higher). The rescue team will enter the Exclusion Zone (if required) to remove the injured person to the hotline. The SHSO and/or Site Manager will evaluate the nature of the injury, and assure that the affected person is decontaminated according to Section 10.2. If required, contact will be made with an ambulance, and/or with the designated medical facility. No persons shall reenter the Exclusion Zone until an accident investigation is performed by the SHSO and/or the Site Manager.

Personnel Injury in the Support Zone (Clean Area): Upon notification of any 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, the designated emergency signal (verbal) warning and/or one long airhorn blast shall be sounded, and all remaining site personnel will move to the support zone for further instructions. Activities on site will stop until the added risk is mitigated.

Fire/Explosion: Upon notification of a fire or explosion on site, the designated emergency signal (verbal) warning and/or one long airhorn blast shall be sounded and all site personnel will report to the assembly area (for Level D or D+) or the CRZ (for Level C or higher). The fire and security departments will be alerted and all personnel will move to a safe distance from the involved area for 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 Exclusion 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 Site Manager and/or the Field Team Leader and SHSO shall be notified to determine the effect of this failure on continuing operations on site. If the failure affects the safety of site personnel, work with the equipment will cease until the situation is evaluated and appropriate actions taken.

Accident/injury reports will be completed for any accidents no matter how minor the injury. All injuries resulting in treatment other than first aid will be reported to the Project Manager and PHSO within 24 hours. Records on equipment failure will also be completed.

In all situations, when an on-site emergency results in evacuation of the Exclusion 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.

12.13 Training

Site personnel will be informed of the details in the Emergency Plan during initial HASP training. The Emergency Plan will be reviewed/rehearsed by site personnel at least monthly or when elements of the plan change.

13.0 SPILL CONTAINMENT PROCEDURES

In the event that a spill (incidental release) of hazardous substances (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. 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/adsorbent 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. Appropriate Navy Activity Personnel including Navy/Marine Corps On-Scene Coordinator/Commander will be notified, should a spill require additional measures beyond those already discussed.

Note: The amount and/or concentration of the hazardous substances on this site is expected to be minimal. Therefore, extensive spill containment procedures will not be implemented.

14.0 WASTE HANDLING PROCEDURES

The protocols outlined in the FSAP for the handling, packaging, storing, and disposing of contaminated materials must be followed to: (1) minimize the risk of off-site exposures that could endanger public health; and (2) limit the potential for liabilities associated with handling, containment, storage, and transportation of contaminated materials.

15.0 DECLARATION OF HASP REVIEW

All site personnel indicated below, have reviewed and are familiar with this Health and Safety Plan. Site personnel were briefed on the contents of this HASP on ________ at ________ a.m./p.m.

1.	(Name-Print)	(Company)
	(Name-Sign)	(Date)
2.	(Name-Print)	(Company)
	(Name-Sign)	(Date)
3.	(Name-Print)	(Company)
	(Name-Sign)	(Date)
4.	(Name-Print)	(Company)
	(Name-Sign)	(Date)
5.	(Name-Print)	(Company)
	(Name-Sign)	(Date)
6.	(Name-Print)	(Company)
	(Name-Sign)	(Date)

Declaration of Health and Safety Plan Review (Cont'd)

7. ______________________________ ______________________________
(Name-Print) (Company)

______________________________ ______________________________
(Name-Sign) (Date)

8. ______________________________ ______________________________
(Name-Print) (Company)

______________________________ ______________________________
(Name-Sign) (Date)

9. ______________________________ ______________________________
(Name-Print) (Company)

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(Name-Sign) (Date)

10. ______________________________ ______________________________
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12. ______________________________ ______________________________
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(Name-Sign) (Date)

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(Name-Print) (Company)

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(Name-Sign) (Date)

Declaration of Health and Safety Plan Review (Cont'd)

14. ______________________ ______________________
(Name-Print) (Company)

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(Name-Sign) (Date)

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(Name-Print) (Company)

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16. ______________________ ______________________
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(Name-Sign) (Date)

17. ______________________ ______________________
(Name-Print) (Company)

______________________ ______________________
(Name-Sign) (Date)

HASP Amendment Briefings:

Date	Time	A.M./P.M.

Attachment A
Medical Surveillance Testing Parameters

ATTACHMENT A

MEDICAL SURVEILLANCE BASELINE TESTING PARAMETERS*

Group I - Individuals Rarely in the Field (<10 days/year)

- Medical History and Physical
- Eye Exam
- EKG (baseline and for individuals over 40 yrs.)
- CBC with differential

Group II - Individuals Occasionally in the Field (10-30 days/year)

- Medical History and Physical
- Eye Exam
- EKG (baseline and for individuals over 40 yrs.)
- Chest X-ray (baseline then every 5 years)
- Spirometry
- CBC with differential
- SMA 12 or 26 (liver enzyme scan)

Group III - Individuals Frequently in the Field (>30 days/year)

- Medical History and Physical
- Eye Exam
- EKG (baseline and for individuals over 40 years)
- Audiometry
- Chest X-ray (baseline then every 3 years))
- Spirometry
- CBC with differential
- SMA 12 or 26 (liver enzyme scan)
- Urinalysis (glucose scan)
- Specific Blood and Urine Tests (dependent on field exposure)

Group III with Asbestos - Individuals frequently in the Field and also associated with asbestos

- Group III testing with the Asbestos Medical Questionnaire

Group IV - Individuals associated with Asbestos

- Medical history and physical
- Eye Exam
- Chest X-ray (baseline then every 5 years)
- Pulmonary Function Test ($FVC_{1.0}$ and $FEV_{1.0}$)
- Urinalysis
- Audiometry
- Asbestos Medical Questionnaire

* The attending physician has the right to reduce or expand the medical monitoring on an annual basis as he/she deems necessary.

** Rare and expensive - to be performed only for individuals identified by the attending physician as being chronically exposed to organic compounds.

Attachment B
OSHA Training History of Project Personnel

ATTACHMENT B

OSHA TRAINING HISTORY OF BAKER PROJECT PERSONNEL*

Personnel	Anticipated Site Activities Phase I	Training Status
Ray Wattras	- Project Manager	- 40-hr. training completed: 04/84 - Supervisory training: Yes - 8-hr. refresher completed: 04/92 - First Aid/CPR Training: No - Medical surveillance: Yes
Barbara Cummings	- Project Health and Safety Officer	- 40-hr. training completed: 10/91 - Supervisory training: Yes - 8-hr. refresher completed: NA - First Aid/CPR Training: 11/91 - Medical surveillance: Yes
Donald Shields	- Site Manager/Project Geologist	- 40-hr. training completed: 02/88 - Supervisory training: Yes - 8-hr. refresher completed: 03/92 - First Aid/CPR Training: No - Medical surveillance: Yes
Peter Monday	- Site Health and Safety Officer/Field Team Leader	- 40-hr. training completed: 03/90 - Supervisory training: Yes - 8-hr. refresher completed: 03/92 - First Aid Training: 10/90 - Medical surveillance: Yes
Richard Dabal	- Environmental Scientist	- 40-hr. training completed: 10/89 - Supervisory training: Yes - 8-hr. refresher completed: 03/92 - First Aid/CPR Training: 11/91 - Medical surveillance: Yes
Matthew Bartman	- Environmental Scientist	- 40-hr. training completed: 08/87 - Supervisory training: No - 8-hr. refresher completed: 04/92 - First Aid/CPR Training: No - Medical surveillance: Yes
Ken Martin	- Environmental Scientist	- 40-hr. training completed: 03/89 - Supervisory training: Yes - 8-hr. refresher completed: 05/92 - First Aid Training: 11/90 - CPR Training: 12/91 - Medical surveillance: Yes

* Training history for contractor personnel will be attached.

NA - Not Applicable

ATTACHMENT B

OSHA TRAINING HISTORY OF BAKER PROJECT PERSONNEL*

Personnel	Anticipated Site Activities Phase I	Training Status
Michael Smith	● Environmental Scientist	● 40-hr. training completed: 09/91 ● Supervisory training: Yes ● 8-hr. refresher completed: NA ● First Aid/CPR Training: No ● Medical surveillance: Yes
Thomas Trebilcock	● Environmental Scientist	● 40-hr. training completed: 06/92 ● Supervisory training: No ● 8-hr. refresher completed: NA ● First Aid/CPR Training: 07/92 ● Medical Surveillance: Yes

* Training history for contractor personnel will be attached.

NA - Not Applicable

Attachment C
Chemical Safety Data Sheets

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

Material Safety Data Sheets Collection:

Sheet No. 332
Tricresyl Phosphate

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

Section 1. Material Identification 32

Tricresyl Phosphate [$(CH_3C_6H_4)_3PO_4$] Description: Exists in three isomeric forms: *ortho, meta, para*. The commercial product is a mixture of the three forms with as little of the highly toxic *ortho*-isomer as possible. The *meta*- and *para*-isomers are relatively inactive. Although the three symmetrical isomers are difficult and costly to separate, tricresyl phosphate should contain no more than 3% *o*-cresol. Tricresyl phosphate is derived from cresol and phosphorus oxychloride, phosphoric acid, or pentachloride. Used as a plasticizer for chlorinated rubber, vinyl plastics, and polystyrene, polyacrylic, and polymethacrylic esters; as a solvent and binder in nitrocellulose and various natural resins to improve toughness, elasticity, and polishing properties of coatings; as an additive to synthetic lubricants and gasoline (to counteract the harmful effects of lead deposits); as an adjuvant in milling of pigment pastes; as an hydraulic fluid and a fire retardant; and in phenol recovery in coke-oven waste waters.

Other Designations: CAS No. 1330-78-5; Celluflex®; Kronitex®; Lindol®; phosphoric acid, tritolyl ester; TCP; tritolyl phosphate.

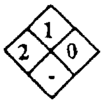
Triorthocresyl Phosphate [$(CH_3C_6H_4)_3PO_4$]: CAS No. 0078-30-8, *o*-cresyl phosphate, TOCP, tricresyl phosphate, tri 2-methylphenyl phosphate.

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

Cautions: This very toxic *ortho*-isomer is excluded from TCP as much as possible. *TOCP is poisonous by ingestion and skin penetration.* TCP is combustible when exposed to heat or flame.

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

NFPA†



† Triorthocresyl phosphate

HMIS
H 2
F 1
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‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Tricresyl phosphate (isomeric mixture), ca 95%

1989 OSHA PEL	1989-90 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data*
None established	None established	None established	Rabbit, eye: 500 mg administered for 24 hr produces mild irritation Woman, oral, TD_{Lo}: 70 mg/kg ingested over 14 days produces flaccid paralysis without anesthesia, changes in motor activity, and muscle weakness

Triorthocresyl phosphate†

1989 OSHA PEL (Skin)	1989-90 ACGIH (Skin)	1988 NIOSH REL	1985-86 Toxicity Data‡
8-hr TWA: 0.1 mg/m³ **1987 IDLH Level** 40 mg/m³	TLV-TWA: 0.1 mg/m³	None established	Rabbit, oral, LD_{Lo}: 100 mg/kg ingested produces behavioral (muscle weakness); gastrointestinal (hypermotility, diarrhea); and kidney, ureter, bladder (interstitial nephritis) changes

* See NIOSH, *RTECS* (TD0175000), for additional irritative, reproductive, and toxicity data.
† *Ortho*-cresyl isomer content is 1% max of the total cresyl isomer content of Lindol® and SYN-O-AD® esters.
‡ See NIOSH, *RTECS* (TD0350000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: 510 °F (265 °C)* at 10 mm Hg
770 °F (410 °C)† at 760 mm Hg
Melting Point: -13 °F (-25 °C)†
Vapor Pressure: 10 mm Hg (1.33 • 10³ Pa) at 198 °C†
Vapor Density (Air = 1): 12.7
Molecular Weight: 368.4
Specific Gravity : 1.16 to 1.18
Water Solubility: Sparingly soluble

Appearance and Odor: Pale yellow to colorless, oily, odorless liquid.

* Tricresyl phosphate
† Triorthocresyl phosphate

Section 4. Fire and Explosion Data

Flash Point: 770 °F (410 °C), CC* 437 °F (225 °C)†	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use CO_2 or dry chemical to fight fire.

Unusual Fire or Explosion Hazards: Tricresyl phosphate is combustible when exposed to heat or flame. However, the high flash point reduces its fire hazard, and it tends to stop burning when the ignition source is removed.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and a fully encapsulating suit. Fight fire at a maximum distance. Remove TCP containers from fire area if you can do it without risk. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

* Tricresyl phosphate
† Triorthocresyl phosphate

Section 5. Reactivity Data

Stability/Polymerization: Tricresyl phosphate is stable at room temperature in closed containers under normal storage and handling conditions. It hydrolyzes slowly at room temperature under wet alkaline conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Tricresyl phosphate can react with oxidizing materials, especially when heated. TCP is inert to common metals.

Hazardous Products of Decomposition: Thermal oxidative decomposition of tricresyl phosphate can emit highly toxic fume of phosphorus oxides (PO_x).

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list TOCP as a carcinogen.
Summary of Risks: TOCP, the greater toxic hazard in TCP, may be present in commercial products containing TCP. Restricting TCP to low triorthocresyl phosphate levels can reduce its toxicity and health hazards. The main causes of chronic intoxication are accidental ingestion and skin penetration. Severe paralysis has resulted from ingesting 6 to 7 mg/kg, and the lethal dose for humans by ingestion is about 1.0 g/kg. Ingesting foodstuffs (ginger ale, edible oil) or therapeutic substances (creosote phosphate) stored in containers of TCP-plasticised resin or additives has caused acute mass poisonings. Since TCP has low volatility, vapor inhalation is unlikely at normal temperatures; however, it may be a hazard if boiled. Most occupational poisonings occur during industrial use of TCP, not during its production phase, which is totally enclosed. During aryl phosphates manufacturing (with up to 20% TOCP), workers exposed to 0.2- to 3.4-mg/m^3 concentrations show some plasma cholinesterase inhibition, but this effect did not correlate with the degree of exposure or with minor gastrointestinal or neuromuscular symptoms.
Medical Conditions Aggravated by Long-Term Exposure: Long-term exposure may cause bilateral wrist drop and numbness of the fingers. Neurologic damage can be severe and permanent.
Target Organs: Central nervous system, gastrointestinal tract.
Primary Entry Routes: Ingestion, inhalation, absorption through the skin and mucous membranes.
Acute Effects: No matter what exposure route, toxicity is characterized by nausea, vomiting, diarrhea, and abdominal pain, usually within 48 hr, followed by a 3- to 40-day latency period. Later symptoms are pain and weakness of the extremities, followed by progressive bilateral foot and wrist drop over several days. The soles of the feet and palms may be cold and sweaty, possibly for months. Severe intoxications result in more serious nerve afflictions such as flaccid paralysis of the limb muscles. The patient develops a swinging, stepping gait. In most cases the paralysis regresses, but there may be permanent residual effects. TOCP is readily absorbed through the skin without local irritant effects. Conjunctivitis (irritation of the eyes) and mild mucous membrane irritation may result during the early pre-paralytic phase of toxicity. Skin irritation is not usually seen but exposure can lead to hyperhidrosis (profuse sweating) of the palms and soles, possibly for months. Nystagmus (rapid eye oscillation with dizziness) is also often present in early and late toxicity phases.
Chronic Effects: The gastrointestinal symptoms may often pass unobserved during a sometimes prolonged latent period. Since TCP inhibits cholinesterase, a fall in cholinesterase is an important warning sign.

FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash thoroughly with soap and water. Get medical attention.
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, induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Consider gastric lavage if patients are comatose or at risk of convulsing. Since prolonged diarrhea may occur, avoid cathartic administration. Avoid administration of atropine and 2-PAM chloride (protopam) since these agents are ineffective. If a worker is diagnosed for chronic poisoning, remove from exposure and treat for polyneuritis. Experimental cholinesterase reactivators used for therapeutic use in TCP poisoning show encouraging results. Observe all exposures for delayed peripheral neuropathies, particularly the axonal type.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against skin contact and vapor inhalation. Absorb spill with sand or other noncombustible, absorbent material and place into containers for later disposal. With a clean shovel, place spilled material into clean, dry containers with covers for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
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: 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. Neoprene and Buna-N are TCP resistant.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLV (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, galvanized containers in a cool, well-ventilated area away from direct sunlight and open flames. Containers should be effectively sealed and clearly marked. Do not store in plastic containers which are likely to contact clothing or foodstuffs. Protect containers from physical damage.
Engineering Controls: Avoid contact with skin or mucous membranes. Use only with appropriate personal protective gear. Warn workers of the specific health hazards and train them to use this material safely. Avoid mixtures containing more than 1% TOCP. Check supplies to determine the *o*-isomer content. Practice good hygiene and housekeeping procedures.
Other Precautions: Provide preplacement and annual physical examinations with emphasis on the peripheral and central nervous system. Monitor blood cholinesterase levels.

Transportation Data (49 CFR 172.102)

IMO Shipping Name: Tricresylphosphate, with more than 3% *ortho*-isomer
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN2574

MSDS Collection **References:** 26, 38, 73, 84, 85, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 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.

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S 2
K 2

NFPA
2
0 0
-

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

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

Section 4. Fire and Explosion Data

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

Extinguishing Media: Use dry chemical, carbon dioxide, foam, water fog or spray. Do not use a forced water spray directly on burning oil since this scatters the fire. Use a smothering technique to extinguish fire.
Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. This fuel oil's volatility is similar to gasoline's.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to health and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Fuel oil no. 2 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of fuel oil no. 2 yields various hydrocarbons and hydrocarbon derivatives and partial oxidation products including carbon dioxide, carbon monoxide, and sulfur dioxide.

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 bsorption 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
ARA 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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Material Safety Data Sheets Collection:

Sheet No. 467
Automotive Gasoline, Lead-free

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

Section 1. Material Identification

35

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

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

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

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

NFPA

HMIS
H 2
F 3
R 1
PPG†
† Sec. 8

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

Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

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

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

1990 NIOSH REL
None established

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

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

Section 3. Physical Data

Boiling Point: Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)
Vapor Density (air = 1): 3.0 to 4.0
Density/Specific Gravity: 0.72 to 0.76 at 60 °F (15.6 °C)
Water Solubility: Insoluble

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

Section 4. Fire and Explosion Data

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

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

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

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

Section 5. Reactivity Data

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

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

Conditions to Avoid: Avoid heat and ignition sources.

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

Section 6. Health Hazard Data

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

FIRST AID

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

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. *Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools.* Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).
Aquatic Toxicity: Bluegill, freshwater, LC_{50}, 8 ppm/96 hr.
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 261.21): Characteristic of ignitability
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

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

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. Note: Resistance of specific materials can vary from product to product.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

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

Transportation Data (49 CFR 172.101, .102)

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

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

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

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Material Safety Data Sheets Collection:

Sheet No. 468
Fuel Oil No. 1

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

Section 1. Material Identification

33

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

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

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

R 1
I -
S 1
K 2

NFPA

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

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

Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 1, ca 100%

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

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

Section 3. Physical Data

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

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

Section 4. Fire and Explosion Data

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

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

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

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

Section 5. Reactivity Data

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

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

Conditions to Avoid: Avoid heat and ignition sources.

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

Section 6. Health Hazard Data

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

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

Continue on next page

Section 6. Health Hazard Data, *continued*

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

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

Target Organs: Central nervous system, skin, and mucous membranes.

Primary Entry Routes: Inhalation, ingestion.

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

Chronic Effects: Repeated skin contact 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 a 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).

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. Nitrile or polyvinyl alcohol gloves are recommended.

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 and 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

OILS, MISCELLANEOUS: LUBRICATING

OLB

Common Synonyms
Crankcase oil
Transmission oil
Motor oil

Oily liquid
Yellow-brown
Lube oil odor

Floats on water.

Stop discharge if possible
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water

Exposure

CALL FOR MEDICAL AID

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Miscellaneous Hydrocarbon Mixtures
3.2 **Formula:** Not applicable
3.3 **IMO/UN Designation:** 3.3/1270
3.4 **DOT ID No.:** 1270
3.5 **CAS Registry No.:** Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Yellow fluorescent
4.3 **Odor:** Characteristic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Protective gloves; goggles or face shield.
5.2 **Symptoms Following Exposure:** INGESTION: minimal gastrointestinal tract irritation; increased frequency of bowel passage may occur. ASPIRATION: pulmonary irritation is normally minimal but may become more severe several hours after exposure.
5.3 **Treatment of Exposure:** INGESTION: do NOT lavage or induce vomiting. ASPIRATION: treatment probably not required; delayed development of pulmonary irritation can be detected by serial chest x-rays. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water.
5.4 **Threshold Limit Value:** Data not available
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 1; LD_{50} = 5 to 15 g/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** 300°F C.C.
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water of foam may cause frothing.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 500°F-700°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 4 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 33

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Various viscosities
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** Not pertinent
12.3 **Boiling Point at 1 atm:** Very high
12.4 **Freezing Point:** Not pertinent
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** (est.) 0.902 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 36-37.5 dynes/cm = 0.036—0.0375 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 33—54 dynes/cm = 0.033—0.054 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** —18,486 Btu/lb = —10,270 cal/g = —429.96 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

OLB — OILS, MISCELLANEOUS: LUBRICATING

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F (estimate)	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)	Temperature (degrees F)	Centipoise
50	56.180	50	.460	35	.920	100.42	275.000
52	56.180	52	.461	40	.919		
54	56.180	54	.462	45	.918		
56	56.180	56	.463	50	.917		
58	56.180	58	.464	55	.916		
60	56.180	60	.465	60	.915		
62	56.180	62	.466	65	.914		
64	56.180	64	.467	70	.913		
66	56.180	66	.468	75	.912		
68	56.180	68	.469	80	.911		
70	56.180	70	.470	85	.910		
72	56.180	72	.471	90	.909		
74	56.180	74	.472	95	.908		
76	56.180	76	.473	100	.907		
78	56.180	78	.474	105	.906		
80	56.180	80	.475	110	.905		
82	56.180	82	.476	115	.904		
84	56.180	84	.477	120	.903		
		86	.478				
		88	.479				
		90	.480				
		92	.481				
		94	.482				
		96	.483				
		98	.484				
		100	.485				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch (estimate)	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE	70	.042		NOT PERTINENT		NOT PERTINENT
		75	.049				
		80	.057				
		85	.065				
		90	.076				
		95	.087				
		100	.100				
		105	.114				
		110	.131				
		115	.149				
		120	.170				
		125	.193				
		130	.218				
		135	.247				
		140	.279				
		145	.314				
		150	.352				
		155	.395				
		160	.443				
		165	.495				
		170	.552				
		175	.615				
		180	.683				
		185	.758				
		190	.841				
		195	.930				

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Material Safety Data Sheets Collection:

Sheet No. 410
Carbon Tetrachloride

Issued: 12/80 Revision: B, 4/90

Section 1. Material Identification

Carbon Tetrachloride Description: A chlorinated hydrocarbon derived from interacting carbon disulfide and chlorine in the presence of iron, or chlorination of methane or higher hydrocarbons at 482 °F/250 °C to 752 °F/400 °C. Carbon tetrachloride is treated with caustic alkali solution to remove sulfur chloride. Its primary use is in manufacturing flurocarbon propellants. It is also used in producing of semiconductors, chlorinating organic compounds, metal degreasing, refrigerants; as a solvent for oils, fats, resins, rubber waxes, lacquers, and varnishes; and as an agricultural fumigant. This material was widely used in the dry-cleaning industry.

Other Designations: CAS No. 0056-23-5; CCl$_4$; carbon chloride; carbon tet; methane tetrachloride; perchloromethane; tetrachlorocarbon; tetrachloromethane.

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

R 1
I 4
S 2*
K 0
*Skin absorption

NFPA
0
3 0
-

HMIS
H 3
F 0
R 0
PPG†
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Carbon tetrachloride, ca 100%

OSHA PEL
8-hr TWA: 2 ppm, 12.6 mg/m^3

ACGIH TLV (Skin), 1989-90
TLV-TWA: 5 ppm, 31 mg/m^3

NIOSH REL, 1987
60-min ceiling: 2 ppm, 12.6 mg/m^3

Toxicity Data*
Rat, oral, LD$_{50}$: 2800 mg/kg; toxic effects not yet reviewed
Rat, inhalation, LC$_{50}$: 8000 ppm over 4 hr; no toxic effect noted
Human, inhalation, TC$_{Lo}$: 20 ppm inhaled produces gastrointestinal effects (nausea or vomiting)

* See NIOSH, *RTECS* (FG4900000), for additional irritative, mutative, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 169.77 °F/76.54 °C
Melting Point: -9.4 °F/-23 °C
Vapor Pressure: 91.3 mm Hg at 68 °F/20 °C
Vapor Density (Air = 1): 5.32
Molecular Weight: 153.84 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 1.5940 at 68 °F/20 °C
Water Solubility: Very slightly soluble (800 mg/l at 68 °F/20 °C)
Evaporation Rate (Butyl Acetate = 1): 12.8

Appearance and Odor: A colorless liquid with a heavy ethereal odor. The high and low odor thresholds are, respectively, 128.4 and 60 mg/m^3. Odor is not an adequate warning sign to prevent overexposure.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Carbon tetrachloride is nonflammable and will not support combustion. Use extinguishing media appropriate to the surrounding fire. This material was previously used as an extinguishing medium in portable fire extinguishers, but its toxicity and fire decomposition products lead to its replacement with "safer" extinguishing media.

Unusual Fire or Explosion Hazards: Carbon tetrachloride can react violently with hot or burning metals such as aluminum and magnesium.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and fully encapsulating suit. Use water spray to cool fire-exposed containers. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

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

Chemical Incompatibilities: Carbon tetrachloride reacts violently with fluorine gas, alkali metals, and aluminum (see reference 126 for specific incompatibilities).

Conditions to Avoid: This material has caused explosions when used as a fire extinguisher on wax fires and uranium fires. It may also form toxic phosgene when used to put out electrical fires.

Hazardous Products of Decomposition: Thermal oxidative decomposition of carbon tetrachloride can produce toxic phosgene and hydrogen chloride.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and ACGIH list carbon tetrachloride as an anticipated human carcinogen, a possible human carcinogen, and a suspected human carcinogen, respectively.
Summary of Risks: Carbon tetrachloride is highly toxic and irritating by inhalation, ingestion (mean lethal dose is 5 to 10 ml), and skin absorption. Alcohol's synergistic effects markedly increase CCl_4's toxicity. Excessive exposure may result in central nervous system depression, cardiac arrhythmias, and gastrointestinal symptoms. In humans the majority of fatalities have been the result of renal injury with secondary cardiac failure. Kidney and liver damage can occur from severe acute or chronic exposure. Human liver damage occurs more often after ingestion of the liquid than after the inhalation of the vapor. However, after a 30 min to 1 hr exposure to concentrations of 1000 to 2000 ppm, humans have died from acute renal damage.
Medical Conditions Aggravated by Long-Term Exposure: Prolonged recovery and permanent disability of the liver, kidney, and lungs are possible.
Target Organs: Central nervous system, eyes, skin, liver, kidneys, lungs.
Primary Entry Routes: Inhalation, percutaneous (through the skin).
Acute Effects: Acute exposure symptoms include eye, nose, skin, and throat irritation; cough, dyspnea, cyanosis, cardiac arrhythmias, headaches, dizziness, mental confusion, nausea, vomiting, abdominal pain, and diarrhea. Jaundice and abnormal liver enlargement accompanied by oliguria (reduced excretion of urine), proteinuria (protein in urine), and hematuria (blood in urine) may occur even after several days delay.
Chronic Effects: Chronic exposure symptoms include defatting dermatitis, headaches, dizziness, mental confusion, apathy, anorexia, nausea, vomiting, abdominal pain, weight loss, narrowing of visual field, optic nerve damage with possible blindness, hearing loss, and renal and hepatic decompensation (loss of these organs' ability to correct dysfunction). Chronic exposure may result in the development of aplastic anemia.

FIRST AID

Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it 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. Give one to two glasses of water to dilute and induce vomiting, unless the person shows evidence of decreasing mental functioning and awareness.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: To minimize hepatorenal damage, consider intravenous acetylcysteine. Hyperbaric oxygen is also utilized for significant exposures. Dialysis has also been suggested in severe cases. Give cardiorespiratory support as indicated and carefully monitor fluid and electrolytes. Closely monitor hepatic and renal functions. Avoid epinephrine because of myocardial sensitization and potential for inducing ventricular arhythymias.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area, and provide maximum exhaust ventilation. Cleanup personnel should protect against inhalation and skin and eye contact. Small spills can be absorbed on paper or some noncombustible, inert ingredient and allowed to evaporate in a hood. For large spills, dike far ahead to contain spill for disposal. Prevent release of CCl_4 to surface water or sewers. 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)
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per RCRA, Sec. 3001, per Clean Water Act, Sec. 307(a), 311 (b)(4)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table 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: 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. Polyvinyl alcohol protective gear is recommended.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL, ACGIH TLV, and NIOSH REL (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 container in a cool, dry, well-ventilated, low fire-risk area away from incompatible materials (Sec. 5), direct sunlight, and heat. Prevent exposure of vapors to high temperature to prevent decomposition to toxic and corrosive gases and vapors.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Use only with adequate ventilation and appropriate personal protective gear. Monitor vapor levels and institute a respiratory protection program which includes training, maintenance, inspection, and evaluation. Practice good personal hygiene procedures. When possible, substitute a less hazardous solvent for CCl_4. Provide preplacement and biannual medical exams, including studies of liver and kidney function. Prevent exposing individuals with liver, kidney, or central nervous system diseases, or alcoholism. Alcohol's synergistic effects markedly increase CCl_4's toxicity.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Carbon tetrachloride
DOT Hazard Class: ORM-A
ID No.: UN1846
DOT Label: None
DOT Packaging Requirements: 173.620
DOT Packaging Exceptions: 173.505

IMO Shipping Name: Carbon tetrachloride
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1846

MSDS Collection References: 7, 26, 38, 53, 73, 84, 85, 88, 89, 100, 103, 109, 124, 126, 127, 129, 130, 131, 134, 136, 137
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD MS

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Material Safety Data Sheets Collection:

Sheet No. 298
Jet Fuels

Issued: 8/90

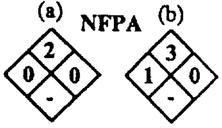
Section 1. Material Identification

32

Jet Fuel Description: A petroleum distillate similar to kerosine composed of C_5 to C_{16} aliphatics, monocycloparaffins, aromatics, and olefins (for turbine engines only). Aromatics are a lower percentage for jet fuels, but there are a number of jet fuel types with somewhat different compositions and properties.
Other Designations: Jet A, Jet A-1, Jet B, Jet fuel HEF-3, JP-1, JP-4, JP-5, JP-6.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.
Cautions: *Jet fuel is volatile, combustible, and thus, a dangerous fire hazard.* It is a skin, eye, and respiratory tract irritant. *Ingestion can be harmful, even fatal.*

(a) Jet A and Jet A-1 (combustible) and JP-5 (flammable to combustible).
(b) Jet B (dangerous fire hazard) and JP-4 (dangerous fire hazard and moderate explosion hazard in the form of vapor).

R 1
I -
S 2
K 2-4*
* Varying flash points



	(a)	(b)
HMIS	HMIS	HMIS
H	1	1
F	2	3
R	0	0
PPG†	PPG†	PPG†

† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Jet fuel, ca 100%

1989 OSHA PEL	**1989-90 ACGIH TLV**	**1988 NIOSH REL**	**1985-86 Toxicity Data***
None established	None established	None established	Rat, oral, LD_{50}: 40 mg/kg Rat, inhalation, LC_{50}: 23 ppm/4 hr Rat, skin, LD_{50}: 317 mg/kg

* These toxicity data pertain to jet fuel HEF-3. See NIOSH, *RTECS* (MH5425100), for additional toxicity data.

Section 3. Physical Data*

Boiling Point: 300 to 550 °F (149 to 288 °C)
Vapor Pressure: 0.1 mm Hg at 20 °C
Viscosity: 1.0 to 2.0 cSt at 72 °F (40 °C)
Relative Density (15 °C/4 °C): 0.79 to 0.84
Water Solubility: Negligible

Appearance and Odor: A clear liquid with a hydrocarbon odor.

* Physical data vary with fuel type. These data pertain to kerosine jet fuels in general.

Section 4. Fire and Explosion Data

Flash Point: 100 °F (37.8 °C), OC*	**Autoignition Temperature:** 446 °F (230.2 °C)*	**LEL:** 0.6% v/v	**UEL:** 3.7% v/v
Jet A and Jet A-1: 110 to 150 °F (43.4 to 65.6 °C)			
Jet B: -16 to -30 °F (-26.7 to -34.5 °C)			
JP-1: 95 to 145 °F (35.0 to 62.8 °C)	JP-1: 442 °F (228 °C)		
JP-4†: -10 to 30 °F (-23.4 to -1.1 °C)	JP-4: 468 °F (242 °C)	JP-4: 1.3% v/v	JP-4: 8.0% v/v
JP-5: 95 to 145 °F (35.0 to 62.8 °C)	JP-5: 475 °F (246 °C)		

Extinguishing Media: For large fire, use water spray, fog, or foam. For small fires, use dry chemical or CO_2. Water may be ineffective in fighting fires involving materials with low flash points. Apply in the form of a spray.
Unusual Fire or Explosion Hazards: Jet fuel is volatile and combustible.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

*A higher kerosene cut than JP-4 with fewer impurities.
† 65% gasoline and 35% light petroleum distillate.

Section 5. Reactivity Data

Stability/Polymerization: Jet fuels are stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: A violent reaction occurs with fluorine (F_2). Jet fuels are also incompatible with halogens, strong acids, alkalines, and oxidizers.
Conditions to Avoid: Avoid heat, sparks, flame, and build up of static electricity.
Hazardous Products of Decomposition: Thermal oxidative decomposition of jet fuel can produce carbon monoxide from incomplete combustion.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list jet fuels as a carcinogen.
Summary of Risks: Jet fuel is a moderate skin, eye, and respiratory irritant. Ingestion may be harmful or fatal. The most serious toxic effect following ingestion is aspiration pneumonitis.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with chronic pulmonary disease should not be exposed to jet fuel vapor.
Target Organs: Central nervous system, respiratory tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Systemic exposure through the respiratory or gastrointestinal (GI) tract may result in increasing levels of central nervous system depression, manifest by a staggering gait, slurred speech, or mental confusion. These symptoms could progress to unconsciousness, coma, and death from respiratory failure. Exposure of lung tissue through aspiration of liquid jet fuel causes an immediate irritant and destructive reaction. The inflammatory lung changes cause a chemical pneumonitis, pulmonary edema (fluid in the lungs), and/or bleeding in the lung tissue. Secondary infection as a result of the injury, and scarring may occur with resultant permanent lung damage. The immediate clinical effects are increasing shortness of breath, coughing, bloody sputum, and chest pain. These symptoms may worsen over the following hours to days. Ingestion causes irritation to the GI tract characterized by vomiting, abdominal pain, and diarrhea. Other organs possibly injured through systemic exposure include parenchyma of the liver, kidney, pancreas, and spleen. Exposure to high mist concentrations may irritate the mucous membrane.
Chronic Effects: Chronic lung dysfunction may result from aspiration into the lungs. Prolonged or repeated skin contact can cause 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. 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*. If the victim is nauseated, position head lower than knees to prevent aspiration. Administer vegetable oil and call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a jet fuel spill control and countermeasure program (SCCP).* Notify safety personnel, isolate hazard area and deny entry, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and direct contact with skin or eyes. Immediately absorb spilled jet fuel with noncombustible, inert material such as fire-retardent treated sawdust or diatomaceous earth. Using nonsparking tools, immediately shovel spilled material in appropriate containers for disposal. After completing material pickup, ventilate area and wash spill site. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
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, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear nonsparking shoes (rubber, cord, or sewn leather soles).
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: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials (Sec. 5). Outside or detached storage is preferred.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Use with appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Jet fuel's greatest hazard is its fire potential. Train all employees to use fire-extinguishing equipment. Perform fire drill exercises periodically. Take all measures to prevent static electricity: electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. Maintain and test grounding and bonding connections. Do not use drag chains or cables on fueling vehicles. After filling jet fuel storage tanks, wait 30 min before opening hatches to permit the relaxation of any static charges generated during filling or hauling. Empty containers or drums retaining residue (liquid and/or vapor) can be dangerous. Do not expose to heat or ignition sources. All drums should be completely drained, properly bunged, and promptly disposed of per local regulations. Practice good personal hygiene and housekeeping procedures. Take care in handling hoses, cans, and funnels wet with jet fuel. Before touching with bare hands, carefully wipe jet fuel containers. Properly dispose of wet rags per EPA hazardous waste requirements. Avoid contamination of jet fuel with water, rust, scale, dirt, and other petroleum products. Use commercial kits (Hydrokit, Aqua-Glo, or "Clear and Bright") to detect water and dirt, respectively.
Transportation Data (49 CFR 172.101, .102): Not listed

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

Material Safety Data Sheet

from Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 683

POLYCHLORINATED BIPHENYLS
(PCBs)

Issued: November 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: POLYCHLORINATED BIPHENYLS (PCBs)

1
3 0
-
Genium

Description (Origin/Uses): Commercial PCBs are mixtures that were once widely manufactured by combining chlorine gas, iron filings, and biphenyls. Their high stability contributes to their intended commercial applications and their accidental, long-term adverse environmental and health effects. PCBs are useful as insulators in electrical equipment because they are electrically nonconductive. Their distribution has been limited since 1976. The Aroclor PCB codes identify PCBs by type. The first two digits of a code indicate whether the PCB contains chlorinated biphenyls (12), chlorinated terphenyls, (54), or both (25, 44); the last two digits indicate the approximate percentage of chlorine. Found in insulating liquid, synthetic rubber, plasticizers, flame retardants, floor tile, printer's ink, paper and fabric coatings, brake linings, paints, automobile body sealants, asphalt, adhesives, electrical capacitors, electrical transformers, vacuum pumps, gas-transmission turbines, heat-transfer fluids, hydraulic fluids, lubricating and cutting oil, copying paper, carbonless copying paper, and fluorescent light ballasts.

Synonym: Chlorodiphenyls

Other Designations (Producer, Trade Name, Nation): Monsanto, Aroclor® (USA, Great Britain); Bayer, Clophen® (German Democratic Republic); Prodelec, Phenoclor®, Pyralene® (France); Kanegafuchi, Kanechlor®; Mitsubishi, Santotherm® (Japan); Caffaro, Fenclor® (Italy).

Trade Name	CAS No.	*RTECS* No.	Trade Name	CAS No.	*RTECS* No.
Aroclors	01336-36-3	TQ1350000	Aroclor 1242	53469-21-9	TQ1356000
Aroclor 1016	12674-11-2	TQ1351000	Aroclor 1248	12672-29-6	TQ1358000
Aroclor 1221	11104-28-2	TQ1352000	Aroclor 1254	11097-69-1	TQ1360000
Aroclor 1232	11141-16-5	TQ1354000	Aroclor 1260	11096-82-5	TQ1362000

HMIS			
H	1	R	1
F	1	I	3
R	0	S	1
PPG*		K	1

SECTION 2. INGREDIENTS AND HAZARDS/EXPOSURE LIMITS

PCB-42% Chlorine/Aroclor 1242
CAS No. 53469-21-9
OSHA PEL (Skin*)
8-Hr TWA: 1 mg/m^3
ACGIH TLV (Skin*), 1988-89
TLV-TWA: 1 mg/m^3

PCB-54% Chlorine/Aroclor 1254
CAS No. 11097-69-1
OSHA PEL (Skin*)
8-Hr TWA: 0.5 mg/m^3
ACGIH TLV (Skin*), 1988-89
TLV-TWA: 0.5 mg/m^3

All PCBs/Aroclors
CAS No. 1336-36-3
NIOSH REL 1977
10-Hour TWA: 0.001mg/m^3
Toxicity Data**
Mouse, Oral, LD$_{50}$: 1900 mg/kg

*This material can be absorbed through intact skin, which contributes to overall exposure.
**See NIOSH, *RTECS* (Genium ref. 90), at the locations specified in section 1 for additional data with references to tumorigenic, reproductive, mutagenic, and irritative effects.

SECTION 3. PHYSICAL DATA

Boiling Point: Ranges from 527°F (275°C) to 725°F (385°C)
Solubility in Water (%): Insoluble
Pour Point: Ranges from -31°F (-35°C) to 87.8°F (31°C)

% Volatile by Volume: Ranges from 1.2 to 1.6
Molecular Weight (Average): Aroclor 1242: 258 Grams/Mole
Aroclor 1254: 326 Grams/Mole

Appearance and Odor: Clear to light yellow mobile oil to a sticky resin; a sweet "aromatic" odor. As the percentage of chlorine increases, the PCB becomes thicker and heavier; e.g., Aroclor 1254 is more viscous than Aroclor 1242.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	**Autoignition Temperature:** Not Found	**LEL:** Not Found	**UEL:** Not Found

Extinguishing Media: Use water spray/fog, carbon dioxide (CO_2), dry chemical, or "alcohol" foam to extinguish fires that involve polychlorinated biphenyls. Although it is very difficult to ignite PCBs, they are often mixed with more flammable materials (oils, solvents, etc.) **Unusual Fire or Explosion Hazards:** If a transformer containing PCBs is involved in a fire, its owner may be required to report the incident to appropriate authorities. Consult and follow all pertinent Federal, state, and local regulations. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode; fire fighters must also wear a complete set of protective clothing. **Comments:** The hazards of PCB fires are associated with the possibility of their being released into the environment where they and their products of degeneration can pose serious long-term health risks. These potential problems are heightened by the PCBs' resistance to biological and chemical degradation and by the possibility that they will contaminate underground water systems (see sect. 5)

*Ranges from 284°F (140°C) to 392°F (200°C).

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Polychlorinated biphenyls are very stable materials. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs can react dangerously with sodium or potassium. These reactions are part of an industrial process used to destroy PCBs; however, people have been killed by explosions at PCB treatment, storage, and disposal sites. **Conditions to Avoid:** Limit human exposure to PCBs to the lowest possible level; especially avoid contact with skin. **Hazardous Products of Decomposition:** Thermal-oxidative degradation of PCBs can produce toxic gases such as carbon monoxide, chlorine, chlorinated aromatic fragments, phenolics, aldehydes, and hydrogen chloride. Incomplete combustion of PCBs produces toxic compounds such as polychlorinated dibenzofuran (PCDF, the major product of combustion), and polychlorinated dibenzo-*p*-dioxin (PCDD or dioxin).

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: The EPA lists PCBs as carcinogens, and the IARC classifies them as probable human carcinogens (group 2B). **Summary of Risks:** Effects of accidental exposure to PCBs include acneform eruptions; eye discharge; swelling of the upper eyelids and hyperemia of the conjunctiva; hyperpigmentation of skin, nails, and mucous membrane; chloroacne; distinctive hair follicles; fever; hearing difficulties; limb spasms; headache; vomiting; and diarrhea. PCBs are potent liver toxins that can be absorbed through unbroken skin in hazardous amounts without immediately discernible pain or discomfort. Severe health effects can develop later. In experimental animals, prolonged or repeated exposure to PCBs by any route results in liver damage at levels that are less than those reported to have caused cancer in rodents. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, eyelids, blood, liver. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** Skin and eye irritation, acneform dermatitis, nausea, vomiting, abdominal pain, jaundice, liver damage. **Chronic Effects:** Possible cancer (evidence of this is inconclusive); reproductive effects (jaundice, excessive secretion of tears, dermal chromopexy); and hepatitis. **FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for 15 minutes. **Skin.** Rinse exposed skin with flooding amounts of water; wash with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion.** Induce vomiting by sticking your finger to the back of the exposed person's throat. Have him or her drink 1 to 2 glasses of milk or water. **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:** PCBs are poorly metabolized, soluble in lipids, and they accumulate in tissues or organs rich in lipids. Liver function tests can help to determine the extent of body damage in exposed persons. If electrical equipment containing PCBs arcs over, the PCBs or other hydrocarbon dielectric fluids may decompose and give off hydrochloric acid (HCl), a potent respiratory irritant.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: *Treat any accidental release of PCBs as an emergency. An SPCCP (spill-prevention control and countermeasure plan) must be formulated before spills or leaks occur.* PCBs are resistant to biodegradation, soluble in lipids, and chemically stable; as such they have become significant contaminants of global ecosystems. Releases of PCBs require immediate, competent, professional response from trained personnel. *Each release situation is unique and requires a specifically designed cleanup response.* General recommendations include adhering to Federal regulations (40 CFR Part 761). Notify safety personnel, evacuate nonessential personnel, ventilate the spill area, and contain the PCBs. All wastes, residues, and contaminated cleanup equipment from the incident are subject to EPA requirements (40 CFR 761). Consult your attorney or appropriate regulatory officials for information about reporting requirements and disposal procedures. **Waste Disposal:** Contact your hazardous waste disposal firm or a licensed contractor for detailed recommendations, especially when PCBs are unexpectedly discovered. Follow Federal, state, and local regulations. PCBs are biomagnified in the food chain; i.e., their concentration increases at each link. The disposal of PCBs or of PCB-contaminated materials is strictly regulated; violations of applicable laws can result in fines, lawsuits, and negative publicity. **Warning:** Accidental spills of PCBs that may affect water supplies must be reported to Coast Guard personnel at the National Response Center, telephone (202) 426-2675.

OSHA Designations

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

EPA Designations (40 CFR 302.4)

CERCLA Hazardous Substance, Reportable Quantity: 10 lbs (4.54 kg), per the Clean Water Act (CWA), §§ 311 (b) (4) and 307 (a).

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of PCBs is possible, wear a full face shield. Follow OSHA eye- and face-protections regulations (29 CFR 1910.133). **Respirator:** Wear a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets, etc., to prevent any contact of PCBs with your skin. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standards cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contamination 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. Heavily soiled clothing must be properly discarded in a manner consistent with applicable regulations. **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 work areas.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation: Store PCBs in closed containers in a cool, dry, well-ventilated area. Protect containers from physical damage. **Special Handling/Storage:** All storage facilities must have adequate containment systems (dikes; elevated, nonporous holding platforms; retaining walls) to prevent any major release of PCBs into the environment. Carefully design and implement these extra precautions now; do not wait until you have to respond to an accidental release of this material.

Transportation Data (49 CFR 172.101-2; PCBs were the first materials to be directly regulated by Congress by way of TSCA in 1976.)

DOT Shipping Name: Polychlorinated Biphenyls
DOT Hazard Class: ORM-E
ID No. UN 23115
DOT Packaging Requirements: 49 CFR 173.510

IMO Shipping Name: Polychlorinated Biphenyls
IMO Hazard Class: 9
IMDG Packaging Group: II

References: 1, 6, 26, 38, 84-94, 100, 101, 116, 117, 120, 122.

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

Technical Review: Northeast Analytical, Inc. (PCB and VOC Specialists), Schenectady, New York, Telephone: (518) 346-4592

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Material Safety Data Sheets Collection:

Sheet No. 517
Pentachlorophenol

Issued: 10/83 Revision: A, 11/90

Section 1. Material Identification

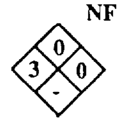
33

Pentachlorophenol (C_6HCl_5O) Description: Derived by chlorination of phenol in the presence of a catalyst. Used as a fungicide, a bactericide, a molluscicide, an algicide, an insecticide (termite control) and herbicide (preharvest defoliant); in sodium pentachlorophenate; in wood preservation (telephone poles, pilings, etc.), wood products, starches, dextrins, and glues. Other registered industrial uses include boat and building construction; treatment of cable coverings, canvas belting, nets, and construction lumber and poles; mold control in petroleum drilling and production; incorporation in paints, pulp, pulp stock, paper, cooling tower water, and hardboard and particle board. Registered homeowner uses include maintenance of boats, trailers, station wagons, siding, fences, and outdoor furniture.
Other Designations: CAS No. 0087-86-5, chlorophen, PCP, penchlorol, penta.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.
Cautions: Pentachlorophenol is *highly toxic by skin absorption, ingestion, and inhalation.* The agent is highly irritating. General metabolism, the heart, the circulatory system, the liver, and the kidneys may be affected.

R	1
I	3
S	2*
K	0

* Skin absorption

NFPA



Dry

Solution†

HMIS		HMIS	
H	3	H	3
F	0	F	2
R	0	R	0
PPG‡		PPG‡	

‡ Sec. 8 ‡ Sec. 8

† PCP is freely soluble in alcohol, ether, and benzene. Depending on medium, PCP's health and flammability hazards increase in solution with such media.

Section 2. Ingredients and Occupational Exposure Limits

Pentachlorophenol, ca 100%*

1989 OSHA PEL
8-hr TWA (skin): 0.5 mg/m^3

1987 IDLH Level
150 mg/m^3

1990-91 ACGIH TLV
TWA (skin): 0.5 mg/m^3

1988 NIOSH REL
None established

1985-86 Toxicity Data†
Rat, oral, LD_{50}: 27 mg/kg ingested affects the vascular (blood pressure elevation), endocrine (hyperglycemia), nutritional, and gross metabolic (body temperature increase) systems
Rat, inhalation, LC_{50}: 355 mg/m^3 inhaled affects behavior (excitement; muscle contraction or spasticity) and respiration (shortness of breath)

* Technical grade pentachlorophenol contains traces of hexa, hepta, and octachlorodibenzo-p-dioxins; hexa, hepta, and octachlorodibenzofurans; and hexachlorobenzene.
† See NIOSH, *RTECS* (SM6300000), for additional irritative, mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 588 to 590 °F (309 to 310 °C),* 592 °F (311 °C) (decomposes)†
Melting Point: 374 °F (190 °C),* 374 °F (190 °C)†
Vapor Pressure: 0.00011 mm Hg at 77 °F (25 °C)
Vapor Density (Air = 1): 9.2

Molecular Weight: 266.35
Specific Gravity (22 °C/4 °C): 1.978
Water Solubility: 14 mg/l at 20 °C

Appearance and Odor: Light brown or tan flake or solid with a phenolic odor and pungent taste. Odor detection is at 1.6 mg/l.

* Pentachlorophenol solution
† Dry pentachlorophenol

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Since pentachlorophenol is noncombustible, use extinguishing media appropriate to the surrounding fire: dry chemical, water spray, carbon dioxide, or foam. Use the water spray to cool fire-exposed containers.
Unusual Fire or Explosion Hazards: When involved in a fire, pentachlorophenol emits toxic fumes. Wood treated with 5% pentachlorophenol solution or pentachlorophenol in petroleum solvents such as mineral spirits or kerosine are combustible.
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. Avoid skin contact. If feasible, remove containers from fire area. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Pentachlorophenol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Pentachlorophenol solutions subjected to sunlight or ultraviolet light undergo photochemical degradation.
Chemical Incompatibilities: Pentachlorophenol is incompatible with strong oxidizers and alkalies.
Conditions to Avoid: Avoid contact with heat and ignition sources (open flame, electric arcs, or hot surfaces) which can cause thermal decomposition.
Hazardous Products of Decomposition: Thermal oxidative decomposition of pentachlorophenol can produce hydrogen chloride, chlorine, and chlorinated hydrocarbons. Prolonged heating above 392 °F (200 °C) produces traces of octachlorodibenzo-para-dioxin.

Section 6. Health Hazard Data

Carcinogenicity: There is animal evidence of an increase in liver and endocrine tumors in some research studies, but not in others. Also, PCP shares some structural similarity to other carcinogens. However, NTP, IARC, and OSHA do not list PCP as a carcinogen. It may be toxic to the fetus, especially during early pregnancy.
Summary of Risks: Airborne exposure is irritating to the eyes, skin, throat, and lungs, and may cause acute and possibly chronic effects (see below). Levels above 1 mg/m^3 may cause cough, sneezing, and tearing of the eyes, especially in unacclimated workers. Skin contact is also irritating and provides an efficient way for the chemical to enter the body and cause systemic poisoning. Skin rashes (dermatitis) including chloracne (a severe and persistent cystic form of acne characterized by blackheads, whiteheads, and yellow cysts) may result from repeated or prolonged contact with even dilute solutions (e.g., 1%). Ingestion may cause severe systemic poisoning.

Continue on next page

Section 6. Health Hazard Data, *continued*

Medical Conditions Aggravated by Long-Term Exposure: Individuals with kidney, liver, endocrine, and metabolic disorders may be at a higher risk from exposure to pentachlorophenol. Consult a physician.
Target Organs: Cardiovascular system, endocrine system, general metabolism, liver, kidneys, respiratory system, eyes, skin, and central nervous system (CNS).
Primary Entry Routes: Inhalation, skin absorption, ingestion, eye contact.
Acute Effects: Acute exposures are irritating and may cause tachycardia (rapid heartbeat), tachypnea (rapid breathing), hypertension (high blood pressure), fevers, muscular weakness, anorexia (loss of appetite), sweating, dizziness, and nausea. Very high doses may cause unconsciousness, seizures (convulsions), or death due to cardiac arrest. The risk of acute poisoning may increase in hot weather.
Chronic Effects: Absorption of PCP and/or its contaminants may cause chloracne. Bronchitis and weight loss may develop. Animal studies suggest that liver and kidney damage may occur.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing with artificial respiration, CPR if necessary, and oxygen if available.
Ingestion: Call a physician or Poison Control Center immediately. Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water, then induce vomiting. If possible, induce vomiting under medical supervision. Do not instill milk or other materials containing vegetable or animal fats since they are likely to enhance absorption.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Severe systemic poisoning results primarily from uncoupling of mitochondrial oxidative phosphorylation, with ensuing hyperpyrexia. Promote heat loss and aggressively manage hyperthermia with physical methods. *Antipyretics (including aspirin), atropine, and phenothiazines are contraindicated.* Force diuresis to reduce body burden. Carefully follow and treat fluid/electrolyte and acid/base alterations. Treat supportively and reduce anxiety. Diagnostic testing should include rectal temperature, PCP urine or plasma levels, blood chemistries (including electrolytes, LFTs, BUN, creatinine), and CBC. Treat ingestion with emesis, gastric lavage, and saline cathartic.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and remove all heat and ignition sources. Cleanup personnel need full protection against vapor inhalation and contact with solution or solid. Collect dry spilled material in a metal container for reclamation or disposal. For liquid spills, collect with an absorbent solid and place in a metal container for disposal. For large liquid spills, dike far ahead of liquid spill to contain. Wash residue with soap and water. Prevent spills from entering sewers, streams, and open waters. Pentachlorophenol is toxic to fish and wildlife. 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), RCRA Waste No. U242
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 10 lb (4.54 kg) [* per Clean Water Act, Sec. 311(b)(4), Sec. 307(a), and per RCRA, Sec. 3001]
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 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, where concentrations of pentachlorophenol exceed or are likely to exceed .5 mg/m^3, wear a NIOSH-approved organic vapor-dust filter type respirator; a full facepiece is needed at concentrations >2.5 mg/m^3. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA; SCBA can be used to 150 mg/m^3. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves (polyvinyl chloride, neoprene or nitrile latex), boots, aprons, and gauntlets to prevent skin contact. Extremely high concentrations may require a full containment suit. Always consult an industrial hygienist.
Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below both OSHA PEL and ACGIH TLV (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. Use separate lockers for street clothes.
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 properly labeled and closed containers in a cool, dry, well-ventilated, low fire hazard area away from heat and ignition sources and combustible materials. Protect containers from physical damage. Outside or detached storage is preferred. Accumulated sludge at the bottom of dipping tanks may concentrate toxic impurities at much higher levels than original product. Do not reuse drums. Clean empty drums, liners, and block wrappings in accordance with 40 CFR 261.7(b)(3) prior to returning for reconditioning, recycling, or other disposal.
Engineering Controls: Educate workers about pentachlorophenol's hazards. Avoid skin contact and vapor or dust inhalation. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures.
Medical Surveillance: Preplacement and periodic medical evaluations should include a complete history and physical examination and a biochemical profile (including LFTs, BUN, creatinine, and electrolytes). Consider baseline pulmonary function tests. Perform biologic monitoring for PCP levels at the end of work shifts (plasma) and toward end of workweek (urine). 24-hr urine collections are more accurate than spot testing.

Transportation Data (49 CFR 172.102)

IMO Shipping Name: Chlorophenols, liquid
IMO Hazard Class: 6.1
ID No.: UN2021
IMO Label: St. Andrews Cross
IMDG Packaging Group: III

IMO Shipping Name: Chlorophenols, solid
IMO Hazard Class: 6.1
ID No.: UN2020
IMO Label: St. Andrews Cross
IMDG Packaging Group: III

MSDS Collection References: 1, 38, 73, 84, 85, 88, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

MALATHION

MLT

Common Synonyms	
Cythion Insecticide	Liquid Yellow to dark brown Skunk-like odor Sinks in water. Freezing point is 37°F.

AVOID CONTACT WITH LIQUID. Keep people away.
Wear chemical protective suit with self-contained breathing apparatus.
Stop discharge if possible.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE AND WHEN HEATED.
Containers may explode in fire.
Wear chemical protective suit with self-contained breathing apparatus.
Extinguish with dry chemical, carbon dioxide, water, or foam.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
Irritating to eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-poison, water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $C_{10}H_{19}O_6PS_2$
3.3 **IMO/UN Designation:** 6.1/2783
3.4 **DOT ID No.:** 2783
3.5 **CAS Registry No.:** 121-75-5

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Yellow to dark brown.
4.3 **Odor:** Characteristic skunk-like mercaptan

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Wear self-contained breathing apparatus (or respirator for organophosphate pesticides) and rubber clothing while fighting fires of malathion with chlorine bleach solution. All clothing contaminated by fumes and vapors must be decontaminated.
5.2 **Symptoms Following Exposure:** Exposure to fumes from a fire or to liquid causes headache, blurred vision, constricted pupils of the eyes, weakness, nausea, cramps, diarrhea, and tightness in the chest. Muscles twitch and convulsions may follow. The symptoms may develop over a period of 8 hours.
5.3 **Treatment of Exposure:** Speed is essential. INHALATION: in the nonbreathing victim immediately institute artificial respiration, using the mouth-to-mouth, the mouth-to-nose, or the mouth-to-oropharyngeal method. Call physician INGESTION: administer milk, water or salt-water and induce vomiting repeatedly. SKIN OR EYE CONTACT: flood and wash exposed skin areas thoroughly with water. Remove contaminated clothing under a shower. Administer atropine, 2 mg(1/30 gr) intramuscularly or intravenously as soon as any local or systemic signs or symptoms of an intoxication are noted; repeat the administration of atropine every 3-8 min. until signs of atropinization (mydriasis, dry mouth, rapid pulse, hot and dry skin) occur; initiate treatment in children with 1 mg of atropine. Watch respiration, and remove bronchial secretions if they appear to be obstructing the airway; intubate if necessary. Give 2-PAM (Pralidoxime; Protopam), 2.5 gm in 100 ml of sterile water or in 5% dextrose and water, intravenously, slowly, in 15-30 min.; if sufficient fluid is not available, give 1 gm of 2-PAM in 3 ml of distilled water by deep intramuscular injection; repeat this every half hour if respiration weakens or if muscle fasciculation or convulsions recur.
5.4 **Threshold Limit Value:** 10 mg/m³
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5g/kg(rat)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** None likely
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.

(Continued)

6. FIRE HAZARDS

6.1 **Flash Point:** >325°F
6.2 **Flammable Limits in Air:** Data not available
6.3 **Fire Extinguishing Agents:** Dry chemical, carbon dioxide, water spray, foam
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Vapors and fumes from fires are hazardous. They include sulfur dioxide and phosphoric acid.
6.6 **Behavior in Fire:** Gives off hazardous fumes. Area surrounding fire should be diked to prevent water runoff.
6.7 **Ignition Temperature:** Data not available
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Data not available
6.10 **Adiabetic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** None
7.2 **Reactivity with Common Materials:** No hazardous reaction
7.3 **Stability During Transport:** Not pertinent
7.4 **Neutralizing Agents for Acids and Caustics:** Liquid bleach solution for decontamination.
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
0.09 ppm/96 hr/bluegill/TL_m/fresh water
0.033-0.063 ppm/96 hr/marine crustacean/LC_{50}
8.2 **Waterfowl Toxicity:** LD_{50} = 1485 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** CYTHION Insecticide; Malathion ULV Concentrate Insecticide. Many powders, dusts, and spray solutions are sold under a variety of trade names.
9.2 **Storage Temperature:** Below 120°F. Decomposition (non-hazardous) occurs at higher temperatures.
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 330.36
12.3 **Boiling Point at 1 atm:** Very high
12.4 **Freezing Point:** 37°F = 2.8°C = 276°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.234 at 25°C (liquid)
12.8 **Liquid Surface Tension:** 37.1 dynes/cm = 0.0371 N/m at 24°C
12.9 **Liquid Water Interfacial Tension:** 19 dynes/cm = 0.019 N/m at 24°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

5. HEALTH HAZARDS (Continued)

5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 5000 mg/m³

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

MALATHION

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
77	77.089	85	.380		NOT PERTINENT	70	45.270
78	77.089	90	.384			72	42.680
79	77.089	95	.389			74	40.260
80	77.089	100	.393			76	37.990
81	77.089	105	.398			78	35.870
82	77.089	110	.402			80	33.880
83	77.089	115	.406			82	32.020
84	77.089	120	.411			84	30.270
85	77.089	125	.415			86	28.620
86	77.089	130	.420			88	27.080
87	77.089	135	.424			90	25.630
88	77.089	140	.429			92	24.270
89	77.089	145	.433			94	22.990
90	77.089	150	.438			96	21.780
91	77.089					98	20.650
92	77.089					100	19.580
93	77.089					102	18.580
94	77.089					104	17.630
95	77.089					106	16.740
96	77.089					108	15.900
97	77.089					110	15.100
98	77.089					112	14.350
99	77.089					114	13.650
100	77.089					116	12.980
101	77.089					118	12.350
102	77.089					120	11.750

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
77.02	.014		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

PARATHION

PTO

Common Synonyms Ethyl parathion Phosphorothioic acid, O, O-diethyl O-p-nitrophenyl ester O, O Diethyl O-(p-nitrophenyl) phosphorothioate	Liquid Light to dark brown Sinks in water. Freezing point is 43°F.

AVOID CONTACT WITH LIQUID AND VAPOR. KEEP PEOPLE AWAY.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	Not flammable. POISONOUS GASES ARE PRODUCED WHEN HEATED.
Exposure	CALL FOR MEDICAL AID. LIQUID **POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.** Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Poison
2.2 **Class:** 6

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not applicable
3.2 **Formula:** $(C_2H_5O)_2PSOC_6H_4NO_2$
3.3 **IMO/UN Designation:** 6.1/2784
3.4 **DOT ID No.:** 2784
3.5 **CAS Registry No.:** 56-38-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Deep brown to yellow
4.3 **Odor:** Characteristic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Neoprene-coated gloves; rubber work shoes or overshoes; latex rubber apron; goggles; respirator or mask approved for toxic dusts and organic vapors
5.2 **Symptoms Following Exposure:** Inhalation of mist, dust, or vapor (or ingestion, or absorption through the skin) cause dizziness, usually accompanied by constriction of the pupils, headache, and tightness of the chest. Nausea, vomiting, abdominal cramps, diarrhea, muscular twitchings, convulsions and possibly death may follow. An increase in salivary and bronchial secretions may result which simulate severe pulmonary edema. Contact with eyes causes irritation.
5.3 **Treatment of Exposure:** Call a doctor for all exposures to this compound. INHALATION: remove victim from exposure immediately; have physician treat with atropine injections until full atropinization; 2-PAM may also be administered by physician. EYES: flush with water immediately after contact for at least 15 min. SKIN: remove all clothing and shoes immediately; quickly wipe off the affected area with a clean cloth; follow immediately with a shower, using plenty of soap. If a complete shower is impossible, wash the affected skin repeatedly with soap and water. INGESTION: if victim is conscious, induce vomiting and repeat until vomit fluid is clear; make victim drink plenty of milk or water; have him lie down and keep warm.
5.4 **Threshold Limit Value:** 0.1 mg/m³
5.5 **Short Term Inhalation Limits:** 0.5 mg/m³ for 30 min.
5.6 **Toxicity by Ingestion:** Grade 4; oral LD_{50} = 2 mg/kg (rat)
5.7 **Late Toxicity:** Birth defects in chick embryos
5.8 **Vapor (Gas) Irritant Characteristics:** Data not available
5.9 **Liquid or Solid Irritant Characteristics:** Data not available
5.10 **Odor Threshold:** 0.04 ppm
5.11 **IDLH Value:** 20 mg/m³

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Water on adjacent fires
6.4 **Fire Extinguishing Agents Not to be Used:** High-pressure water hoses may scatter parathion from broken containers, increasing contamination hazard.
6.5 **Special Hazards of Combustion Products:** Fumes from decomposing material may contain oxides of sulfur and nitrogen.
6.6 **Behavior in Fire:** Containers may explode when heated.
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** Slow reaction, not considered hazardous
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
1.6 ppm/96 hr/minnow/TL_m/fresh water
0.43 ppm/<24 hr/brine shrimp/lethal/salt water
8.2 **Waterfowl Toxicity:** LD_{50} = 2.13 mg/kg
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** No buildup in food chain

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** 98.5+% Sometimes distributed as solutions emulsifiable in water.
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-O-X-Y

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Poison, B
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	4
Flammability (Red)	1
Reactivity (Yellow)	2

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 291.3
12.3 **Boiling Point at 1 atm:** Very high; decomposes
12.4 **Freezing Point:** 43°F = 6°C = 279°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.269 at 25°C (liquid)
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** −9,240 Btu/lb = −5,140 cal/g = −215 X 10^4 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

PTO

PARATHION

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)	Temperature (degrees F)	Centipoise
65	79.379	65	.338	60	.967	65	20.340
70	79.209	70	.339	61	.967	70	18.290
75	79.049	75	.341	62	.967	75	16.480
80	78.879	80	.343	63	.967	80	14.880
85	78.719	85	.345	64	.967	85	13.460
90	78.559	90	.347	65	.967	90	12.200
95	78.400	95	.349	66	.967	95	11.070
100	78.240	100	.350	67	.967	100	10.070
105	78.080	105	.352	68	.967	105	9.173
110	77.929	110	.354	69	.967	110	8.370
115	77.770	115	.356	70	.967	115	7.649
120	77.620	120	.358	71	.967	120	7.001
125	77.459	125	.359	72	.967	125	6.417
		130	.361	73	.967		
				74	.967		
				75	.967		
				76	.967		
				77	.967		

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE REACTS SLOWLY		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

DIAZINON

DZN

Common Synonyms

O, O-Diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate
Alfa-tox
Spectracide
Sarolex

Liquid — Light to dark brown

Sinks in water.

Stop discharge if possible. Keep people away.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES ARE PRODUCED WHEN HEATED.

Exposure

CALL FOR MEDICAL AID.

LIQUID
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, water contaminant, high flammability (if solution)
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $C_{12}H_{21}N_2O_3PS$
3.3 IMO/UN Designation: 6.1/1615
3.4 DOT ID No.: 1615
3.5 CAS Registry No.: 333-41-5

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid or liquid solution
4.2 Color: Amber to dark brown
4.3 Odor: Data not available

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Goggles or face shield; rubber gloves; protective clothing.
5.2 Symptoms Following Exposure: Ingestion or prolonged inhalation of mist causes headache, giddiness, blurred vision, nervousness, weakness, cramps, diarrhea, discomfort in the chest, sweating, miosis, tearing, salivation and other excessive respiratory tract secretion, vomiting, cyanosis, papilledema, uncontrollable muscle twitches, convulsions, coma, loss of reflexes, and loss of sphincter control. Liquid irritates eyes and skin.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; keep warm; get medical attention at once. EYES: flush with plenty of water for at least 15 min. and get medical attention. SKIN: wash contaminated area with soap and water. INGESTION: get medical attention at once; give water slurry of charcoal; do NOT give milk or alcohol.
5.4 Threshold Limit Value: 0.1 mg/m³
5.5 Short Term Inhalation Limits: Not pertinent
5.6 Toxicity by Ingestion: Grade 3; oral LD_{50} = 76 mg/kg (rat)
5.7 Late Toxicity: May be mutagenic
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 82-105°F C.C. (solutions only; pure liquid difficult to burn)
6.2 Flammable Limits in Air: Not pertinent
6.3 Fire Extinguishing Agents: (for solutions) Foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.
6.5 Special Hazards of Combustion Products: Oxides of sulfur and of phosphorus are generated in fires.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not pertinent
6.8 Electrical Hazard: Data not available
6.9 Burning Rate: (for solutions) 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity:
0.025 ppm/96 hr/stonefly nymph/TL_m/fresh water
30 μg/l/48 hr/bluegill/TL_m/fresh water
(becomes bound to soil when used according to directions)
8.2 Waterfowl Toxicity: LD_{50} = 3.54 mg/kg
LC_{50} = 5 days, 90 ppm mallard duck
LC_{50} = 7 days, 66 ppm quail
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical; wettable powders; a variety of emulsifiable solutions in combustible solvents.
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 304.4
12.3 Boiling Point at 1 atm: Very high; decomposes
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.117 at 20°C (liquid)
12.8 Liquid Surface Tension: (est.) 35 dynes/cm = 0.035 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 40 dynes/cm = 0.040 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: (est.) −12,000 Btu/lb = −6,500 cal/g = −270 X 10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

DZN

DIAZINON

12.17 SATURATED LIQUID DENSITY	
Temperature (degrees F)	Pounds per cubic foot (estimate)
52	70.280
54	70.209
56	70.139
58	70.070
60	70.000
62	69.929
64	69.860
66	69.790
68	69.730
70	69.660
72	69.589
74	69.520
76	69.450
78	69.379
80	69.309
82	69.240
84	69.169
86	69.099

12.18 LIQUID HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F (estimate)
51	.400
52	.400
53	.400
54	.400
55	.400
56	.400
57	.400
58	.400
59	.400
60	.400
61	.400
62	.400
63	.400
64	.400
65	.400
66	.400
67	.400
68	.400
69	.400
70	.400
71	.400
72	.400
73	.400
74	.400
75	.400
76	.400

12.19 LIQUID THERMAL CONDUCTIVITY	
Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)
51	1.048
52	1.048
53	1.048
54	1.048
55	1.048
56	1.048
57	1.048
58	1.048
59	1.048
60	1.048
61	1.048
62	1.048
63	1.048
64	1.048
65	1.048
66	1.048
67	1.048
68	1.048
69	1.048
70	1.048
71	1.048
72	1.048
73	1.048
74	1.048
75	1.048
76	1.048

12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Centipoise (estimate)
51	4.064
52	4.005
53	3.948
54	3.892
55	3.836
56	3.782
57	3.729
58	3.677
59	3.625
60	3.575
61	3.525
62	3.476
63	3.428
64	3.381
65	3.335
66	3.290
67	3.245
68	3.201
69	3.158
70	3.116
71	3.074
72	3.033
73	2.993
74	2.954
75	2.915
76	2.877

12.21 SOLUBILITY IN WATER	
Temperature (degrees F)	Pounds per 100 pounds of water
68	.004

12.22 SATURATED VAPOR PRESSURE	
Temperature (degrees F)	Pounds per square inch
	NOT PERTINENT

12.23 SATURATED VAPOR DENSITY	
Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

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Material Safety Data Sheets Collection:

Sheet No. 68
Calcium Hypochlorite

Issued: 7/80 Revision: A, 11/89

Section 1. Material Identification

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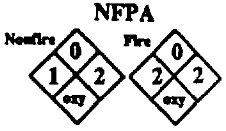
Calcium Hypochlorite Description: Calcium hypochlorite dihydrate precipitates from chlorinated lime slurry and caustic soda and is dried under vacuum to produce calcium hypochlorite. Used as a disinfectant (for swimming pools), bleaching agent (paper towels), fungicide, deodorant, oxidizing agent, bactericide, and algicide; in sugar refining and potable water purification.
Other Designations: Calcium oxychloride (improperly called); losantin; hypochlorous acid; calcium salt; HTH® (high-test hypochlorite); lime chloride; $Ca(OCl)_2$; CAS No. 7778-54-3.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.

R 1
I -
S 3
K -

NFPA



HMIS		HMIS	
H	1	H	2
F	0	F	0
R	2	R	2
PPG*		PPG*	

* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Calcium hypochlorite*

OSHA PEL	ACGIH TLV, 1988-89	NIOSH REL, 1987	Toxicity Data
None established	None established	None established	Rat, oral, LD_{50}: 850 mg/kg

* Concentration is usually stated in terms of weight % of available chlorine (see *ASTM* D2022). This material contains 39% or less available chlorine. Calcium hypochlorite mixture, dry, contains more than 39% available chlorine. HTH® contains about 70% available chlorine. Solid materials with less than 39% available chlorine include chloride of lime and bleaching powder, which contain much chloride ion, water, and possibly other impurities, for example, $Ca(OCl)Cl \cdot 2H_2O$. The presence of magnesium hypochlorite in material of high available chlorine level may reduce its stability.

Section 3. Physical Data

Boiling Point: None reported
Melting Point: Decomposes at 212 °F (100 °C)
Molecular Weight: 142.98 g/mol
Specific Gravity (H_2O = 1 at 39 °F (4 °C)): 2.35
Water Solubility: Soluble

Appearance and Odor: White nonhygroscopic (doesn't absorb moisture from the air) granules or tablets with a strong chlorine odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use a water spray to cool fire-exposed containers of this material and *drench* the area with large amounts of water from a safe position. *Never use* a dry chemical or CO_2.
Unusual Fire or Explosion Hazards: When heated in a fire situation, containers can rupture violently! Contaminating or mixing calcium hypochlorite with foreign materials (combustibles, grease, chemicals, fuels) can cause fires of great intensity. Its solid form is moderately explosive when heated.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Full protective clothing is also necessary. Fight massive fires using unmanned hose holders. If this is impossible, let fire burn and withdraw from hazardous areas.

Section 5. Reactivity Data

Stability/Polymerization: Calcium hypochlorite is stable at room temperature in suitable closed containers when kept dry and free from contamination. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Calcium hypochlorite is a powerful oxidizing agent that readily ignites combustibles. Violent reactions or explosions can occur, for example, with amines, carbon tetrachloride and heat, carbon or charcoal and heat, ethyl alcohol, metal oxides, mercaptons, sulfur, turpentine, strong reducing agents, organic matter, combustible materials, nitromethane, ammonium chloride, N,N-dichloromethylamine and heat, acetic acid and potassium cyanide, ethanol, isobutanethiol, methanol, 1-pro-panethiol, and rust. Reacts with water or steam to produce toxic and corrosive fumes or HCl and Cl^- (Sec. 6). Potentially explosive with sodium carbonate, starch, and sodium hydrogen sulfate. Reaction with nitrogenous bases or acetylene forms explosive products. Ignites on contact with glycerine algacide and hydroxy compounds (e.g., glycerol, diethylene glycol monomethyl ether, and phenol), and organic sulfur compounds. Material containing over 60% available chlorine ignites on contact with lubricating oil (addition of about 20% or more water prevents this). On contact with acids it forms hypochlorous acid and liberates Cl_2 gas. It forms the highly explosive NCl_3 with urea.
Hazardous Products of Decomposition: Rapid exothermic (heat-producing) decomposition above 347 °F(175 °C) releases oxygen and chlorine. When heated to decomposition, calcium hypochlorite emits highly toxic hydrochloric acid (HCl) fumes and explodes.

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists calcium hypochlorite as a carcinogen.
Summary of Risks: This strong oxidizing agent can irritate and damage all the tissue it contacts, with the degree of injury depending on the dose, available chlorine level, and exposure time. The chlorine this compound generates is the primary toxic agent. Both the powder and solutions produce chlorine levels corrosive to body tissues. Inhaling its vapor is extremely irritating and toxic. Possible injuries include: conjunctivitis, blepharitis (inflammation of the margins of the eyelids), corneal ulcerations, gingivitis, contact dermatitis, and tooth damage. **Medical Conditions Aggravated by Long-Term Exposure:** Repeated contact can severely damage tissue. **Target Organs:** Skin, eyes, respiratory system, stomach. **Primary Entry:** Inhalation, ingestion. **Acute Effects:** Skin contact can produce irritation and vesicular eruptions. Dust inhalation irritates the respiratory tract and may cause pulmonary edema. Ingestion irritates the mouth, throat, and stomach, and gastric acid liberates hypochlorous acid. Fatalities can result from severe complications of local injury, shock, toxemia, hemorrage, wall perforation, and obstruction.
Chronic Effects: Eczematoid dermatitis may result from repeated skin contact. Eye contact can cause severe eye damage.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: After rinsing affected area with flooding amounts of water, wash it 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, promptly rinse mouth of conscious person with water before giving large amounts of milk or water to drink, followed by milk of magnesia.
After first aid, get appropriate in-plant, paramedic, or community medical attention and support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spills. Remove combustibles and ignition sources. Those involved in cleanup need protection against contact with the solid and dust inhalation. Prevent dust generation and prevent direct discharge into sewers or waterways since this material, in low concentrations, is toxic to aquatic life. Recover uncontaminated solid material in clean, dry containers. Cover other spilled material with weak reducing agents (3M H_2SO_4 with bisulfites or ferrous salts), slurry it with water, and then flush it with water to a suitable holding tank. Wash spill site well with soap solution containing a weak reducing agent.
Disposal: Use reducing agents to destroy available chlorine. Adjust this reduced liquid's pH to neutral and decant. Discharge neutral liquid, diluting with much water. Dispose of neutral sludge (if any) in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 10 lb (4.54 kg) [* per Clean Water Act, Sec. 311(b)(4)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): 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: Wear a NIOSH-approved respirator if necessary. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. Use a dust respirator as required for dusty conditions.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious neoprene gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by eliminating it at its source (Genium ref. 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. Launder contaminated clothing before wearing. Remove this material from your shoes and 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: Store away from combustible and incompatible materials (Sec. 5) in closed containers in a cool, dry, well-ventilated low fire-risk area. Since traces of water may ignite or detonate this material, prevent contamination and protect containers from physical damage. Do not drop, roll, or skid containers.
Engineering Controls: Calcium hypochlorite, a powerful oxidizing agent, is a dangerous fire hazard when it contacts organic materials. Mix it only with water. These water solutions are unstable, but undergo a slow decomposition. Proper storage and shipping are essential; separate this material from ammonium compounds and heat sources.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Calcium hypochlorite mixture, dry (containing more than 39% available chlorine)
DOT Hazard Class: Oxidizer
ID No.: UN1748
DOT Label: Oxidizer
DOT Packaging Requirements: 49 CFR 173.217
DOT Packaging Exceptions: 49 CFR 173.153

IMO Shipping Name: Calcium hypochlorite mixtures, dry, with more than 39%, available chlorine (8.8% available oxygen)
IMO Hazard Class: 5.1
IMO Label: Oxidizer
IMDG Packaging Group: 2

MSDS Collection References: 1, 81, 84, 85, 90, 91, 101, 109, 126
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** Warren Silverman, MD M7

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 603

2-CHLOROACETOPHENONE

Issued: May 1986

SECTION 1. MATERIAL IDENTIFICATION

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MATERIAL NAME: 2-CHLOROACETOPHENONE

OTHER DESIGNATIONS: alpha-Chloroacetophenone, Chloro Methyl Phenyl Ketone, Mace, Phenacyl Chloride, Phenylchloromethyl Ketone, Phenyl Chloromethyl Ketone, C_8H_7ClO, CAS #0532-27-4.

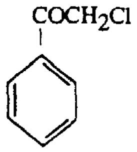
MANUFACTURER/SUPPLIER:
Haarmann & Reimer Corp., Aroma Chemical Div., PO Box 175,
111 US Hwy. 22, N. Springfield, NJ 07081; Telephone: (201) 686-3132

1
2 0
-

HMIS
H: 2
F: 1
R: 1
PPE*
*See Sect. 8

R 1
I 4
S 3
K 1

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
2-Chloroacetophenone, CAS #0532-27-4 COCH$_2$Cl  * Current (1985-86) ACGIH TLV or OSHA PEL.	ca 100	8-hr. TWA: 0.05 ppm or 0.3 mg/m^3* Rat, Oral, LD$_{50}$: 127 mg/m^3 Human, Inhalation, LCLo: 159 mg/m^3/20 min. Human, Inhalation, TCLo: 20 mg/m^3: Irritation Rabbit, Eye: 3 mg, Severe

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm ... 477°F (247°C)
Vapor Pressure @ 20°C, mm Hg ... 0.012
Water Solubility @ 20°C ... Insoluble
Vapor Density (Air = 1) ... 5.32
Evaporation Rate ... Not Found

Specific Gravity (H_2O = 1) ... 1.324
Melting Point ... 138°F (59°C)
Percent Volatile by Volume ... ca 100
Molecular Weight ... 154.60

Appearance and odor: Colorless-to-gray crystalline solid with a sharp, irritating floral odor. The odor threshold for 2-chloroacetetophenone is 0.1 mg/m^3.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
244°F (118°C) CC	Not Found	Not Found	–	–

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, foam, water fog. Water or foam may cause frothing. Use water spray to cool tanks/containers exposed to fire.

This OSHA class IIIB combustible liquid is a slight fire hazard when exposed to heat, sparks, or open flame. When involved in a fire, 2-chloroacetophenone emits toxic and corrosive vapors.
Fire fighters should use self-contained breathing apparatus and fully protective clothing when fighting fires involving this material.

SECTION 5. REACTIVITY DATA

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

This material is incompatible with strong oxidizers. It reacts slowly with water or steam, generating hydrogen chloride.

Thermal decomposition or burning produces toxic vapors and gases such as carbon monoxide and fumes of chlorine.

SECTION 6. HEALTH HAZARD INFORMATION

2-Chloroacetophenone is not listed as a carcinogen by the NTP, IARC, or OSHA.
This material is a potent irritant and lacrimator (promotes tears). It is highly toxic by inhalation and ingestion. Symptoms of overexposure include tingling in the nose, lacrimation, burning of and/or pain in the eyes, blurred vision, rhinorrhea, burning in the chest, difficulty in breathing, and nausea. In extreme cases pulmonary congestion and edema may result, with onset of edema appearing several hours to days after exposure. Humans exposed to levels of 200 to 340 mg/m^3 could not tolerate exposure for more than 30 seconds. 2-Chloroacetophenone is irritating to the skin and intensely irritating to the eyes. Overexposure of eyes can cause severe conjunctivitis; corneal haziness; pain; and, in severe cases, permanent partial opacity (leukoma). Contact with the skin may cause a burn, especially if the skin is moist or wet. It can also cause dermatitis and skin sensitization. The TLV of 0.05 ppm is set to prevent lacrimation and irritation. The irritation threshold for 2-chloroacetophenone ranges from 0.15 to 0.4 mg/m^3, while the lacrimation threshold is 0.3 to 0.4 mg/m^3. No chronic effects are reported. FIRST AID: EYE CONTACT: Promptly flush eyes, including under the eyelids, with running water for at least 15 minutes. Get medical help.* SKIN CONTACT: Promptly flush skin with running water for at least 15 minutes while removing contaminated clothing and shoes. Get medical help if irritation persists.* INHALATION: Remove victim to fresh air. Restore and/or support his breathing as required. Keep him/her warm and quiet. Observe victim for symptoms of pulmonary edema. Get medical help.* INGESTION: Give victim 1 or 2 glasses of water or milk to drink as quickly as possible. Contact a physician or poison control center. Do not induce vomiting unless directed to do so. Never give anything by mouth to someone who is unconscious or is convulsing.*

GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel of large 2-chloroacetophenone spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate the spill area and limit access to necessary personnel only. Remove any leaking containers to a safe place, if feasible. Those involved in cleanup need protection against contact with the solid form and inhalation of dust and vapor (see sect. 8).

Scoop, shovel, or vacuum spilled material into closed containers. Use caution to avoid generating dust. Flush spill area with water and collect flushings and waste water for disposal. Do not flush waste to a sewer, watershed, or waterway.

Place waste in a suitable container for disposal by a licensed contractor, dispose of it in a landfill, or dissolve it in an organic solvent and burn it in an approved incinerator equipped with an afterburner and a scrubber. Follow all Federal, state, and local regulations.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. Ventilation fans and other electrical service must be nonsparking and have an explosion-proof design. Exhaust hoods should have a face velocity of at least 100 lfm (linear feet per minute). For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH-approved respirator.

Impervious gloves, face shield, apron, boots, plastic coveralls, and other protective clothing and equipment should be available and worn as necessary to prevent contact with skin or clothing. Wear safety goggles to prevent any possibility of 2-chloroacetophenone coming in contact with the eyes. Remove contaminated clothing immediately and do not wear it again until it has been properly laundered.

Eyewash stations and safety showers should be readily available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store 2-chloroacetophenone in closed containers in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks, and open flame. Storage area must be suitable for combustible solids. Protect containers from physical damage. Ground and bond conveying equipment and storage containers when transferring the solid to prevent the possibility of a dust explosion. Any bulk storage system should have an explosion-relief design. Do not smoke in use or handling areas. Use only with adequate ventilation. Avoid inhalation of dust and vapor and contact with skin, eyes, and clothing. Practice good industrial hygiene when handling this material. Avoid generating dust. Emptied containers retain product residues; handle them accordingly!
Preplacement and periodic physical examinations should be provided to those who work with this material. Individuals with histories of chronic respiratory, skin, or eye disease may be at increased risk from exposure.

DOT Classification: Irritating Material. DOT No. UN1697
Data Source(s) Code: 2, 4, 5, 7, 8, 23, 34, 47, 63, 69, 75, 78, 79-82. CR

Approvals

Indust. Hygiene/Safety

Medical Review

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    /POISON\
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DATE: 3 Dec 1990
HCSDS NO: 20058A

U.S. ARMY CHEMICAL
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

Emergency Telephone #s:
CRDEC Safety Office
301-671-4411 0700-1700
EST After normal duty
hours: 301-278-5201
Ask for CRDEC Staff
Duty Officer

HD, AND THD (See Addendum A)

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Department of the Army

MANUFACTURER'S ADDRESS:
U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND
CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING CENTER
ATTN: SMCCR-CMS-E
ABERDEEN PROVING GROUND, MD 21010-5423

CAS REGISTRY NUMBER: 505-60-2, 39472-40-7, 68157-62-0

CHEMICAL NAME AND SYNONYMS:

Sulfide, bis (2-chloroethyl)
Bis(beta-chloroethyl)sulfide
Bis(2-chloroethyl)sulfide
1-chloro-2(beta-chloroethylthio)ethane
beta, beta'-dichlorodiethyl sulfide
2,2'dichlorodiethyl sulfide
Di-2-chloroethyl sulfide
beta, beta'-dichloroethyl sulfide
2,2'-dichloroethyl sulfide

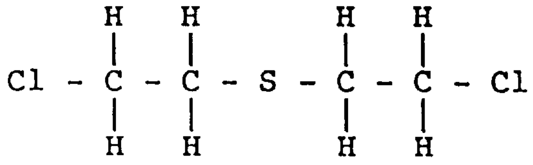
TRADE NAME AND SYNONYMS:

HD
Sulfur mustard
Iprit
Kampstoff "Lost"
Lost
Mustard Gas
Senfgas
S-lost
Sulphur mustard gas
S-yperite
Yellow Cross Liquid
Yperite
H
HS

CHEMICAL FAMILY: chlorinated sulfur compound

FORMULA/CHEMICAL STRUCTURE:

C4(H8)Cl2(S)



$$Cl-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-S-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-Cl$$

NFPA 704 SIGNAL: Health - 4
Flammability- 1
Reactivity- 1

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SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Sulfur Mustard	C4(H8)Cl2(S)	100	0.003 mg/m3 (8 hr-TWA)

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 422 DEG F (217 DEG C)

VAPOR PRESSURE (mm Hg): 0.072 mm Hg @ 20 DEG C (0.11 mm Hg @ 25 DEG C)

VAPOR DENSITY (AIR=1): 5.5

SOLUBILITY IN WATER: Negligible. Soluble in acetone, CH3(Cl), tetrachloroethane, ethylbenzoate, and ether.

SPECIFIC GRAVITY (H2O=1): 1.27 @ 20 DEG C

VOLATILITY: 610 mg/m3 @ 20 DEG C
920 mg/m3 @ 25 DEG C

APPEARANCE AND ODOR: Water clear if pure. Normally pale yellow to black. Slight garlic type odor. The odor threshold for HD is 0.0006 mg/m3

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): 105 DEG C (ignited by large explosive charges)

FLAMMABILITY LIMITS (% by volume): Unknown

EXTINGUISHING MEDIA: Water, fog, foam, CO2. Avoid use of extinguishing methods that will splash or spread mustard.

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving HD should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, firefighting personnel should wear full firefighter protective clothing (without TAP clothing) during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full facepiece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. The M9 or M17 series mask may be worn in lieu of SCBA when there is no danger of oxygen deficiency. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes vice firefighting, they will wear appropriate levels of protective clothing (see Section 8).

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): The AEL for HD is 0.003 mg/m3 as proposed in the USAEHA Technical Guide No. 173, " Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT". No individual should be intentionally exposed to any direct skin or eye contact.

EFFECTS OF OVEREXPOSURE: HD is a vesicant (causing blisters) and alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues which are especially sensitive. The rate of detoxification of HD in the body is very slow and repeated exposures produce a cumulative effect. HD has been found to be a human carcinogen by the International Agency for Research on Cancer (IARC).

Median doses of HD in man are:

LD50 (skin) = 100 mg/kg
ICt50 (skin) = 2000 mg-min/m3 at 70 - 80 DEG F (humid environment)
= 1000 mg-min/m3 at 90 DEG F (dry environment)
ICt50 (eyes) = 200 mg-min/m3
ICt50 (inhalation) = 1500 mg-min/m3 (Ct unchanged with time)
LD50 (oral) = 0.7 mg/kg

aximum safe Ct for skin and eyes are 5 and 2 mg-min/m3, respectively.

ACUTE PHYSIOLOGICAL ACTION OF HD IS CLASSIFIED AS LOCAL AND SYSTEMIC.

LOCALLY, HD affects both the eyes and the skin. SKIN damage occurs after percutaneous resorption. Being lipid soluble, HD can be resorbed into all organs. Skin penetration is rapid without skin irritation. Swelling (blisters) and reddening (erythema) of the skin occurs after a latency period of 4-24 hours following the exposure, depending on degree of exposure and individual sensitivity. The skin healing process is very slow. Tender skin, mucous membrane and perspiration covered skin are more sensitive to the effects of HD. HD's effect on the skin, however, is less than on the eyes. Local action on the eyes produces severe necrotic damage and loss of eyesight. Exposure of eyes to HD vapor or aerosol produces lacrimation, photophobia, and inflammation of the conjunctiva and cornea.

SYSTEMIC ACTIONS occur primarily through inhalation and ingestion. The HD vapor or aerosol is less toxic to the skin or eyes than the liquid form. When inhaled, the upper respiratory tract (nose, throat, trachea) is inflamed after a few hours latency period, accompanied by sneezing, coughing, and bronchitis, loss of appetite, diarrhea, fever, and apathy. Exposure to nearly lethal dose of HD can produce injury to bone marrow, lymph nodes, and spleen as indicated by a drop in WBC count and, therefore, results in increased susceptibility to local and systemic infections. Ingestion of HD will produce severe stomach pains, vomiting, and bloody stools after a 15-20 minute latency period.

CHRONIC EXPOSURE to HD can cause sensitization, chronic lung impairment, (cough, shortness of breath, chest pain), and cancer of the mouth, throat, respiratory tract, skin, and leukemia. It may also cause birth defects.

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION. Remove from the source IMMEDIATELY. If breathing has stopped, give artificial respiration. If breathing is difficult, administer oxygen. Seek medical attention IMMEDIATELY.

EYE CONTACT. Speed in decontaminating the eyes is absolutely essential. Remove person from the liquid source, flush the eyes immediately with water by tilting the head to the side, pulling the eyelids apart with the fingers and pouring water slowly into the eyes. Do not cover eyes with bandages but, if necessary, protect eyes by means of dark or opaque goggles. Transfer the patient to a medical facility IMMEDIATELY.

SKIN CONTACT. Don respiratory protective mask and gloves; remove victim from agent source immediately. Flush skin and clothes with 5 percent solution of sodium hypochlorite or liquid household bleach within one minute. Cut and remove contaminated clothing, flush contaminated skin area again with 5 percent sodium hypochlorite solution, then wash contaminated skin area with soap and water. If shower facilities are available, wash thoroughly and transfer to medical facility. If the skin becomes contaminated with a thickened agent, blot/wipe the material off immediately with an absorbent pad/paper towel prior to using decontaminating solution.

INGESTION. Do not induce vomiting. Give victim milk to drink. Seek medical attention IMMEDIATELY.

SECTION VI - REACTIVITY DATA

STABILITY: Stable at ambient temperatures. Decomposition temperature is 149 DEG C to 177 DEG C. Mustard is a persistent agent depending on pH and moisture, and has been known to remain active for up to three years in soil.

INCOMPATIBILITY: Conditions to avoid. Rapidly corrosive to brass @ 65 DEG C. Will corrode steel at a rate of .0001 in. of steel per month @ 65 DEG C.

HAZARDOUS DECOMPOSITION: Mustard will hydrolyze to form HCl and thiodiglycol.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Only personnel in full protective clothing (see Section 8) will be allowed in an area where mustard is spilled.

RECOMMENDED FIELD PROCEDURES:
The mustard should be contained using vermiculite, diatomaceous earth, clay or fine sand and neutralized as soon as possible using copious amounts of 5.25 percent Sodium Hypochlorite solution.

Scoop up all material and place in an approved DOT container. Cover the contents of the drum with decontaminating solution as above. The exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of the material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

If 5.25 percent Sodium Hypochlorite solution is not available then the following decontaminants may be used instead and are listed in the order of preference: Calcium Hypochlorite, Decontamination Solution No. 2 (DS2), and Super Tropical Bleach Slurry (STB). WARNING: Pure, undiluted Calcium Hypochlorite (HTH) will burn on contact with liquid blister agent.

RECOMMENDED LABORATORY PROCEDURES:
A minimum of 65 grams of decon solution per gram of HD is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour if a single phase is obtained. At the end of 24 hours, the resulting solution shall be adjusted to a pH between 10 and 11. Test for presence of active chlorine by use of acidic potassium iodide solution to give free iodine color. Place 3 ml of the decontaminate in a test tube. Add several crystals of Potassium Iodine and swirl to dissolve. Add 3 ml of 50 wt percent Sulfuric Acid:water and swirl. IMMEDIATE Iodine color indicates the presence of active chlorine. If negative, add additional 5.25 percent Sodium Hypochlorite solution to the decontamination solution, wait two hours, then test again for active chlorine. Continue procedure until positive chlorine is given by solution.

A 10 wt percent Calcium hypochlorite (HTH) mixture may be substituted for Sodium Hypochlorite. Use 65 grams of decon per gram of HD and continue the test as described for Sodium Hypochlorite.

Scoop up all material and place in approved DOT containers. Cover the contents of the drum with decontaminating solution as above. The exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of the material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (see Section 8).

NOTE: Surfaces contaminated with HD and then rinse-decontaminated may evolve sufficient mustard vapor to produce a physiological response.

WASTE DISPOSAL METHOD: All decontaminated material should be collected, contained and chemically decontaminated or thermally decomposed in an EPA approved incinerator, which will filter or scrub toxic by-products from effluent air before discharge to the atmosphere. Any contaminated protective clothing should be decontaminated using HTH or bleach and analyzed to assure it is free of detectable contamination (3X) level. The clothing should then be sealed in plastic bags inside properly labeled drums and held for shipment back to the DA issue point. Decontamination of waste or excess material shall be accomplished in accordance with the procedures outlined above with the following exception:

---- HD on laboratory glassware may be oxidized by its vigorous reaction with concentrated nitric acid.

Open pit burning or burying of HD or items containing or contaminated with HD in any quantity is prohibited.

NOTE: Some states define decontaminated surety material as a RCRA hazardous waste.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration mg/m3	Respiratory Protection/Ensemble Required
Less than or equal to 0.003 as an 8-hr TWA	Protective mask not required provided that: (a) Continuous real-time monitoring (with alarm capability) is conducted in the work area at the 0.003 mg/m3 level of detection. (b) M9, M17 or M40 mask is available and donned if ceiling concentrations exceed 0.003 mg/m3. (c) Exposure has been limited to the extent practicable by engineering controls (remote operations, ventilation, and process isolation) or work practices. If these conditions are not met then the following applies: Full facepiece, chemical canister, air-purifying respiratiors. (The M9, M17, or M40 series or other certified equivalent masks are acceptable for this purpose in conjunction with the M3 toxicological agent protective (TAP) suit for dermal protection.)
Greater than 0.003 as an 8-hr TWA	The Demilitarization Protective Ensemble (DPE), 30 mil, may be used with prior approval from the AMC Field Safety Activity Use time for the 30 mil DPE must be restricted to two hours or less. NOTE: When 30 mil DPE is not available the M9 or M40 series mask with Level A protective ensemble including impregnated innerwear can be used. However, use time shall be restricted to the extent operationally feasible, and may not exceed one hour. As an additional precaution, the cuffs of the sleeves and the legs of the M3 suit shall be taped to the gloves and boots respectively to reduce aspiration.

VENTILATION:

Local Exhaust. Mandatory. Must be filtered or scrubbed.

Special. Chemical laboratory hoods shall have an average inward face velocity of 100 linear feet per minute (lfpm) plus or minus 10% with the velocity at any point not deviating from the average face velocity by more that 20%. Laboratory hoods shall be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test utilizing smoke producing devices shall be performed in assessing the ability of the hood to contain agent HD.

Other. Recirculation of exhaust air from agent areas is prohibited. No connection between agent area and other areas through the ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested semi-annually or after modification or maintenance operations. Operations should be performed 20 cm inside hoods.

PROTECTIVE GLOVES: MANDATORY. Butyl toxicological agent protective gloves (M3, M4, gloveset).

EYE PROTECTION: As a minimum, chemical goggles will be worn. For splash hazard use goggles and face-shield.

OTHER PROTECTIVE EQUIPMENT: Full protective clothing will consist of the M3 butyl rubber suit with hood, M2A1 boots, M3 gloves, impregnated underwear, M9 series mask and coveralls (if desired), or the Demilitarization Protective Ensemble (DPE). For general lab work, gloves and lab coat shall be worn with M9 or M17 mask readily available.

In addition, when handling contaminated lab animals, a daily clean smock, foot covers, and head covers are required.

MONITORING: Available monitoring equipment for agent HD is the M8/M9 detector paper, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAMMS), Automated Continuous Air Monitoring System (ACAMS), CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), and the Miniature Chemical Agent Monitor (MINICAM).

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:
During handling, the "buddy" (two-man) system will be used. Containers should be periodically inspected for leaks, either visually or using a detector kit, and prior to transfering the containers from storage to work areas. Stringent control over all personnel handling HD must be exercised. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Each worker will wash their hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap before leaving at the end of the work day. No smoking, eating, or drinking is permitted at the work site. Decontaminating equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. HD should be stored in containers made of glass for Research, Development, Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent shall be double-contained in liquid-tight containers when in storage.

OTHER PRECAUTIONS: For additional information see AMC-R 385-131, "Safety Regulations for Chemical Agents H, HD, HT, GB and VX" and USAEHA Technical Guide No.173, "Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT".

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquid, n.o.s.

DOT HAZARD CLASS: Poison A

DOT LABEL: Poison Gas

DOT MARKING: Poisonous liquid, n.o.s. (Sulfide, bis 2-chloroethyl)) NA 195

DOT PLACARD: POISON GAS

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: See Sections IV and VIII.

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be placarded regardless of quantity. Driver shall be given full and complete information regarding shipment and conditions in case of emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

While the Chemical Research Development and Engineering Center, Department of the Army believes that the data contained herein are factual and the opinions expressed are those of qualified experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Chemical Research Development and Engineering Center assumes legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

ADDENDUM A
ADDITIONAL INFORMATION FOR THICKENED HD

TRADE NAME AND SYNONYMS: Thickened HD, THD

HAZARDOUS INGREDIENTS: K125 (acryloid copolymer, 5%) is used to thicken HD. K125 is not known to be hazardous except in a finely-divided, powder form.

PHYSICAL DATA: Essentially the same as HD except for viscosity. The viscosity of HV is between 1000 and 1200 centistokes @ 25 DEG C.

FIRE AND EXPLOSION DATA: Same as HD.

HEALTH HAZARD DATA: Same as HD except for skin contact. For skin contact, don respiratory protective mask and remove contaminated clothing IMMEDIATELY. IMMEDIATELY scrape the HV form the skin surface, then wash the contaminated surface with acetone. Seek medical attention IMMEDIATELY.

SPILL, LEAK, AND DISPOSAL PROCEDURES: If spills or leaks of HV occur, follow the same procedures as those for HD, but dissolve the THD in acetone prior to introducing any decontaminating solution. Containment of THD is generally not necessary. Spilled THD can be carefully scraped off the contaminated surface and placed in a fully removable head drum with a high density, polyethylene lining. The THD can then be decontaminated, after it has been dissolved in acetone, using the same procedures used for HD. Contaminated surfaces should be treated with acetone, then decontaminated using the same procedures as those used for HD.

NOTE: Surfaces contaminated with THD or HD and then rinse-decontaminated may evolve sufficient mustard vapor to produce a physiological response.

SPECIAL PROTECTION INFORMATION: Same as HD.

SPECIAL PRECAUTIONS: Same as HD with the following addition. Handling the THD requires careful observation of the "stringers" (elastic, thread-like attachments) formed when the agents are transferred or dispensed. These stringers must be broken cleanly before moving the contaminating device or dispensing device to another location, or unwanted contamination of a working surface will result.

TRANSPORTATION DATA: Same as HD.

DATE: 3 Dec 1990

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U.S. ARMY CHEMICAL
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

Emergency Telephone #s:
CRDEC, Safety Office
301-671-4411 0700-1700
EST After normal duty
hours: 301-278-5201
Ask for CRDEC Staff
Duty Officer

MATERIAL SAFETY DATA SHEET

LETHAL NERVE AGENT (GB)

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Department of the Army

MANUFACTURER'S ADDRESS: U.S. ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING
CENTER
ATTN: SMCCR-CMS
ABERDEEN PROVING GROUND, MD 21010-5423

CAS REGISTRY NUMBER: 107-44-8 or 50642-23-4

CHEMICAL NAME AND SYNONYMS:

Phosphonofluoridic acid, methyl-, isopropyl ester
Phosphonofluoridic acid, methyl-, 1-methylethyl ester

ALTERNATE CHEMICAL NAMES:

Isopropyl methylphosphonofluoridate
Isopropyl ester of methylphosphonofluoridic acid
Methylisopropoxfluorophosphine oxide
Isopropyl Methylfluorophosphonate
O-Isopropyl Methylisopropoxfluorophosphine oxide
O-Isopropyl Methylphosphonofluoridate
Methylfluorophosphonic acid, isopropyl ester
Isopropoxymethylphosphonyl fluoride

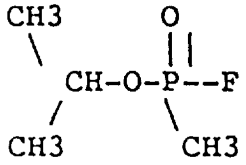
TRADE NAME AND SYNONYMS:

GB Sarin
Zarin

CHEMICAL FAMILY: Fluorinated organophosphorous compound

FORMULA/CHEMICAL STRUCTURE:

C4 H10 FO2 P



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CH3      O
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NFPA 704 SIGNAL: Health - 4 /\

Flammability- 1
Reactivity-   1

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SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
GB	$C_4H_{10}FO_2P$	100	.0001 mg/m3

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 316 (158)

VAPOR PRESSURE (mm Hg): 2.9 @ 25 DEG C

VAPOR DENSITY (AIR=1): 4.86

SOLUBILITY IN WATER: Complete

SPECIFIC GRAVITY (H2O=1): 1.0887 @ 25 DEG C

APPEARANCE AND ODOR: Colorless liquid
Odorless in pure form

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT (METHOD USED): Did not flash to 280 DEG F

FLAMMABLE LIMIT: Not applicable

LOWER EMPLOSIVE LIMIT: Not available

UPPER EXPLOSIVE LIMIT: Not available

EXTINGUISHING MEDIA: Water mist, fog, foam, CO2 - Avoid using extinguishing methods that will cause splashing or spreading of the GB.

SPECIAL FIRE FIGHTING PROCEDURES: GB will react with steam or water to produce toxic & corrosive vapors. All persons not engaged in extinguishing the fire should be evacuated. Fires involving GB should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, firefighting personnel clothing (without TAP clothing) during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full facepiece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. The M9 or M17 series mask may be worn in lieu of SCBA when there is no danger of oxygen deficiency. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes vice firefighting, they will wear appropriate levels of protective clothing (see Section 8).

USUAL FIRE AND EXPLOSION HAZARDS: Hydrogen may be present.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): The suggested permissible airborne exposure concentration for GB for an 8-hour workday or a 40 hour work week is an 8-hour time weight average (TWA) of 0.0001 mg/m3 (2X10-5 ppm). This value is based on the TWA of GB as proposed in the USAEHA Technical Guide No. 169, "Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX". To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated permissible exposure concentration for GB.

EFFECTS OF OVEREXPOSURE:
It is a lethal anticholinergic agent with median dose in man being:

LD50 (Skin) = 24 mg/kg
ICt50 (Skin) = 8000 mg-min/m3
LCt50 (inhalation) = 70 mg-min/m3 (t=0.5-2 min) (inhalation)

*a. One to several minutes after overexposure to airborne GB, the following acute symptoms appear:

(1) Local effects (lasting 1-15 days, increases with dose):

a. On eyes: Miosis (constriction of pupils); redness, pressure and heaviness in and behind the eyes.

b. By inhalation: Rhinorrhea (runny nose), nasal congestion, tightness in chest, wheezing, salivation, nausea, vomiting.

(2) Systemic effects (increases with dose): By inhalation - excessive secretion causing coughing/breathing difficulty; salivation and sweating; vomiting, diarrhea; stomach cramps; involuntary urination/defecation; generalized muscle twitching/muscle cramps; CNS depression including anxiety; restlessness, giddiness, insomnia, excessive dreaming and nightmares. With more severe exposure, also headache, tremor, drowsiness, concentration difficulty, memory impairment, confusion, unsteadiness on standing or walking.

b. After overexposure to liquid GB, the following acute symptoms appear:

(1) Local Effects:

a. On eyes; Miosis, redness, pressure sensation on eyes.

b. By ingestion: Salivation, anorexia, nausea, vomiting, abdominal cramps, diarrhea, involuntary defecation, heartburn.

c. On skin: Sweating, muscle twitching.

(2) Systemic Effects: Similar to generalized effects from exposure to airborn GB.

c. Chronic overexposure to GB causes forgetfulness, thinking difficulty, vision disturbances, muscular aches/pains. Although certain organophosphate pesticides have been shown to be teratogenic in animals, these effects have not been documented in carefully controlled toxicological evaluations for B.

GB is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

** See addendum A for detailed information. **

*EMERGENCY AND FIRST AID PROCEDURES:

INHALATION: Hold breath until respiratory protective mask is donned. If severe signs of agent exposure appear (chest tightens, pupil constriction, incoordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by the local physician). Injections using the MarkI kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. If breathing is difficult, administer oxygen. Seek medical attention IMMEDIATELY.

EYE CONTACT: Immediately flush eyes with water for 10-15 minutes, then on respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken IMMEDIATELY to the medical treatment facility for observation.

SKIN CONTACT: Don respiratory protective mask and remove contaminated clothing. Immediately wash contaminated skin with copious amounts of soap and water, 10% sodium carbonate solution, or 5% liquid household bleach. Rinse well with water to remove decontaminant. Administer an intramuscular injection with the MARK I kit injectors only if local sweating and muscular twitching symptoms are observed. SEEK MEDICAL ATTENTION IMMEDIATELY.

INGESTION: Do not induce vomiting. First symptoms are likely to be gastronintestinal. Immediately administer an intramuscular injection of the MARK I kit auto-injectors. SEEK MEDICAL ATTENTION IMMEDIATELY.

** See addendum B for detailed instructions. **

SECTION VI - REACTIVITY DATA

STABILITY: Stable when pure.

INCOMPATIBILITY: Attacks tin, magnesium, cadmium plated steel, some alumiums. Slight attack on copper, brass, lead, practically no attack on 1020 steel, Inconel & K-monel.

Hydrolyzes to form HF under acid conditions and isopropyl alcohol & polymers under basic conditions.

SECTION VII - SPILL, LEAK AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: If leak or spills occur, only personnel in full protective clothing (see section 8) will remain in area. In case of personnel contamination see section V "Emergency and First Aid Instructions".

RECOMMENDED FIELD PROCEDURES: Spills must be contained by covering with vermiculite, diatomaceous earth clay, fine sand, sponges, and paper or cloth towels. Decontaminate with copious amounts of aqueous Sodium Hydroxide solution (a minimum 10 wt percent). Scoop up all material and place in a fully removable head drum with a high density polyethylene liner. Cover the contents of the drum with decontaminating solution as above before affixing the drum head. After sealing the head, the exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

If 10 wt percent aqueous Sodium Hydroxide solution is not available then the following decontaminants may be used instead and are listed in the order of preference: Decontamination Solution No. 2 (DS2), Sodium Carbonate, and Su- ertropical Bleach Slurry (STB).

RECOMMENDED LABORATORY PROCEDURES: A minimum of 56 grams of decon solution is required for each gram of GB. Decontaminant/agent solution is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour. At the end of the one hour, the resulting solution should be adjusted to a pH greater than 11.5. If the pH is below 11.5, NaOH should be added until a pH above 11.5 can be maintained for 60 minutes.

An alternate solution for the decontamination of GB is 10 wt percent Sodium Carbonate in place of the 10 percent Sodium Hydroxide solution above. Continue with 56 grams of decon to 1 gram of agent. Agitate for one hour but allow three (3) hours for the reaction. The final pH should be adjusted to above 10. It is also permitted to substitute 5.25% Sodium Hypochlorite or 25 wt percent Monoethylamine (MEA) for the 10% Sodium Hydroxide solution above. MEA must be completely dissolved in water prior to addition of the agent. Continue with 56 grams of decon for each gram of GB and provide agitation for one hour. Continue with same ratios and time stipulations.

Scoop up all material and place in a fully removable head drum with a high density polyethylene liner. Cover the contents of the drum with decontaminating solution as above before affixing the drum head. After sealing the head, the exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

WASTE DISPOSAL METHOD: Open pit burning or burying of GB or items containing or contaminated with GB in any quantity is prohibited. The detoxified GB using procedures above) can be thermally destroyed by incineration in an EPA approved incinerator in accordance with appropriate provisions of Federal, state and local RCRA regulations.

NOTE: Some states define decontaminated surety material as a RCRA Hazardous waste.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration	Respiratory Protective Equipment
< .0001 mg/m3	M9, M17, or M40 series mask shall be available this purpose.
.0001 to 0.2 mg/m3	M9, or M40 series mask with Level A or Level B ensemble (see AMCR 385-131 for determination of appropriate level). Demilitarization Protective Ensemble (DPE), or Toxicological Agent Protective Ensemble Self-Contained (TAPES), used with prior approval from AMC Field Safety Activity.
> 0.2 mg/m3 or unknown	DPE or TAPES used with prior approval from AMC Field Safety Activity. NOTE: When DPE or TAPES is not available the M9 or M40 series mask with Level A protective ensemble can be used. However, use time shall be restricted to the extent operationally feasible, and may not exceed one hour. As an additional precaution, the cuffs of the sleeves and the legs of the M3 suit shall be taped to the gloves and boots respectively to reduce aspiration.

VENTILATION: Local Exhaust: Mandatory must be filtered or scrubbed to limit exit concentration to < .0001 mg/m3 averaged over 8 hr/day indefinitely.

SPECIAL: Chemical laboratory hoods shall have an average inward face velocity of 100 linear feet per minute (lfpm) plus or minus 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Laboratory hoods shall be located such that cross drafts do not exceed 20 percent of the inward face velocity. A visual performance test utilizing smoke producing devices shall be performed in the assessment of the hood's ability to contain agent GB. Emergency backup power necessary. Hoods should be tested semi-annually or after modification or maintenance operations. Operations should be performed 20 cm inside hood face.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection is allowed between agent areas and other areas through ventilation system.

PROTECTIVE GLOVES: Butyl Glove M3 and M4
Norton, Chemical Protective Glove Set

EYE PROTECTION: Chemical goggles. For splash hazards use goggles and faceshield.

OTHER PROTECTIVE EQUIPMENT: Full protective clothing will consist of the M3 Butyl rubber suit with hood, M2A1 boots, M3 gloves, coveralls, fatigues, or similar (with drawers and undershirt) and socks, M9 mask or the Demilitarization Protective Ensemble (DPE). For general lab work, gloves and lab coat shall be worn with M9 or M17 mask readily available.

MONITORING: Available monitoring equipment for agent GB is the M8/M9 Detector paper, detector ticket, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automatic Continuous Air Monitoring System (ACAMS), real time monitoring (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A2, Hydrogen Flame Photometric Emission Detector (HYFED), CAM-M1, and Miniature Chemical Agent Monitor (MINICAM).

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:
In handling, the buddy system will be incorporated. No smoking, eating and drinking in areas containing agent is permitted. Containers should be periodically inspected for leaks (either visually or by a detector kit). tringent control over all personnel practices must be exercised. Decontamination equip shall be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eye-wash stations, and personal cleanliness facilities must be provided. Wash hands before meals and each worker will shower thoroughly with special attention given to hair, face, neck, and hands, using plenty of soap before leaving at the end of the work day.

OTHER PRECAUTIONS: Agents must be double contained in liquid and vapor tight containers when in storage or when outside of ventilation hood.

For additional information see "AMC-R 385-131, Safety Regulations for Chemical Agents H, HD, HT, GB, and VX" and "USAEHA Technical Guide No. 169, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX".

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquid, n.o.s.

DOT HAZARD CLASSIFICATION: Poison A

DOT LABEL: Poison Gas

OT MARKING: Poisonous liquid, n.o.s. (Isopropyl methylphosphonofluoridate)
NA1955

DOT PLACARD: POISON GAS

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be placarded regardless of quantity. Driver shall be given full and complete information regarding shipment and conditions in case of emergency.

50-6 deals specifically with the shipment of chemical agents. Shipments of agent will be escorted in accordance with AR 740-32.

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: See sections IV, VII, and VIII.

While the Chemical Research, Development and Engineering Center, Dept. of the Army believes that the data contained herein are factual and the opinion expressed are those of qualified experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Chemical Research, Development and Engineering Center assumes legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

ADDENDUM A

1. Acute Physiological Effects:

Site of Action	Signs and Sympotoms
	Following Local Exposure
Muscarine-like-	
Pupils	Miosis, marked, usually maximal (pinpoint), sometimes unequal.
Ciliary body	Frontal headache, eye pain on focusing, slight dimness of vision, occasional nausea and vomiting.
Conjunctivae	Hyperemia.
Nasal mucous membranes	Rhinorrhea, hyperemia.
Bronchial tree	Tightness in chest, sometimes with prolonged wheezing expiration suggestive of broncho-constriction or increased secretion, cough.
	Following Systemic Absorption
Bronchial tree	Tightness in chest, with prolonged wheezing, expiration suggestive broncho-constriction or increased secretion, dyspnea, slight pain in chest, increase bronchial secretion,

	cough, pulmonary edema, cyanosis.
Gastrointestinal	Anorexia, nausea, vomiting, abdomina cramps, epigastric and substernal tightness (cardiospasm) with "heartburn" and eructation, diarrhea, tenesmus, involuntary defecation.
Sweat glands	Increased sweating.
Salivary glands	Increased salivation.
Lacrimal glands	Increased lacrimation.
Heart	Slight bradycardia.
Pupils	Slight miosis, occasionally unequal, later maximal miosis (pinpoint).
Ciliary body	Blurring of vision.
Bladder	Frequency, involuntary micturition
Nicotine-like-	
Striated muscle	Easy fatigue, mild weakness, muscula twitching, fasciculations, cramps, generalized weakness, including muscles of respiration, with dyspnea and cyanosis.
Sympathetic ganglia	Pallor, occasional elevation of bloc pressure.
Central nervous system	Giddiness, tension, anxiety, jitteriness, restlessness, emotional lability, excessive dreaming, insomnia, nightmares, headaches, tremor, withdrawal and depression, bursts of slow waves of elevated voltage in EEG, especially on overventilation, drowsiness, difficult concentration, slowness on recall, confusion, slurred speech, ataxia, generalized weakness, coma, with absence of reflexes, Cheyne-Stokes respirations, convulsions, depression of respiratory and circulatory centers, with dyspnea cyanosis, and fall in blood pressure.

2. Chronic Physiological Effects:

a. Acute Exposure.

If recovery from nerve agent poisoning occurs, it will be complete unless anoxia or convulsions have gone unchecked so long that irreversible central nervous system changes due to anoxemia have occurred.

b. Chronic Exposure.

The inhibition of cholinesterase enzymes throughout the body by nerve ents is more or less irreversible so that their effects are prolonged. ntil the tissue cholinesterase enzymes are restored to normal activity, probably by very slow regeneration over a period of weeks or 2 to 3 months if damage is severe, there is a period of increased susceptibility to the effect of another exposure to any nerve agent. During this period the effects of repeated exposures are cumulative; after a single exposure, daily exposure to concentrations of a nerve agent insufficient to product symptoms may result i the onset of symptoms after several days. Continued daily exposure may be followed by increasingly severe effects. After symptoms subside, increased susceptibility persists for one to several days. The degree of exposure required to produce recurrence of symptoms, and the severity of these symptoms, depend on duration of exposure and time intervals between exposures. Increased susceptibility is not limited to the particular nerve agent initially absorbed.

Estimates have been made for the times at which 50% of exposed subjects would be affected (Et50's) at median incapacitating doses. These are presented below.

Et50	Degree of Effectiveness	ICt50	Exposure Time
in		mg min/m3	min
1.5	Moderate	27	0.5
3.0	Incap.	27	2.0
6.0		40	10.0
1.0	Severe	37	0.5
3.8	Incap.	37	2.0
7.8		56	10.0
2.0	Very	47	0.5
4.5	Severe	47	2.0
9.5	Incap.	72	10.0
6.5	Death	70	0.5
9.0		70	2.0
13.5		103	10.0

Exposure to high concentrations of nerve agent may bring on incoordination, mental confusion and collaspe so rapidly that the casualty cannont perform self-aid. If this happens, the man nearest to him will give first aid.

Onset Time of Symptoms.

When Effects

Types of Effects	Route of Absorption	Description of Effects	Appear After Exposure
Vapor Local	Lungs	Rhinorrhea, nasal hyperemia tightness in chest, wheezing	One to several minutes
Vapor Local	Eyes	Miosis, Conjunctival hyperemia eye pain, frontal headache.	One to several minutes
Vapor Systemic	Lungs or eyes	Muscarine-like, nicotine-like and central nervous system effects. (See 2a above)	Less than 1 min to a few min after moderate or marked exposoure; about 30 min after mild exposure.
Liquid Local	Eyes	Same as vapor effects.	Instantly
Liquid Local	Ingestion	Gastrointestinal. (See 2a above).	About 30 min. after ingestion
Liquid Local	Skin	Local sweating and muscular twitching.	3 min to 2 hour
Liquid Systemic	Lungs	See 2a above.	Several minutes
Liquid Systemic	Eyes	Same as for vapor	Several minutes
Liquid Systemic	Skin	Generalized sweating.	15 minutes to 2 hours
Liquid Systemic	Ingestion	Gastrointestinal (See 2a above).	15 minutes to 2 hours

Onset Time of Symptoms. (cont'd)

Types of Effects	Route of Absorption	Duration of Effects After Mild Exposure	Duration of Effects After Severe Exposure
Vapor Local	Lungs	A few hours	1 to 2 days
Vapor Local	Eyes	Miosis - 24 hours	3 to 14 days 2 to 5 days
Vapor Systemic	Lungs or eyes	Several hours	8 days
Liquid Local	Eyes	Similar to effects of vapor	

Liquid Local	Ingestion	3 days	5 days
Liquid Local	Skin	3 days	5 days
Liquid Systemic	Lungs		1 to 5 days
Liquid Systemic	Eyes		2 to 4 days
Liquid Systemic	Skin		2 to 5 days
Liquid Systemic	Ingestion		3 to 5 days

ADDENDUM B

First aid procedures.

a. Exposed personnel will be removed immediately to an uncontaminated atmosphere. Personnel handling casualty cases will give consideration to their own safety and will take precautions and employ the prerequisite protective equipment to avoid becoming exposed themselves.

CAUTION: Due to the rapid effects of nerve agents, it is extremely important that decontamination of personnel not be delayed by attempting to blot off excessive agent prior to decontamination with sodium hypochlorite.

b. The casualty will then be decontaminated by washing the contaminated areas with commercial liquid household bleach (nominal 5% solution hypochlorite or 10 percent sodium carbonate solution) and flushing with clean water to remove excess bleach followed by copious soap and water wash. Mask will be left on the victim until decontamination has been completed unless it has been determined that areas of the face were contaminated and the mask must be removed to facilitate decontamination. After decontamination, the contaminated clothing will be removed and skin contamination washed away. If possible, decontamination will be completed before the casualty is taken to the aid station or medical facility.

CAUTION: Care must be taken when decontaminating facial areas to avoid getting the hypochlorite into the eye or mouth. Only clean water shall be used when flushing the eyes or mouth. Skin surfaces decontaminated with bleach should be thoroughly flushed with water to prevent skin irritation from the bleach.

c. If there is no apparent breathing, artifical resuscitation will be started immediately (mouth-to-mouth, or with mechanical resuscitator). The situation will dictate method of choice, e.g., contaminated face. Do not use mouth-to-mouth resuscitation when facial contamination exists. When appropriate and when trained personnel are available, cardiopulmonary resuscitation (CPR) may be necessary.

d. An individual who has received a known agent exposure or who exhibits definite signs or symptoms of agent exposure shall be given an intramuscular injection immediately with the MARK I kit auto-injectors.

(1) Some of the early symptoms of a vapor exposure may be rhinorrhea (runny nose) and/or tightness in the chest with shortness of breath (bronchial constriction).

(2) Some of the early symptoms of a percutaneous exposure may be local muscular twitching or sweating at the area of exposure followed by nausea or vomiting.

(3) Although myosis (pin-pointing of the pupils) may be an early sign of agent exposure, an injection shall not be administered when myosis is the only sign present. Instead, the individual shall be taken immediately to the medical facility for observation.

(4) Injections using the MARK I kit injectors (or atropine only if directed by the local physician) may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections shall be given unless directed by the physician-in-charge. In addition, a record shall be maintained of all injections given.

(5) Administer, in rapid succession, all three MARK I kit injectors (or atropine if directed by the local physician) in the case of SEVERE signs of agent exposure.

e. If indicated, CPR should be started immediately. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists.

CAUTION: Atropine does not act as a prophylactic and shall not be administered until an agent exposure has been ascertained.

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  /POISON\
  \ GAS  /
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U.S. ARMY CHEMICAL
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

MATERIAL SAFETY DATA SHEET

DATE: 3 Dec 1990

Emergency Telephone #s:
CRDEC Safety Office
301-671-4411 0700-1700
EST After normal duty
hours: 301-278-5201
Ask for CRDEC Staff
Duty Officer

LETHAL NERVE AGENT (VX)

SECTION I - GENERAL INFORMATION

MANUFACTURER'S ADDRESS: U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND
CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING
CENTER
ATTN: SMCCR-CMS-E
ABERDEEN PROVING GROUND, MD 21010-5423

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U.S. ARMY CHEMICAL
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

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LETHAL NERVE AGENT (VX)

SECTION I - GENERAL INFORMATION

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U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND
CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING CENTER
ATTN: SMCCR-CMS-E
ABERDEEN PROVING GROUND, MD 21010-5423

CAS REGISTRY NUMBER: 50782-69-9, 51848-47-6, 53800-40-1, 70938-84-0

CHEMICAL NAME:
Phosphonothioic acid, methyl-, S-(2-bis(1-methylethylamino)ethyl) O-ethyl ester
O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothioate
S-2-Diisopropylaminoethyl O-ethyl methylphosphonothioate
-2(2-Diisopropylamino)ethyl) O-ethyl methylphosphonothiolate
O-ethyl S-(2-diisoproplyaminoethy) methylphosphonothioate
O-ethyl S-(2-diisoproplyaminoethy) methylthiolphosphonoate

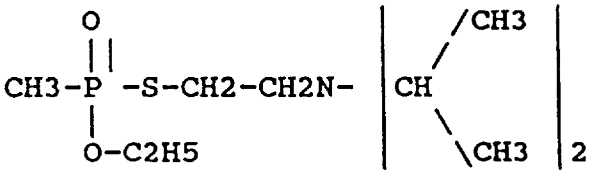
TRADE NAME AND SYNONYMS:

VX
EA 1701
TX60

CHEMICAL FAMILY: sulfinated organophosphorus compound

FORMULA/CHEMICAL STRUCTURE:

$C_{11}\ H_{26}\ N\ O_2\ P\ S$



$$CH_3-\underset{O-C_2H_5}{\overset{\overset{O}{||}}{P}}-S-CH_2-CH_2N-\left|CH\begin{matrix}/CH_3\\ \backslash CH_3\end{matrix}\right|_2$$

NFPA 704 SIGNAL:
Health - 4
Flammability - 1
Reactivity- 1

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SECTION II - COMPOSITION

NAME		BY WEIGHT	LIMIT
VX	$C_{11}H_{26}NO_2PS$	100%	.00001 mg/m3

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 568 (298)

VAPOR PRESSURE (mm Hg): 0.0007 @ 25 Deg C

VAPOR DENSITY (AIR=1): 9.2

SOLUBILITY IN WATER: moderate

APPEARANCE AND ODOR: Colorless to straw colored liquid & odorless, similar in appearance to motor oil.

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT: 159 Deg C (McCutchan - Young)

FLAMMABILITY LIMITS (% by volume): Not Available

LOWER EXPLOSIVE LIMIT: Not Applicable

UPPER EXPLOSIVE LIMIT: Not Applicable

EXTINGUISHING MEDIA: Water mist, fog, foam, CO_2. Avoid using extinguishing methods that will cause splashing or spreading of the VX.

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving VX should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, firefighting personnel should wear full firefighter protective clothing (without TAP clothing) during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full facepiece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief of chemical accident/incident (CAI) operations officer. The M9 or M17 series mask may be worn in lieu of SCBA when there is no danger of oxygen deficiency. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes vice firefighting, they will wear appropriate levels of protective clothing (see Section 8).

Do not breathe fumes. Skin contact with V-agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminated other areas or sewers. Contact with VX or VX vapors can be fatal.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None known.

SECTION V - HEALTH HAZARD DATA

8-hour workday of a 40-hour work week is an 8-hour time weighted average (TWA) of 0.00001 mg/m3 (9X10-7 ppm). This value is based on the TWA of VX as proposed in the USAEHA Technical Guide 169, "Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX". To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated permissible exposure concentration for VX.

VX is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

EFFECTS OF OVEREXPOSURE: VX is a lethal anticholinergic agent with median dose in man being: LD50 (Skin) = 0.135 mg/kg; ID50 (Skin) - 0.07 - 0.71 mg/kg; LCt50 (inhalation) = 30 mg min/m3; LCt50 (inhalation) - 24 mg min/m3.

a. One to several minutes after overexposure to airborne VX, the following acute symptoms appear:

(1) Local effects (lasting 1-15 days, increases with dose):

(a) On Eyes: Miosis (constriction of pupils); redness, pressure sensation on eyes.

(b) By Inhalation: Rhinorrhea (runny nose), nasal congestion, tightness in chest, wheezing, salivation, nausea, vomiting.

(2) Systemic Effects (increases with dose): By Inhalation - excessive secretion causing coughing/breathing difficulty; salivation and sweating; vomiting, diarrhea; stomach cramps; involuntary urination/defecation; generalized muscle twitching/muscle cramps; CNS depression including anxiety, restlessness, giddiness, insomnia, excessive dreaming and nightmares. With more severe exposure, also headache, tremor, drowsiness, concentration difficulty, memory impairment, confusion, unsteadiness on standing or walking.

b. After overexposure to liquid VX, the following acute symptoms appear:

(1) Local Effects

(a) On Eyes: Miosis, redness, pressure sensation on eyes.

(b) By Ingestion: Salivation, anorexia, nausea, vomiting, abdominal cramps, diarrhea, involuntary defecation, heartburn.

(c) On Skin: sweating, muscle twitching.

(2) Systemic Effects: similar to generalized effects from exposure to airborne VX.

c. Chronic overexposure to VX causes forgetfulness, thinking difficulty, vision disturbances, muscular aches/pains. Although cer- rganophosphate pesticides have been shown to be teratogenic in animals, these effects have not been documented in carefully controlled toxicological evaluations for VX.

** See Addendum A for detailed information. **

EMERGENCY AND FIRST AID PROCEDURES:

severe signs of agent exposure appear (chest tightens, pupil constriction, incoordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by the local physician). Injections using the Mark I kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. If breathing is difficult, administer oxygen. Seek medical attention IMMEDIATELY.

EYE CONTACT: IMMEDIATELY flush eyes with water for 10-15 minutes, then don respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken IMMEDIATELY to the medical treatment facility for observation.

SKIN CONTACT: Don respiratory protective mask and remove contaminated clothing. Immediately wash contaminated skin with a solution of 5% househould bleach, rinse well with water to remove excess bleach followed by copious soap and water wash. Administer nerve agent antidote kit, Mark I, only if local sweating and muscular twitching symptoms are observed. Seek medical attention IMMEDIATELY.

INGESTION: Do not induce vomiting. First symptoms are likely to be gastrointestinal. IMMEDIATELY administer Nerve Agent Antidote Kit, Mark I. Seek medical attention IMMEDIATELY.

** See Addendum B for detailed instructions. **

SECTION VI - REACTIVITY DATA

STABILITY: Relatively stable at room temperature. Unstabilized VX of 95% purity decomposed at a rate of 5% a month at 71 Deg C.

HAZARDOUS DECOMPOSITION PRODUCTS: During basic hydrolysis of VX up to about 10% of the agent is converted to EA2192 (diisopropylaminoethyl methylphosphonothioic acid). Based on the concentration of EA2192 expected to be formed during hydrolysis and its toxicity (1.4 mg/kg dermal in rabbit at 24 hours in a 10/90 wt% ethanol/water solution), a Class B poison would result.

The large scale decon procedure, which uses both HTH and NaOH, destroys VX by oxidation and hydrolysis. Typically the large scale product contains 0.2 - 0.4 wt% EA2192 at 24 hours. At pH 12, the EA2192 in the large scale product has a half-life of about 14 days. Thus the 90 day holding period at pH 12 results in about a 64-fold reduction of EA2192 (six half-lives). This holding period has been shown to be sufficient to reduce the toxicity of the product below that of a Class B poison.

Other less toxic products are ethyl methylphosphonic acid, methylphosphinic acid, diisopropylaminoethyl mercaptan, diethyl methylphosphonate, and ethanol.

The small scale decontamination procedure uses sufficient HTH to oxidize all VX thus no EA2192 is formed.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
If leaks or spills occur, only personnel in full protective clothing (See Section 8) will remain in area. In case of personnel contamination see Section V "Emergency and First Aid Instructions". Spills must be contained by covering with vermiculite, diatomaceous earth, clay or fine sand. This containment is followed by the following treatment:

RECOMMENDED LABORATORY PROCEDURES (For Quantities less than 50 grams):
If the active chlorine of the Calcium Hypochlorite (HTH) is at least 55 percent, then 80 grams of a 10 percent slurry is required for each gram of VX. Proportionally more HTH is required if the chlorine activity of the HTH is lower than 55 percent. The mixture is agitated as the VX is added and the agitation is maintained for a minimum of one hour. If phasing of the VX/decon solution continues after 5 minutes, an amount of denatured ethanol equal to a 10 wt percent of the total agent/decon shall be added to assist miscibility. NOTE: ETHANOL SHOULD BE MINIMIZED TO PREVENT THE FORMATION OF A HAZARDOUS WASTE. Upon completion of the one hour agitation the decon mixture shall be adjusted to a pH between 10 and 11. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

RECOMMENDED FIELD PROCEDURES (For Quantities greater than 50 grams):
(NOTE: These procedures can only be used with the approval of the CRDEC Safety Office.)

An alcoholic HTH mixture is prepared by adding 100 milliliters of denatured ethanol to a 900 milliliter slurry of 10 percent HTH in water. This mixture should be make just prior to use since the HTH can react with the ethanol. Fourteen grams of alcoholic HTH solution is used for each gram of VX. Agitate the decontamination mixture as the VX is added. Continue the agitation for a minimum of one hour. This reaction is reasonable exothermic and evolves substantial off gassing. The evolved reaction gases should be routed through a decontaminate filled scrubber prior to release through filtration systems. After completion of the one hour minimum agitation, 10 percent Sodium Hydroxide is added in a quantity equal to that necessary to assure that a pH of 12.5 is maintained for a period not less than 24 hours. Hold the material at a pH between 10 and 12 for a period not less than 90 days to ensure that a hazardous intermediate material is not formed.

After sealing the head, the exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

If the alcoholic Calcium Hypochlorite (HTH) mixture is not available then the following decontaminants may be used instead and are listed in the order of preference: Decontamination solution No. 2 (DS2), Supertropical Bleach Slurry (STB), and Sodium Hypochlorite.

WASTE DISPOSAL METHOD: Open pit burning or burying of VX or items containing or contaminated with VX in any quantity is prohibited. The detoxified VX (using procedures above) can be thermally destroyed by inciner-

NOTE: Some states define decontaminated surety material as a RCRA Hazardous Waste.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

VX CONCENTRATION	RESPIRATORY PROTECTIVE EQUIPMENT
Less than 0.00001 mg/m3	M9, M17, or M40 series mask shall be available for escape as necessary.
0.00001 mg/m3 to 0.02 mg/m3	M9 or M40 series mask with Level A or Level B protective ensemble (see AMCR 385-131 for determination of appropriate level). Demilitarization Protective Ensemble (DPE) or Toxicological Agent Protective Ensemble Self-Contained (TAPES), used with prior approval from AMC Field Safety Activity.
Greater than 0.02 mg/m3 or unknown	DPE or TAPES used with prior approval from AMC Field Safety Activity. NOTE: When DPE or TAPES is not available the M9 or M40 series mask with Level A protective ensemble can be used. However, use time shall be restricted to the extent operationally feasible, and may not exceed one hour. As an additional precaution, the cuffs of the sleeves and the legs of the M3 suit shal be taped to the gloves and boots to reduce aspiration.

Local exhaust: Must be filtered or scrubbed to limit exit conc. to .00001 mg/m3.

Special: Chemical laboratory hoods shall have an average inward face velocity of 100 linear feet per minute (lfpm) + 10 percent with the velocity at any point not deviating from the average face velocity by more than 20 percent. Laboratory hoods shall be located such that cross-drafts do not exceed 20 percent of the inward face velocity. A visual performance test utilizing smoke-producing devices shall be performed in assessing the ability of the hood to contain agent VX.

Emergency backup power necessary. Hoods should be tested semi-annually or after modification or maintenance operations. Operations should be performed 20 cm inside hood face.

Other: Recirculation or exhaust air from agent areas is prohibited. No connection between agent areas and other areas through ventilation system is permitted.

PROTECTIVE GLOVES: Butyl glove M3 and M4
Norton, Chemical Protective Glove Set

OTHER PROTECTIVE EQUIPMENT: Full protective clothing will consist of M9 mask and hood, M3 butyl rubber suit, M2A1 butyl boots, M3 or M4 gloves, nimpregnated underwear; or demilitarization protective ensemble (DPE). For aboratory operations, wear lab coats, gloves and mask readily available.

In addition, daily clean smock, foot covers, and head covers will be required when handling contaminated lab animals.

MONITORING: Available monitoring equipment for agent HD is the M8/M9 detector paper, detector ticket, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAMMS), Automated Continuous Air Monitoring System (ACAMS), Real-Time Monitor (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A1, CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), and the Miniature Chemical Agent Monitor (MINICAM).

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: In handling, the buddy system will be incorporated. No smoking, eating, and drinking in areas containing agent is permitted. Containers should be periodically inspected for leaks (either visually or by a detector kit). Stringent control over all personnel practices must be exercised. Decontamination equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eye-wash stations and personal cleanliness facilities must be provided. Wash hands before meals and each worker will shower thoroughly with special attention given to air, face, neck, and hands, using plenty of soap before leaving at the end of the workday.

OTHER PRECAUTIONS: Agent must be double contained in liquid and vapor tight container when in storage or when outside of ventilation hood.

For additional information see AMC-R 385-131, "Safety Regulations for Chemical Agents H, HD, HT, GB and VX" and "USAEHA Technical Guide No. 169, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX".

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquid, n.o.s.

DOT HAZARD CLASS: Poison A

DOT LABEL: Poison gas

DOT MARKING: Poisonous liquid, n.o.s. (O-ethyl S-(2-diisopropylaminoethyl) methyl phosphonothioate) NA 1955

DOT PLACARD: POISON GAS

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: See Sections IV, VII and VIII.

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be placarded, regardless of quantity. Driver shall be given full and complete information regarding shipment and conditions in case of emergency.

While the Chemical Research Development and Engineering Center, Department of the Army believes that the data contained herein are factual and the opinions expressed are those of qualified experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Chemical Research Development and Engineering Center assumes legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

ADDENDUM A

1. Acute Physiological Effects:

Site of Action	Signs and Sympotoms
	Following Local Exposure
Muscarine-like-	
Pupils	Miosis, marked, usually maximal (pinpoint), sometimes unequal.
Ciliary body	Frontal headache, eye pain on focusing, slight dimness of vision, occasional nausea and vomiting.
Conjunctivae	Hyperemia.
Nasal mucous membranes	Rhinorrhea, hyperemia.
Bronchial tree	Tightness in chest, sometimes with prolonged wheezing expiration sugge tive of broncho-constriction or increased secretion, cough.
	Following Systemic Absorption
Bronchial tree	Tightness in chest, with prolonged wheezing, expiration suggestive of broncho-constriction or increased secretion, dyspnea, slight pain in chest, increased bronchial secretio cough, pulmonary edema, cyanosis.
Gastrointestinal	Anorexia, nausea, vomiting, abdomin cramps, epigastric and substernal tightness (cardiospasm) with "heart

Sweat glands	Increased sweating.
Salivary glands	Increased salivation.
Lacrimal glands	Increased lacrimation.
Heart	Slight bradycardia.
Pupils	Slight miosis, occasionally unequal, later maximal miosis (pinpoint).
Ciliary body	Blurring of vision.
Bladder	Frequent, involuntary micturition
Nicotine-like-	
Striated muscle	Easy fatigue, mild weakness, muscul twitching, fasciculations, cramps, generalized weakness, including muscles of respiration, with dyspne and cyanosis.
Sympathetic ganglia	Pallor, occasional elevation of bloc pressure.
Central nervous system	Giddiness, tension, anxiety, jitteriness, restlessness, emotional lability, excessive dreaming, insomnia, nightmares, headaches, tremor, withdrawal and depression, bursts of slow waves of elevated voltage in EEG, especially on overventilation, drowsiness, difficult concentration, slowness on recall, confusion, slurred speech, ataxia, generalized weakness, coma, with absence of reflexes, Cheyne-Stokes respirations, convulsions, depression of respiratory and circulator centers, with dyspnea, cyanosis, an fall in blood pressure.

2. Chronic Physiological Effects:

a. Acute Exposure.

If recovery from nerve agent poisoning occurs, it will be complete unless anoxia or convulsions have gone unchecked so long that irreversible central nervous system changes due to anoxemia have occurred.

b. Chronic Exposure.

The inhibition of cholinesterase enzymes throughout the body by nerve agents is more or less irreversible so that their effects are prolonged. Until the tissue cholinesterase enzymes are restored to normal activity, probably by very slow regeneration over a period of weeks or 2 to 3 months i damage is severe there is a period of increased susceptibility to the effect of another exposure to any nerve agent. During this period the effects of repeated exposures are cumulative; after a single exposure, daily exposure t ollowed by increasingly severe effects. After symptoms subside, increased susceptibility persists for one to serveral days. The degree of exposure required to produce recurrence of symptoms, and the severity of these symptoms, depend on duration of exposure and time intervals between exposure: Increased susceptibility is not limited to the particular nerve agent initially absorbed.

Estimates have been made for the times as which 50% of exposed subjects woul be affected (Et50's) at median incapacitating doses. These are presented below.

Et50	Degree of Effectiveness	ICt50	Exposure Time
min		mg min/m3	min
1.5	Moderate	27	0.5
3.0	Incap.	27	2.0
6.0		40	10.0
1.0	Severe	37	0.5
3.8	Incap.	37	2.0
7.8		56	10.0
2.0	Very	47	0.5
4.5	Severe	47	2.0
9.5	Incap.	72	10.0
6.5	Death	70	0.5
9.0		70	2.0
13.5		103	10.0

Exposure to high concentrations of nerve agent may bring on incoordination, mental confusion and collapse so rapidly that the casualty cannot perform self-aid. If this happens, the man nearest to him will give first aid.

Onset Time of Symptons.

Types of Effects	Route of Absorption	Description of Effects	When Effects Appear After Exposure
Vapor Local	Lungs	Rhinorrhea, nasal hyperemia tightness in chest, wheezing	One to several minutes
Vapor Local	Eyes	Miosis, Conjectival hyperemia eye pain, frontal headache.	One to several minutes

		effects. (See 2a above)	after moderate or marked expo oure; about 30 min after mild exposure.
Liquid Local	Eyes	Same as vapor effects.	Instantly
Liquid Local	Ingestion	Gastrointestinal. (See 2a above).	About 30 min. after ingestio
Liquid Local	Skin	Local sweating and muscular twitching.	3 min to 2 hour
Liquid Systemic	Lungs	See 2a above.	Several minutes
Liquid Systemic	Eyes	Same as for vapor	Several minutes
Liquid Systemic	Skin	Generalized sweating.	15 minutes to 2 hours
Liquid Systemic	Ingestion	Gastrointestinal (See 2a above).	15 minutes to 2 hours

Onset Time of Symptoms. (cont'd)

Types of Effects	Route of Absorption	Duration of Effects After Mild Exposure	Severe Exposure
Vapor Local	Lungs	A few hours	1 to 2 days
Vapor Local	Eyes	Miosis - 24 hours	3 to 14 days 2 to 5 days
Vapor Systemic	Lungs or eyes	Several hours	8 days
Liquid Local	Eyes	Similar to effects of vapor	
Liquid Local	Ingestion	3 days	5 days
Liquid Local	Skin	3 days	5 days
Liquid Systemic	Lungs		1 to 5 days
Liquid Systemic	Eyes		2 to 4 days
Liquid Systemic	Skin		2 to 5 days

ADDENDUM B

First Aid Procedures.

a. Exposed personnel will be removed immediately to an uncontaminatec atmosphere. Personnel handling casualty cases will give consideration tc their own safety and will take precautions and employ the prerequiste protective equipment to avoid becoming exposed themselves.

CAUTION: Due to the rapid effects of nerve agents, it is extremely important that decontamination of personnel not be delayed by attempting to blot off excessive agent prior to decontamination.

b. The casualty will then be decontaminated by immediately removing any contaminated clothing and washing the contaminated areas with copious amounts of soap and water, 5% sodium hypochlorite solution, or liquid household bleach (nominal 5% solution sodium hypochlorite) and flushing with clean water. Mask will be left on the victim until decontamintion has been completed unless it has been determined that areas of the face were contaminated and the mask must be removed to facilitate decontamination. After decontamination, the contaminated clothing will be removed and skin contamination washed away. If possible, decontamination will be completed ›efore the casualty is taken to the aid station or medical facility.

CAUTION: Care must be taken when decontaminating facial areas to avoid getting the hypochlorite into the eyes or mouth. Only clean water shall be used when flushing the eyes or mouth. Skin surfaces decontaminated with bleach should be thoroughly flushed with water to prevent skin irritation from the bleach.

c. If there is no apparent breathing, artifical resuscitation will be started immediately (mouth-to-mouth, or with mechanical resuscitator). The situation will dictate method of choice, e.g., contaminated face. Do not use mouth-to-mouth resuscitation when facial contamination exists. When appropriate, and when trained personnel are available, cardio-pulmonary resuscitation (CPR) may be necessary.

d. An individual who has received a known agent exposure or who exhibits definite signs or symptoms of agent exposure shall be injected immediately with the Nerve Agent Antidote Kit, MARK I.

(1) Some of the early symptoms of a vapor exposure may be rhinorrhea (runny nose) and/or tightness in the chest with shortness of breath (bronchial constriction).

(2) Some of the early symptomsi of percutaneous exposure may be local muscular twitching or sweating at the area of exposure followed by nausea or ʼomiting.

(3) Although myosis (pin-pointing of the pupils) may be an early sign of agent exposure, a MARK I Kit shall not be administered when myosis is the only sign present. Instead, the individual shall be taken immediately tc the medical facility for observation.

DATE: 3 Dec 1990

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U.S. ARMY CHEMICAL
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

Emergency Telephone #s:
CRDEC Safety Office
301-671-4411 0700-1700
EST After normal duty
hours: 301-278-5201
Ask for CRDEC Staff
Duty Officer

HT

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Department of the Army

MANUFACTURER'S ADDRESS: U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND
CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
ATTN: SMCCR-CMS-E
ABERDEEN PROVING GROUND, MD 21010-5423

CAS REGISTRY NUMBER: Not Available

CHEMICAL NAME:

HD : Bis-(2-chloroethyl) sulfide
T : Bis-[2-(2-chloroethylthio)-ethyl] ether

Alternate chemical names:

See components (HD, T)

TRADE NAME AND SYNONYMS:

HT
Sulfur - Mustard (Vesicant)

CHEMICAL FAMILY: Chlorinated sulfur compound

FORMULA/CHEMICAL STRUCTURE: Mixture of 60% Sulfur Mustard (HD) and 40% Sulfur Mustard (T) by weight
HD: $C_4H_8Cl_2S$
T: $C_8H_{16}Cl_2OS_2$

NFPA 704 SIGNAL: Health - 4
Flammability - 1
Reactivity - 1

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SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
HT	*	100	0.003 mg/m3

* See Section I

SECTION III - PHYSICAL DATA

BOILING POINT: No constant boiling point. Above 228 DEG C

VAPOR PRESSURE (torr): 0.104 @ 25 DEG C

VAPOR DENSITY (AIR=1): 6.92

SOLUBILITY IN WATER: Practically insoluble.

SPECIFIC GRAVITY (H2O=1): 1.265 at 20 DEG C

FREEZING (MELTING) POINT: 0.0 to 1.3 DEG C

AUTOIGNITION TEMPERATURE DEG F (DEG C): Data not available

VISCOSITY (CENTISTOKES): 6.05 @ 20 DEG C

VOLATILITY (mg/m3): 831 @ 25 DEG C

EVAPORATION RATE: Data not available

APPEARANCE & ODOR: Odor: Garlic-like
Appearance: Highly viscous clear to pale yellow liquid

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT: (METHOD USED): approximately 100 DEG C (method unknown)

FLAMMABILITY LIMITS (% by volume): Data not available

EXTINGUISHING MEDIA: Water, fog, foam, CO2. Avoid use of extinguishin methods that will splash or spread mustard.

UNUSUAL FIRE & EXPLOSION HAZARDS: May produce hydrogen chloride and sulfu oxides in a fire. Unburned agent vapors may be present and can cause toxi and vesicant effects.

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishin the fire should be immediately evacuated from the area. Fires involving H should be contained to prevent contamination to uncontrolled areas. Whe responding to a fire alarm in buildings or areas containing agents, fire-fighting personnel should wear full firefighter protective clothing (withou TAP clothing) during chemical agent firefighting and fire rescue operations Respiratory protection is required. Positive pressure, full facepiece NIOSH-approved self-contained breathing apparatus (SCBA) will be worn wher there is danger of oxygen deficiency and when directed by the fire chief o chemical accident/incident (CAI) operations officer. The M9 or M17 series mask may be worn in lieu of SCBA when there is no danger on oxygen deficiency. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance pruposes vice firefighting, they will wear appropriate levels of protective clothing (see Section 8).

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): The AEL for HT is 0.003 mg/m3 as proposed in the USAEHA Technical Guide No. 173, "Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT". No individual should be intentionally exposed to any direct skin or eye contact.

HD, a component of HT, is recognized as a human carcinogen by the International Agency for Research on Cancer (IARC).

EFFECTS OF OVEREXPOSURE: HT is a vesicant (causing blisters). Since HT contains HD, HT is an alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues which are especially sensitive. The rate of detoxification of HT in the body is very slow and repeated exposure produce a cumulative effect. Median lethal and incapacitating doses of HT in man have not been established. However, the inhalation LCt50s in certain animal species have been established as follows:

Dog:	100 - 200 mg-min/m3
Guinea Pig:	3000 - 6000 mg-min/m3
Rabbit:	3000 - 6000 mg-min/m3
Mouse:	820 mg-min/m3

Maximum safe Ct for HD for skin and eyes are 5 and 2 mg-min/m3, respectively.

ACUTE PHYSIOLOGICAL ACTION OF HT IS CLASSIFIED AS LOCAL AND SYSTEMIC.

LOCALLY, HT affects both the eyes and the skin. SKIN damage occurs after percutaneous resorption. Being lipid soluble, HT can be resorbed into all organs. Skin penetration is rapid without skin irritation. Swelling (blisters) and reddening (erythema) of the skin occurs after a latency period of 4-24 hours following the exposure, depending on the degree of exposure and individual sensitivity. The skin healing process is very slow. Tender skin, mucous membranes, and perspiration covered skin are more sensitive to the effects of HT. HT's effect on the skin, however, is less than on the eyes. Local action on the eyes produces severe necrotic damage and loss of eyesight. Exposure of eyes to HT vapor or aerosol produces lacrimation, photophobia, and inflammation of the conjunctiva and cornea.

SYSTEMIC ACTIONS occur primarily through inhalation and ingestion. The HT vapor or aerosol is less toxic to the skin or eyes than the liquid form. When inhaled, the upper respiratory tract (nose, throat, trachea) is inflamed after a few hours latency period, accompanied by sneezing, coughing and bronchitis, loss of appetite, diarrhea, fever, and apathy. Exposure to nearly lethal doses of HT can produce injury to bone marrow, lymph nodes, and spleen as indicated by a drop in WBC count and, therefore, results in an increased susceptibility to local and systemic infections. Ingestion of HT will produce severe stomach pains, vomiting, and bloody stools after a 15-20 minute latency period.

CHRONIC EXPOSURE to HT can cause sensitization, chronic lung impairment, (cough, shortness of breath, chest pain) and cancer of the mouth, throat, respiratory tract, and skin, and leukemia. It may also cause birth defects.

MERGENCY AND FIRST AID PROCEDURES:

INHALATION: Remove from the source IMMEDIATELY. If breathing has stopped, give artifical respiration. If breathing is difficult, administer oxygen. Seek medical attention IMMEDIATELY.

EYE CONTACT: Speed in decontaminating the eyes is absolutely essential. Remove person from the liquid source, flush the eyes immediately with water by tilting the head to the side, pulling the eyelids apart with the fingers and pouring water slowly into the eyes. Do not cover eyes with bandages but, if necessary, protect eyes by means of dark or opaque goggles. Transfer the victim to the medical facility IMMEDIATELY.

SKIN CONTACT: Don respiratory protection mask and gloves; remove victim from agent source immediately. Flush skin and clothes with 5 percent sodium hypochlorite solution or liquid household bleach, then wash contaminated skin area with soap and water. If shower facilities are available, wash thoroughly and transfer to medical facility IMMEDIATELY.

INGESTION: Do not induce vomiting. Give victim milk to drink. Seek medical attention IMMEDIATELY.

SECTION VI - REACTIVITY DATA

ABILITY: Stable at ambient temperatures. Decomposition temperature is 165 EG C to 185 DEG C. HT is a persistent agent depending on pH and moisture, and has been known to remain active for up to three years in soil.

INCOMPATIBILITY: Conditions to avoid. Rapidly corrosive to brass @ 65 DEG C. Will corrode steel at a rate of .0001 in. of steel per month @ 65 DEG C.

HAZARDOUS DECOMPOSITION: HT will hydrolyze to form HCl, thiodiglycol, and bis-(2-(2-hydroxyethylthio) ethyl ether.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Only personnel in full protective clothing will be allowed in an area where HT is spilled (See section 8). In case of personnel contamination see section V "Emergency and First Aid Instructions."

RECOMMENDED FIELD PROCEDURES: Spills of HT must be contained by using vermiculite, diatomaceous earth, clay or fine sand and neutralized as possible using copious amounts of 5.25 percent Sodium Hypochlorite solution. Scoop up all material and place in approved DOT containers. Cover the con-ents of the drum with decontaminating solution as above. The exterior of e drum shall be decontaminated and then labeled IAW EPA and DOT regulations All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

f 5.25 percent Sodium Hypochlorite solution is not available then the following decontaminants may be used instead and are listed in the order of preference: Calcium Hypochlorite, Decontamination Solution No. 2 (DS2) and Super Tropical Bleach Slurry (STB). WARNING: Pure, undiluted Calcium Hypochlorite (HTH) will burn on contact with liquid blister agent.

RECOMMENDED LABORATORY PROCEDURES: A minimum of 65 grams of decon solution is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour if a single phase is obtained. At the end of 24 hours, the resulting solution shall be adjusted to a pH between 10 and 11. Test for presence of active chlorine by use of acidic potassium iodide solution to give free iodine color. Place 3 ml of the decontaminate in a test tube. Add several crystals of Potassium Iodine and swirl to dissolve. Add 3 ml of 50 wt percent Sulfuric Acid:water and swirl. IMMEDIATE Iodine color indicates the presence of active chlorine. If negative, add additional 5.25 percent Sodium Hypochlorite solution to the decontamination solution, wait two hours, then test again for active chlorine. Continue procedure until positive chlorine is given by solution.

A 10 wt percent HTH (calcium hypochlorite) mixture may be substituted for Sodium Hypochlorite. Use 65 grams of decon per gram of HT and continue the test as described for Sodium Hypochlorite.

Scoop up all material and place in approved DOT containers. Cover the conents of the drum with decontaminating solution as above. The exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of the material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (see Section 8).

NOTE: Surfaces contaminated with HT and then rinse-decontaminated may evolve sufficient HT vapor to produce a physiological response.

WASTE DISPOSAL METHOD: All neutralized material should be collected, contained and thermally decomposed in an EPA permitted incinerator for decontaminated HT (see note), which will filter or scrub toxic by-products from effluent air before discharge to the atmosphere. Any contaminated protective clothing should be decontaminated using HTH or bleach and analyzed to assure it is free of detectable contamination (3X) level. The clothing should then be sealed in plastic bags inside properly labeled drums and held for shipment back to the DA issue point. Decontamination of waste or excess material shall be accomplished in accordance with the following procedure outlined above with the following exception:

--- HT on laboratory glassware may be oxidized by its vigorous reaction with concentrated nitric acid.

Open pit burning or burying of HT or items containing or contaminated with HT in any quantity is prohibited.

Note: Some states consider certain decontaminated surety agents as RCRA haz ardous waste. Local regulations must be considered before disposal action is taken.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration (mg/m3)	Respiratory Protection/Ensemble Required
Less than or equal to 0.003 as an 8-hr TWA	Protective mask not required provided that: (a) Continuous real-time monitoring (with alarm capability) is conducted in the work area at the 0.003 mg/m3 level of detection. (b) M9, M17 or M40 mask is available and donned if concentrations exceed 0.003 mg/m3. (c) Exposure has been limited to the extent practicable by engineering controls (remote operations, ventilation, and process isolation) or work practices. If these conditions are not met then the following applies: Full facepiece, chemical canister, air-purifying respirators. (The M9, M17, or M40 series or other certified equivalent masks acceptable for this purpose in conjunction with the M3 toxicological agent protective (TAP) suit for dermal protection.)
Greater than 0.003 as an 8-hr TWA	The Demilitarization Protective Ensemble (DPE), 30 mil, may be used with prior approval from the AMC Field Safety Activity Use time for the 30 mil DPE must restricted to two hours or less. NOTE: When 30 mil DPE is not available the M9 or M40 series mask with Level A protective ensemble including impregnated innerwear can be used. However, use time shall be restricted to the extent operationally feasible, and may not exceed one hour. As an additional precaution, the cuffs of the sleeves and the legs of the M3 suit shall be taped to the gloves and boots to reduce aspiration.

VENTILATION:

Special. Chemical laboratory hoods shall have an average inward face velocity of 100 linear feet per minute (lfpm) plus or minus 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Laboratory hoods shall be located such that cross drafts do not exceed 20% of inward face velocity. A visual performance test utilizing smoke producing devices shall be performed in assessing the ability of the hood to contain agent HT.

Other. Recirculation of exhaust air from agent areas is prohibited. No connection between agent area and other areas through the ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested semi-annually or after modification or maintenance operations. Operations should be performed 20 cm inside hoods.

PROTECTIVE GLOVES: MANDATORY. Butyl Toxicological Agent Protective gloves (M3, M4, gloveset).

EYE PROTECTION: As a minimum, chemical goggles will be worn. For splash hazard use goggles and face-shield.

OTHER PROTECTIVE EQUIPMENT: Full protective clothing will consist of the M3 butyl rubber suit with hood, M2A1 boots, M3 gloves, impregnated underwear, M9 series mask and coveralls (if desired), or the Demilitarization Protective Ensemble (DPE). For general lab work, gloves and lab coat shall be worn with M9 or M17 mask readily available.

In addition, when handling contaminated lab animals, a daily clean smock, foot covers, and head covers are required.

MONITORING: Available monitoring equipment for agent HT is the M8/M9 detector paper, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAMMS), Automated Continuous Air Monitoring System (ACAMS), CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), and the Miniature Chemical Agent Monitor (MINICAM).

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:
During handling, the "buddy" (two-man) system will be used. Containers should be periodically inspected for leaks, either visually or using a detector kit, and prior to transferring the containers from storage to work areas. Stringent control over all personnel handling HT must be exercised. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and each worker will shower thoroughly with special attention given to hair, face, neck, and hands, using plenty of soap before leaving at the end of the workday. No smoking, eating, or drinking is permitted at the work site. Decontamination equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. HT should be stored in containers made of glass for Research Development Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent shall be double-contained in liquid-tight containers when in storage.

OTHER PRECAUTIONS: See AMC-R 385-131, "Safety Regulations for Chemical Agents H, HD, and HT, GB and VX," 9 Oct 1987 and USAEHA Technical Guide No. 173, "Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT," for additional information.

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquid, n.o.s.

DOT HAZARD CLASSIFICATION: Poison A

DOT LABEL: Poison Gas

DOT MARKING: Poisonous liquid, n.o.s. (Bis-(2-chloroethyl) sulfide, and Bis-[2-(2-chloroethylthis)-ethyl] ether) NA 1955

DOT PLACARD: POISON GAS

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be placarded regardless of quantity. Driver shall be given full and complete information regarding shipment and conditions in case of emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: See sections IV, VII, and VIII.

While the Chemical Research Development and Engineering Center, Department of the Army believes that the data contained herein are factual and the opinions expressed are those of qualified experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Chemical Research Development and Engineering Center assumes legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Attachment D
Baker Environmental, Inc.
Safety Standard Operating Procedures

ATTACHMENT D

BAKER ENVIRONMENTAL, INC.
SAFETY STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

1.0 - CONFINED SPACE ENTRY PROGRAM

1.1 INTRODUCTION

All confined space entries shall be performed in accordance with the following program based on the "Criteria Document for a Recommended Standard for Working in Confined Spaces," issued by NIOSH. A confined space refers to a space, which by design has limited openings for entry and exit, unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy.

Confined spaces include, but are not limited to, storage tanks, compartments of ships, process vessels, pits, silos, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines. If there is a question as to whether or not an area should be considered as a confined space, appropriate safety personnel should be consulted prior to entry.

1.2 HAZARD IDENTIFICATION

Identify and evaluate each hazard of the permit spaces. Hazardous substances should be identified through the use of Dräger tubes and/or direct reading instruments such as HNu or OVA meters. Oxygen and explosive levels will be monitored using a Lower Explosive Level/Oxygen (LEL/O_2) meter.

1.3 HAZARD CONTROL

Establish and implement the means, procedures, and practices by which the permit spaces can be entered safely. Ventilation and area cleaning should be considered in addition to personal protective equipment.

1.4 PERMIT SYSTEM

Complete the confined space entry permit, as attached. This form must be posted at the point of entry and is valid for eight consecutive hours. After eight hours, or sooner if there is reason to believe that conditions may have changed, additional readings and a new form must be filled out. Forms must be returned to the on-site Health and Safety Officer (HSO).

1.5 EMPLOYEE INFORMATION

Signs shall be posted near permit spaces to notify employees as to what hazards may be present and that only authorized entrants may enter.

1.6 EMPLOYEE TRAINING

All employees entering or directly involved in the confined space activities must complete a 40-hour health and safety training course in accordance with 29 CFR 1910.120. Additionally, site-specific training must be conducted regarding the hazards associated with each particular entry.

1.7 EQUIPMENT

All equipment must be inspected and maintained to ensure the proper use of the equipment, necessary for safe entry. Respirators and emergency equipment, lanyard, harness, etc. must be thoroughly inspected prior to the confined space entry. Records of the inspection shall be kept in the project file. The equipment shall be adequately decontaminated following each entry.

1.8 RESCUE

Ensure that procedures and equipment necessary to rescue entrants from permit spaces are implemented and provided. The buddy system shall be used for all entries. The attached table provides a list of requirements with respect to each entry classification. The following items describe the three confined space entry classifications.

I CLASS A

- Immediate Danger to Life and Health (IDLH) condition exists
- Should only be entered under emergency conditions (Level A or B)
- Efforts should be made to reduce IDLH levels such as ventilation, cleaning, etc.
- IDLH conditions may include:
    - Oxygen levels below 19.5% or greater than 25%
    - LEL levels 20% or greater

II CLASS B

- Dangerous, but not IDLH conditions
- Levels of protection can range from C to A
- Range of conditions:
  - Oxygen from to 19.5% to 21.5%
  - LEL levels from 10% to 19%

III CLASS C

- Low Hazard Potential
- Requires no modification of work procedures
- Range of conditions:
  - Oxygen levels from 19.5% to 22%
  - LEL levels less than 10%

CONFINED SPACE ENTRY

ITEM	CLASS A	CLASS B	CLASS C
1. Permit	X	X	X
2. Atmospheric Testing	X	X	X
3. Monitoring	X	O	O
4. Medical Surveillance	X	X	O
5. Training of Personnel	X	X	X
6. Labeling and Posting	X	X	X
7. Preparation Isolate/Lockout/Tag	X	X	X
Purge and Ventilate	X	X	O
Cleaning Procedures	O	O	O
Requirements for Special Equipment/Tools	X	X	O
8. Procedures Initial Plan	X	X	X
Standby	X	X	O
Communication/Observation	X	X	X
Rescue	X	X	X
Work	X	X	X
9. Safety Requirement and Clothing Head Protection	O	O	O
Hearing Protection	O	O	O
Hand Protection	X	O	O
Foot Protection	X	O	O
Body Protection	X	O	O
Respiratory Protection	X	X	O
Safety Belts	X	X	X
Life Lines, Harness	X	X	X
10. Rescue Equipment	X	X	X
11. Recordkeeping/Exposure	X	X	X

X - Indicates requirements
O - Indicates determination by the qualified individual

Baker
Baker Environmental, Inc

☐ CONFINED SPACE ENTRY PERMIT
☐ HAZARDOUS AREA ENTRY PERMIT

LOCATION and DESCRIPTION of Confined Space ______________________

Date ______________________

PURPOSE of Entry ______________________

Time ______________ a.m./p.m.

JOB/SITE ______________________

Expiration ______________ a.m./p.m.

PERSON in Charge of Work ______________________

SAFETY REQUIREMENTS	Yes	No		Yes	No
Lock Out - De-Energize			Escape Harness		
Lines Broken - Capped or Blanked			Tripod Emergency Escape Unit		
Purge - Flush and Vent			Lifelines		
Ventilation			Fire Extinguishers		
Secure Area			Lighting		
Breathing Apparatus			Protective Clothing		
Resuscitator - Inhalator			Respirator		

TEST(S) TO BE TAKEN Valid for One 8-Hour Entry	Yes	No	CONCENTRATION	INSTRUMENT USED AND DATE CALIBRATED
% of Oxygen				
% of L.E.L.*				
Carbon Monoxide				
Aromatic Hydrocarbon				
Hydrocyanic Acid				
Hydrogen Sulfide				
Sulfur Dioxide				
Ammonia				
Other:				
Other:				

*L.E.L. = Lower Explosion Level

Atmosphere Tester: ______________________ Name (print) ______________________ Signature

Note: Continuous/periodic tests shall be established before beginning job. Any questions pertaining to test requirements contact the Site Health and Safety Officer.

Safety Standby Person(s)	Title

Supervisor authorizing all above conditions specified ______________________

ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED.

2.0 - RESPIRATORY PROTECTION PROGRAM

2.1 INTRODUCTION

In accordance with OSHA requirements (29 CFR 1910.134), this document represents Baker Environmental, Inc.'s (Baker's) program governing the selection and use of respiratory protection for its employees. It is Baker's policy to provide its employees with the proper protective equipment, training, and medical surveillance necessary to protect individuals from any potential hazards which may be present during the tasks performed throughout the course of each individual's employment. This program specifically describes the procedures which have been established and implemented for the use of respiratory protection equipment. The effectiveness of this program shall be reevaluated on an annual basis and appropriate changes shall be made if deemed necessary.

2.2 EMPLOYER RESPONSIBILITY

Baker shall provide its employees the respiratory protection equipment which is appropriate and suitable for the purpose intended, when such equipment is necessary to protect the health of the employee.

2.3 EMPLOYEE RESPONSIBILITY

The employee shall use the respiratory protection provided in accordance with instructions and training received, and shall report any malfunction of the equipment to a responsible person. The employee shall not wear contact lenses in atmospheres where respiratory protection is required. Corrective lens inserts will be provided, at Baker's expense, for employees who require corrective lenses.

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 may be part of the site-specific Health and Safety Plan.

After a task-specific assessment is completed and it is determined that airborne exposure concentrations exceed or may exceed the recommended limits, engineering and administrative controls should be implemented, whenever feasible.

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 Site Health and Safety Officer 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.

Respirator training will be conducted on an annual basis, at a minimum. 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 provides employees with the North Brand half-face (Model 7700) and full-face (Model 7600) air purifying respirators, positive pressure 30-minute Self-Contained Breathing Apparatus (SCBAs) (Model 800), positive pressure supplied airline respirators, with 5-minute escape air cylinders (Model 85500). 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. As an alternate air purifying respirator, Baker will also keep, on-hand, the MSA ultra twin full-face respirator. All Baker employees who regularly perform tasks requiring respiratory protection will be issued their own half-face 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 and liquid 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 as described in Compressed Gas Association Commodity Specification G-7.1-1966. Breathing air may be supplied to respirators from cylinders or air compressors. 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 shall be marked in accordance with American National Standard Method of marking Portable Compressed Gas Containers to Identify the Material Contained, Z48.1-1954; Federal Specification BB-A-1034a, June 21, 1968, Air, Compressed for Breathing Purposes; or Interim Federal Specification GG-B-00675b, April 27, 1965, Breathing Apparatus, Self-Contained.

2.8 CLEANING AND MAINTENANCE

Respirator maintenance will be performed by each trained individual on a regular basis. The maintenance shall be carried out on a schedule which ensures that each respirator wearer is provided with a respirator that is clean and in good operating condition.

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. Inspections shall be conducted before and after each use.

Respiratory equipment that has been issued to an employee shall be cleaned/sanitized then rinsed and air-dried by the wearer on a schedule (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.

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 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. Retesting shall be performed, at a minimum, on an annual basis or if a different model respirator, other than the model he/she was previously fit-tested for, is to be used by the wearer. Air purifying respirators fit-tested qualitatively will be assigned a protection factor of 10 (APF = 10).

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.

2.10 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 physical and a pulmonary function test conducted by the company's physician and at the expense of the company. Test parameters included in Baker's medical surveillance program is included as Attachment A in each site-specific Health and Safety Plan.

2.11 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 Health and Safety Plan under the Heat Stress section.

Baker

Baker Environmental, Inc

SCBA AND SAR (WITH 5-MINUTE ESCAPE TANK) DAILY INSPECTION FORM

Type (SCBA or SAR)	Cylinder Condition (Damaged or Undamaged)	Cylinder (Full or MT)	Facepiece and Hoses (Damaged or Undamaged)	Connections (Damaged or Undamaged)	Apparatus Complete (Yes/No)	Cleaned and Sanitized (Yes/No)	Remarks	Inspected By (Initials)	Date Inspected

Baker

Baker Environmental, Inc

FULL-FACE AND HALF-FACE RESPIRATOR INSPECTION FORM

Inspection Date	Type	FACE PIECE					HEADSTRAPS OR HEADBANDS		RESPIRATOR INTERIOR		
		Clean and Sanitized	No Cracks, Tears, or Holes	Proper Shape and Flexibility	Air Purifying Element Holders Operate Correctly	Proper Storage Free From Heat, Dirt, Sunlight, etc.	No Signs of Wear or Tears	Buckles Function Properly	No Foreign Material Under Valve Seat	No Cracks or Tears in Valves or Valve Bodies	Valve Covers and Bodies in Good Condition and Installed Correctly

✓ = OK X = Not OK

3.0 - CARE AND CLEANING OF PERSONAL PROTECTIVE EQUIPMENT

3.1 INTRODUCTION

The following procedures cover the care and cleaning of Levels D, C, and B personal protective equipment. 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 EQUIPMENT CARE

3.2.1 Chemical Resistant Suit (Levels C and B)

- 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)

- 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 C and B)

- 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. Dispose of according to site procedures.

3.2.4 Safety Shoes/Boots (Levels D through B)

- Examine daily for gauges, open seams, etc., anything that would lessen the integrity of the boot. Replace as shoe/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 and C)

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

3.2.7 Respirators (Levels C and B)

- Procedures for care of respiratory protective equipment are covered in Attachment D - Baker SOPs.

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 Attachment D - Baker SOPs.

3.3.1 Gross Physical Removal

Large amounts of contaminated soil is scraped off with a tongue depressor, or wiped off using a disposable wipe.

3.3.2 Physical/Chemical Removal

The residual contamination will be scrubbed with a soft-bristled, long-handled brush using a nonphosphate detergent solution.

3.3.3 Rinsing/Dilution

The detergent solution and residual contaminants will be rinsed with tap water using a pressurized sprayer.

4.0 - SANITATION/SITE PRECAUTIONS

4.1 SANITATION

- 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 which is either chemical, recirculating, combustion, or flush, depending on local code requirements.
- A place for food handling meeting all applicable laws, otherwise, 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 and the Baker Site Trailer.

4.2 SITE PRECAUTIONS

- 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 not be allowed in areas where flammable materials are present.
- Hands and face must be thoroughly washed upon leaving the work area.
- 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.

- No contaminated work garments are to be worn off site.
- Contact lenses are not permitted to be worn on site.
- No facial hair which interferes with a satisfactory fit of the mask-to-face seal, is allowed on personnel required to wear respirators.
- Contact with contaminated or potentially contaminated surfaces should be avoided. Wherever possible, do not walk through puddles, leachate, discolored surfaces, kneel on ground, lean, sit or place equipment on drums/containers.
- Medicine and alcohol can potentiate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel where the potential for absorption, inhalation, or ingestion of toxic substances exist unless specifically approved by a qualified physician. Alcoholic beverage intake should be minimized or avoided during after-hour operations.
- Alcoholic beverages are prohibited on site.
- Personal radios, TVs, and tape players are prohibited on site.
- Firearms are prohibited on site.
- All personnel will observe any posted sign, warning, fence, or barrier posted around contaminated areas.

5.0 - SAFE BOAT OPERATIONS

5.1 OBJECTIVE

To provide safe operating procedures while performing sampling activities from a boat.

5.2 EQUIPMENT

Refer to Attachment A, "Federal Requirements for Recreational Boats," for a list of required equipment.

5.3 PRELIMINARY ACTIVITIES

Ensure that requirements governing the safe operation of a boat, published by the Department of Transportation, United States Coast Guard (Attachment A) are reviewed prior to placing the boat in the water.

5.4 OPERATING PROCEDURE

Operate the boat according to the Department of Transportation, United States Coast Guard Regulations (Attachment A), where applicable.

5.5 REFERENCES

U.S. Department of Transportation, United States Coast Guard. Federal Requirements for Recreational Boats. United States Coast Guard, Washington, D. C. 20593.*

* It is recognized that these requirements are directed towards recreational boating, but Baker Environmental, Inc. believes that the topics of discussion included in this reference are applicable to the size of boat, and activities to be performed during environmental sampling.

ATTACHMENT A

BE SAFE ON THE WATER

KNOW . . .

- ☐ The stability and handling of the boat you are using.
- ☐ How to use the equipment on the boat.
- ☐ The waters you will be using, tides, currents, sand bars, and other hazards.
- ☐ The weather conditions.
- ☐ The safety devices and emergency equipment
  Make sure that life jackets fit properly.
- ☐ The navigation rules and observe the courtesies of safe boating.
- ☐ Your personal limitations and responsibilities.
  Exposure to sun, wind, cold water, all affect your ability to react.
- ☐ That it is illegal to operate a vessel while intoxicated. If you add alcohol or drugs to boating, the results can be fatal.

. . . BEFORE YOU GO!

US Department
of Transportation
United States
Coast Guard

Federal Requirements for Recreational Boats

FLOAT PLAN

Complete this page, before going boating and leave it with a reliable person who can be depended upon to notify the Coast Guard or other rescue organization, should you not return as scheduled. Do not file this plan with the Coast Guard.

1. NAME OF PERSON REPORTING AND TELEPHONE NUMBER.

2. DESCRIPTION OF BOAT. TYPE ____________
COLOR ________ TRIM __________ REGISTRATION NO. ______________ LENGTH _____ NAME ______________ MAKE ____________
OTHER INFO. ______________

3. PERSONS ABOARD ______________

NAME	AGE	ADDRESS & TELEPHONE NO.

4. DO ANY OF THE PERSONS ABOARD HAVE A MEDICAL PROBLEM? ________ IF SO, WHAT? ______________

5. ENGINE TYPE ______________ H.P. ________
NO. OF ENGINES ______ FUEL CAPACITY ____________

6. SURVIVAL EQUIPMENT: (CHECK AS APPROPRIATE)
PFDs ________ FLARES ________ MIRROR ________
SMOKE SIGNALS ________ FLASHLIGHT ________
FOOD ______ PADDLES ________ WATER ________
OTHERS ________ ANCHOR ____________
RAFT OR DINGHY ________ EPIRB ________

7. RADIO YES/NO TYPE ______________
FREQS. ______________

8. TRIP EXPECTATIONS: LEAVE AT ____________
FROM ____________ GOING TO ____________
EXPECT TO RETURN BY ________ (TIME) AND IN NO EVENT LATER THAN ____________

9. ANY OTHER PERTINENT INFO. ____________

10. AUTOMOBILE LICENSE ______________
TYPE ____________ TRAILER LICENSE ____________
COLOR AND MAKE OF AUTO ______________
WHERE PARKED ______________

11. IF NOT RETURNED BY ______________ (TIME)
CALL THE COAST GUARD, OR ____________ (LOCAL AUTHORITY)

12. TELEPHONE NUMBERS ______________
____
____
____

This pamphlet contains the Federal equipment carriage requirements for recreational vessels. The owner/operator may be required to comply with additional regulations specific to the State in which the vessel is registered or operated. State laws vary. A vessel in compliance with the laws of the State of registration, may not meet the requirements of another State where it may be operating.

To insure compliance with State boating laws, contact your State boating safety agency.

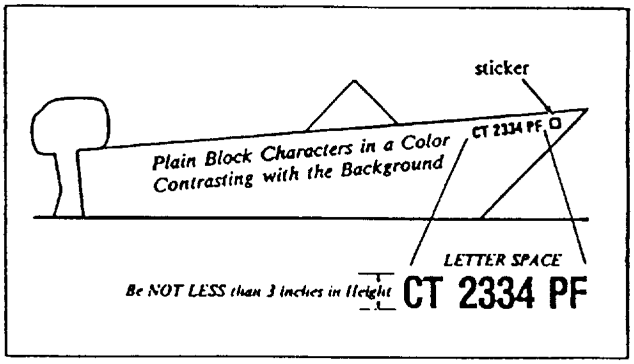
REGISTRATION AND NUMBERING REQUIREMENTS

All undocumented vessels equipped with propulsion machinery must be registered in the State of principal use. A certificate of number will be issued upon registering the vessel. These numbers must be displayed on your vessel. Some States require all vessels to be numbered, check with your State boating authority for numbering requirements.

A documented vessel is not exempt from applicable State or Federal taxes, nor is its operator exempt from compliance with Federal or State equipment carriage requirements.

DISPLAY OF NUMBER

Numbers must be painted or permanently attached to each side of the forward half of the vessel. The Coast Guard and many States issue two validation stickers. They must be affixed within six inches of the registration number. No other letters or numbers may be displayed nearby.



CERTIFICATE OF NUMBER

The owner/operator of a vessel must carry a valid certificate of number whenever the vessel is in use. When a vessel is moved to a new State of principal use, the certificate of number is valid for 60 days.

The Coast Guard issues the certificate of numbers in Alaska.

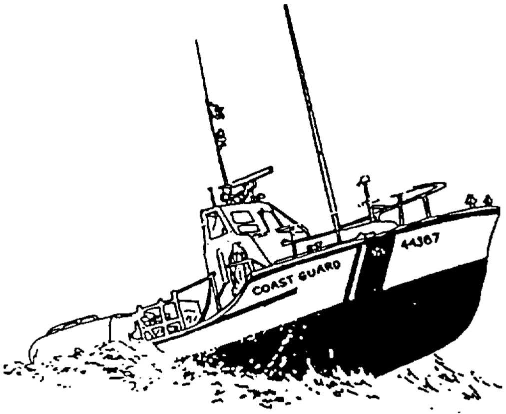
NOTIFICATION OF CHANGES

The owner of a vessel must notify the agency which issued the certificate of numbers within 15 days if:

- The vessel is transferred, destroyed, abandoned, lost, stolen or recovered.
- The certificate of number is lost, destroyed or the owner's address changes.

If the certificate of number becomes invalid for any reason, it must be surrendered in the manner prescribed by the issuing authority within 15 days.

LAW ENFORCEMENT



A vessel underway, when hailed by a Coast Guard vessel is required to heave to, or maneuver in such a manner that permits a boarding officer to come aboard.

Other Federal, State and local law enforcement officials may board and examine your vessel, whether it is numbered, unnumbered or documented. Coast Guard law enforcement personnel may also be found aboard other vessels.

The Coast Guard may impose a civil penalty up to $1,000 for failure to: comply with numbering requirements; comply with equipment requirements; report a boating accident; or comply with other Federal regulations. Failure to comply with the unified Inland Rules of the Road (Inland Navigation Rules Act of 1980) can result in a civil penalty up to $5,000.

Improper use of a radiotelephone is a criminal offense. The use of obscene, indecent or profane language during radio communications is punishable by a $10,000 fine, imprisonment for two years or both. Other penalties exist for misuse of a radio, such as improper use of Channel 16 VHF-FM.

Channel 16 is a calling and distress channel. It is not to be used for conversation or radio checks. Such traffic should be conducted on an authorized working channel.

OPERATING A VESSEL WHILE INTOXICATED became a specific federal offense effective January 13, 1988. The final rule set standards for determining when an individual is intoxicated. The BAC is .10% (.08% in Utah) for operators of recreational vessels being used only for pleasure. Violators are subject to civil penalty not to exceed $1,000 or criminal penalty not to exceed $5,000, 1 year imprisonment or both.

NEGLIGENT or GROSSLY NEGLIGENT OPERATION of a vessel which endangers lives and property is prohibited by law. The Coast Guard may impose a civil penalty for negligent operation. GROSSLY NEGLIGENT OPERATION is a criminal offense and an operator may be fined up to $5,000, imprisoned for one year, or both. Some examples of actions that may constitute negligent or grossly negligent operation are:

- Operating a boat in a swimming area.
- Operating a boat while under the influence of alcohol or drugs.
- Excessive speed in the vicinity of other boats or in dangerous waters.
- Hazardous water skiing practices.
- Bowriding, also riding on seatback, gunwale or transom.

TERMINATION OF USE

A Coast Guard boarding officer who observes a boat being operated in an UNSAFE CONDITION, specifically defined by law or regulation, and who determines that an ESPECIALLY HAZARDOUS CONDITION exists, may direct the operator to take immediate steps to correct the condition, including returning to port. Termination of unsafe use may be imposed for:

- Insufficient number of CG Approved Personal Flotation Devices (PFDs).
- Insufficient fire extinguishers.
- Overloading beyond manufacturers recommended safe loading capacity.
- Improper navigation light display.
- Fuel leakage.
- Fuel in bilges.
- Improper ventilation.
- Improper backfire flame control.
- Operating in regulated boating areas during predetermined adverse conditions. (Applies in 13th CG District Only).
- Manifestly unsafe voyage.

An operator who refuses to terminate the unsafe use of a vessel can be cited for failure to comply with the directions of a Coast Guard boarding officer, as well as for the specific violations which were the basis for the termination order. Violators may be fined not more than $1000 or imprisoned not more than one year or both.

COAST GUARD APPROVED EQUIPMENT

The Coast Guard sets minimum safety standards for vessels and associated equipment. To meet these standards various equipment must be Coast Guard approved. "Coast Guard Approved Equipment" has been determined to be in compliance with USCG specifications and regulations relating to performance, construction or materials.

PERSONAL FLOTATION DEVICES (PFDS)

PFDs must be Coast Guard Approved, in good and serviceable condition, and of appropriate size for the intended user. Wearable PFDs must be readily accessible, meaning you must be able to put them on in a reasonable amount of time in an emergency (vessel sinking, on fire, etc.). They should not be stowed in plastic bags, in locked or closed compartments or have other gear stowed on top of them. Throwable devices must be immediately available for use. Though not required, a PFD should be worn at all times when the vessel is underway. A wearable PFD can save your life, but only if you wear it.

Boats less than 16 feet in length (including canoes and kayaks of any length) must be equipped with one Type I, II, III, IV or V PFD for each person aboard.

Boats 16 feet and longer must be equipped with one Type I, II, III or V for each person aboard PLUS one Type IV.

Federal law does not require PFDs on racing shells, rowing skulls and racing kayaks; State laws vary.

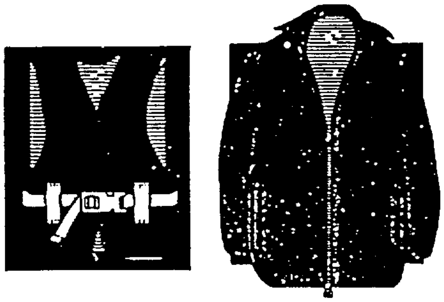
TYPES OF PFDS

A TYPE I PFD, or OFF-SHORE LIFE JACKET provides the most buoyancy. It is effective for all waters, especially open, rough or remote waters where rescue may be delayed. It is designed to turn most unconscious wearers in the water to a face-up position. The Type I comes in two sizes. The adult size provides at least 22 pounds buoyancy, the child size, 11 pounds, minimum.

Off-shore Lifejacket

Near-Shore Buoyant Vest

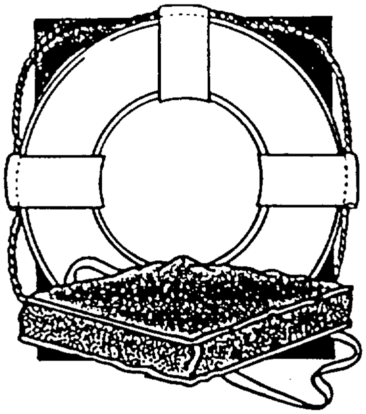
A TYPE II PFD, or NEAR-SHORE BUOYANT VEST is intended for calm, inland water or where there is a good chance of quick rescue. This type will turn SOME unconscious wearers to a face-up position in the water. The turning action is not as pronounced and it will not turn as many persons under the same conditions as a Type I. An adult size device provides at least 15 1/2 pounds buoyancy, a medium child size provides 11 pounds. Infant and small child sizes each provide at least 7 pounds buoyancy.



Flotation Aid

A TYPE III PFD, or FLOTATION AID is good for calm, inland water, or where there is a good chance of quick rescue. It is designed so wearers can place themselves in a face-up position in the water. The wearer may have to tilt head back to avoid turning face-down in the water. The Type III has the same minimum buoyancy as a Type II PFD. It comes in many styles, colors and sizes and is generally the most comfortable type for continuous wear. Float coats, fishing vests and vests designed with features suitable for various sports activities are examples of this type PFD.

A TYPE IV PFD, or THROWABLE DEVICE is intended for calm, inland water with heavy boat traffic, where help is always present. It is designed to be thrown to a person in the water and grasped and held by the user until rescued. It is not designed to be worn. Type IV devices include buoyant cushions, ring buoys and horseshoe buoys.

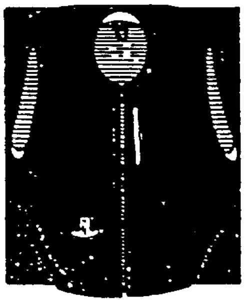


Throwable Device

A TYPE V PFD, or SPECIAL USE DEVICE is intended for specific activities and may be carried instead of another PFD only if used according to the approval conditions on the label. Some Type V devices provide significant hypothermia protection. Varieties include deck suits, work vests, board sailing vests and Hybrid PFDs.

A TYPE V HYBRID INFLATABLE PFD is the least bulky of all PFD types. It contains a small amount of inherent buoyancy, and an inflatable chamber. Its performance is equal to a Type I, II, or III PFD (as noted on the PFD label) when inflated. Hybrid PFDs must be worn when underway to be acceptable.

Inflated Hybrid



WATER SKIING

A water skier, while being towed, is considered on board the vessel and a PFD is required for the purposes of compliance with the PFD carriage requirements. Although not required by Federal law it is advisable and recommended for a skier to wear a PFD designed and intended to withstand the impact off hitting the water at high speed as when a skier falls. "Impact Class" marking refers to PFD strength, not personal protection. Some State laws require skiers to wear a PFD.

VISUAL DISTRESS SIGNALS

All vessels, used on coastal waters, the Great Lakes, territorial seas and those waters connected directly to them, up to a point where a body of water is less than two miles wide, must be equipped with visual distress signals. Vessels owned in the United States operating on the high seas must be equipped with visual distress signals. The following vessels are not required to carry day signals but must carry night signals when operating from sunset to sunrise:

- Recreational boats less than 16 feet in length.
- Boats participating in organized events such as races, regattas or marine parades.
- Open sailboats less than 26 feet in length not equipped with propulsion machinery.
- Manually propelled boats.

PYROTECHNIC VISUAL DISTRESS SIGNALS must be Coast Guard Approved, in serviceable condition and readily accessible. They are marked with a date showing the service life, which must not be expired. Launchers manufactured before January 1, 1981, intended for use with approved signals, are not required to be Coast Guard Approved. If pyrotechnic devices are selected, a minimum of three are required. That is three signals for day use and three signals for night. Some pyrotechnic signals meet both day and night use requirements. Pyrotechnic devices should be stored in a cool, dry location. A watertight container painted red or orange and prominently marked "DISTRESS SIGNALS" is recommended.

USCG Approved Pyrotechnic Visual Distress Signals and Associated Devices include:

- Pyrotechnic red flares, hand-held or aerial.
- Pyrotechnic orange smoke, hand-held or floating.
- Launchers for aerial red meteors or parachute flares.

NON-PYROTECHNIC VISUAL DISTRESS SIGNALS must be in serviceable condition, readily accessible and certified by the manufacturer as complying with USCG requirements, they include:

- Orange distress flag
- Electric distress light

The distress flag is a day signal only. It must be at least 3 x 3 feet with a black square and ball on an orange background. It is most distinctive when attached and waved on a paddle or boathook or flown from a mast.

The electric distress light is accepted for night use only and must automatically flash the international SOS distress signal (···———···). This is an unmistakable distress signal. A standard flashlight is not acceptable as a visual distress signal.

Under Inland Navigation Rules, a high intensity white light flashing at regular intervals from 50-70 times per minute is considered a distress signal. Strobe lights used in inland waters shall only be used as a distress signal.

Regulations prohibit display of visual distress signals on the water under any circumstances except when assistance is required to prevent immediate or potential danger to persons on board a vessel.

All distress signals have distinct advantages and disadvantages, no single device is ideal under all conditions or suitable for all purposes. Pyrotechnics are excellent distress signals, universally recognized. However, there is potential for injury and property damage if not properly handled. These devices produce a very hot flame, the residue can cause burns and ignite flammable material. Pistol launched and hand-held parachute flares and meteors have many characteristics of a firearm and must be handled with caution.

FIRE EXTINGUISHERS

Approved extinguishers are classified by a letter and number symbol. The letter indicates the type fire the unit is designed to extinguish (Type B designed to extinguish flammable liquids such as gasoline, oil and grease fires). The number indicates the relative size of the extinguisher (minimum extinguishing agent weight).

Approved extinguishers are hand-portable, either B-I or B-II classification and have the following characteristics:

<u>Classes</u>	*Foam* <u>*(Gals.)*</u>	*CO_2* <u>*(LBS)*</u>	*Dry Chemical* <u>*(LBS)*</u>	*Halon* <u>*(LBS)*</u>
B-I	1.25	4	2	2.5
B-II	2.5	15	10	10

Fire extinguishers are required if any one or more of the following conditions exist:

- Inboard engines.
- Closed compartments under thwarts and seats where portable fuel tanks may be stored.
- Double bottoms not sealed to the hull or which are not completely filled with flotation materials.
- Closed living spaces.
- Closed stowage compartments in which combustible or flammable materials are stored.
- Permanently installed fuel tanks. Fuel tanks secured so they cannot be moved in case of fire or other emergency are considered permanently installed. There are no gallon capacity limits to determine if a fuel tank is portable. If the weight of a fuel tank is such that persons on board cannot move it, the Coast Guard considers it permanently installed.

Dry chemical fire extinguishers without gauges or indicating devices must be inspected every 6 months. If the gross weight of a carbon dioxide (CO_2) extinguisher is reduced by more than 10% of the net weight, the extinguisher is not acceptable and must be recharged.

Check extinguishers regularly to ensure gauges are free and nozzles are clear.

Minimum number of hand portable fire extinguishers required:

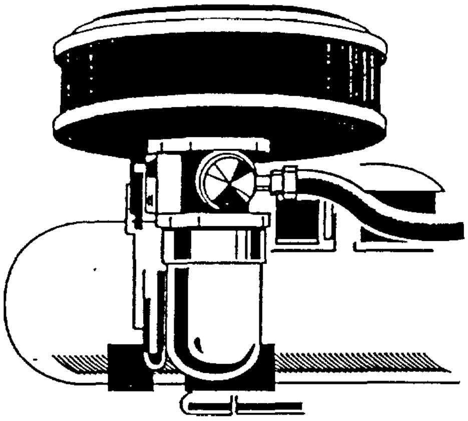
VESSEL LENGTH	NO FIXED SYSTEM	WITH APPROVED FIXED SYSTEM
Less than 26'	1 B-I	0
26' to less than 40'	2 B-I or 1 B-II	1 B-I
40' to 65'	3 B-I or 1 B-II and 1 B-1	2 B-I or 1 B-II

Coast Guard Approved extinguishers are identified by the following marking on the label: "Marine Type USCG Approved, Size . . ., Type . . ., 162.208/ . . . /", etc.

Types of Fire Extinguishers

BACKFIRE FLAME CONTROL

Gasoline engines installed in a vessel after April 25, 1940, except outboard motors, must be equipped with an acceptable means of backfire flame control. The device must be suitably attached to the air intake with a flametight connection and is required to be Coast Guard approved.



Back Fire Flame Arrester

REQUIRED NONAPPROVED EQUIPMENT

NATURAL VENTILATION

All vessels with propulsion machinery that use gasoline for fuel, with enclosed engine and/or fuel tank compartments built after April 25, 1940 and before August 1, 1980 are required to have natural ventilation.

Natural ventilation consists of at least two ventilation ducts fitted with cowls or their equivalent for the purpose of efficiently ventilating the bilges of every engine and fuel tank compartment. At least one exhaust duct extending to the lower portion of the bilge and at least one intake duct extending to a point midway to the bilge or at least below the level of the carburetor air intake is required.

Vessels built after July 31, 1978, but prior to August 1, 1980, have no requirement for ventilation of the fuel tank compartment if there is no electrical source in the compartment and the tank vents to the outside of the vessel.

POWERED VENTILATION

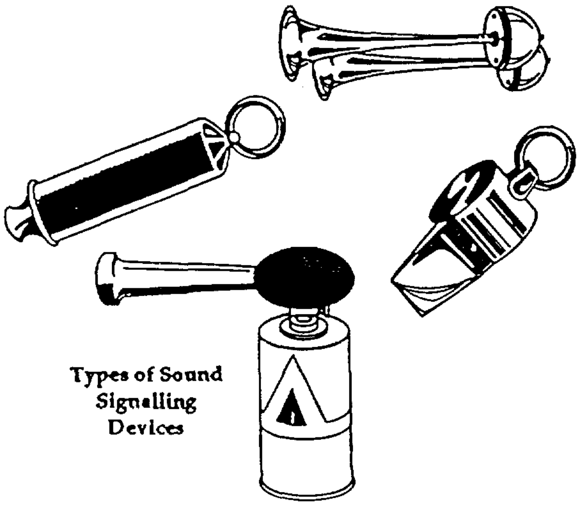
Vessels built after July 31, 1980 that have gasoline engines, with a cranking motor (starter), for electrical generation, mechanical power or propulsion in a closed compartment are required to have a powered ventilation system. This includes each compartment with such an engine.

No person may operate a vessel built after July 31, 1980 with a gasoline engine in a closed compartment unless it is equipped with an operable ventilation system that meets Coast Guard standards. The operator is required to keep the system in operating condition and ensure cowls and ducting are not blocked or torn.

SOUND SIGNALLING DEVICES

Regulations do not specifically require vessels less than 12 meters to carry a whistle, horn or bell. However, the navigation rules require sound signals to be made under certain circumstances. Meeting, crossing and overtaking situations described in Navigation Rules section are examples of when sound signals are required. Recreational vessels are also required to sound fog signals during periods of reduced visibility. Therefore, you must have some means of making an efficient sound signal.

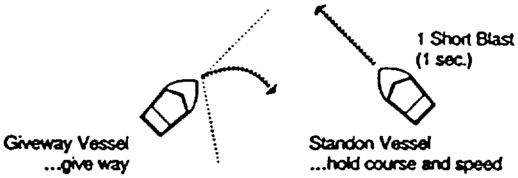
Vessels 12 meters or more in length are required to carry on board a power whistle or power horn and a bell.



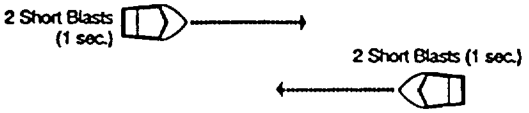
Types of Sound Signalling Devices

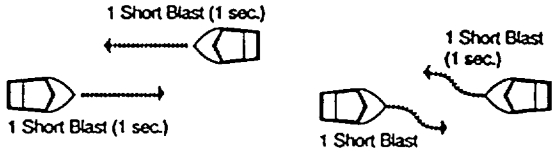
NAVIGATION RULES

The Navigation Rules establish actions to be taken by vessels to avoid collision. The vessel operator is responsible for knowing and following applicable navigation rules. The following diagrams describe the whistle signals and actions to be taken by recreational vessels in a crossing, meeting and overtaking situation. These are basic examples, for further information consult the NAVIGATION RULES International - Inland (COMDTINST M16672.2A).

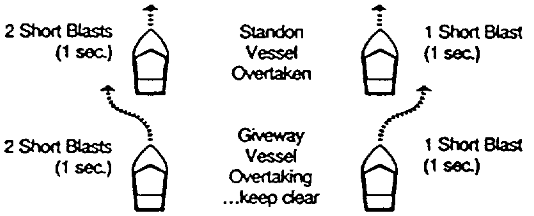


Meeting Head-On or Nearly So





Overtaking Situations



International Rules apply outside established lines of demarcation and Inland Rules apply inside the lines. Demarcation lines are printed on most navigational charts and are published in the Navigation Rules.

NAVIGATION LIGHTS

Recreational vessels are required to display navigation lights between sunset and sunrise and other periods of reduced visibility (fog, rain, haze etc.). The U. S. Coast Guard Navigation Rules, International - Inland encompasses lighting requirements for every description of watercraft. The information provided here is intended for power-driven and sailing vessels less than 20 meters.

POWER DRIVEN VESSELS

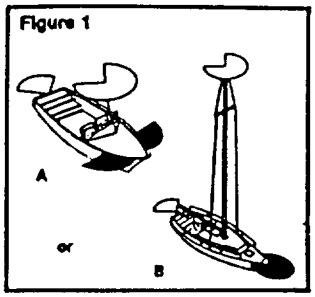


Figure 1

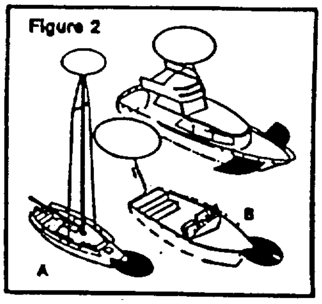


Figure 2

Power-driven vessels of less than 20 meters, shall exhibit navigation lights as shown in Figure 1. Vessels of less than 12 meters in length, may show the lights in either Figure 1 or Figure 2.

Power-driven vessels of less than 7 meters whose maximum speed cannot exceed 7 knots may exhibit an all-round white light, and if practicable sidelights instead of the lights prescribed above, in International Waters only.

Sailing vessels operating under machinery, or under sail and machinery are considered power-driven and must display the lights prescribed for a power-driven vessel.

SAILING VESSELS AND VESSELS UNDER OARS

Sailing vessels less than 20 meters exhibit navigation lights shown in Figures 3 or 4 or may be combined in a single lantern carried at the top of the mast as shown in Figure 5.

Sailing vessels less than 7 meters may carry an electric torch or lighted lantern showing a white light

Figure 3

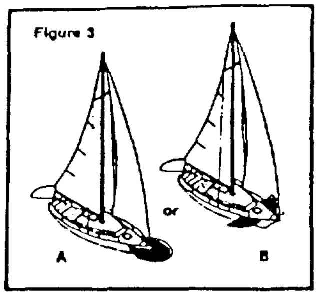


Figure 4

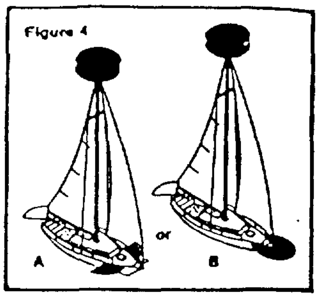


Figure 5

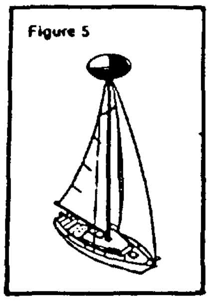
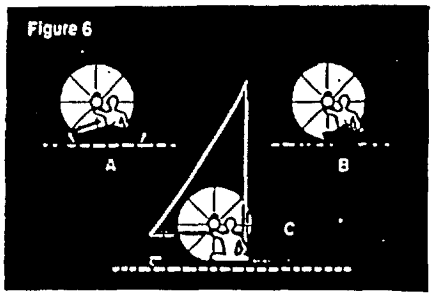


Figure 6



to be displayed in sufficient time to prevent collision (see Figure 6), if practicable, the lights prescribed for sailing vessels less than 20 meters should be displayed.

Vessels under oars may display the lights prescribed for sailing vessels, but if not, must have ready at hand an electric torch or lighted lantern showing a white light to be shown in sufficient time to prevent collision (see Figure 6).

LIGHTS FOR ANCHORED VESSELS

Power-driven vessels and sailing vessels at anchor must display anchor lights. An anchor light for a vessel less than 20 meters in length is an all-round white light visible for 2 miles exhibited where it can best be seen.

Vessels less than 7 meters are not required to display anchor lights unless anchored in or near a narrow channel, fairway or anchorage or where other vessels normally navigate.

Anchor lights are not required on vessels less than 20 meters, anchored in special anchorages designated by the Secretary of Transportation in Inland Waters.

Vessels under sail also being propelled by machinery, must exhibit forward, where it can best be seen, a conical shape, apex down (See Figure 7). Vessels less than 12 meters are not required to exhibit the dayshape in Inland Waters.

DIVING OPERATIONS

The Navigational Rules require vessels restricted in ability to maneuver to display appropriate day shapes. To meet this requirement, recreational vessels engaged in diving activities may exhibit a rigid replica of the international code flag "A" not less than one meter in height (See Figure 8).

This requirement does not affect the use of the red and white diver's flag which may be required by State or local law to mark the diver's location under water. The "A" flag is a navigation signal advertising the vessel's restricted maneuverability. It does not pertain to the diver.

DAY SHAPES
REQUIRED BETWEEN SUNRISE AND SUNSET

Figure 7

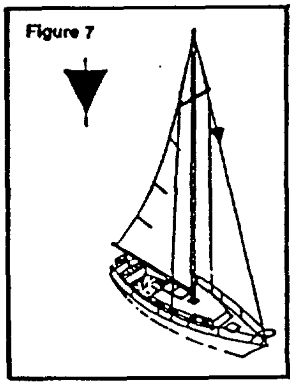
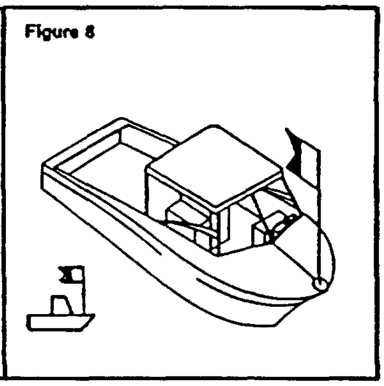


Figure 8



The operator of each self-propelled vessel 12 meters or more in length is required to carry on board, and maintain for ready reference, a copy of the Inland Navigation Rules while operating on Inland waters, subject to a penalty for failure to comply of not more than $5,000. Copies of the rules may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 (tel: (202) 783-3238). Stock number 050-012-00205-3, $6.00 each.

POLLUTION REGULATIONS

The Refuse Act of 1899 prohibits throwing, discharging or depositing any refuse matter of any kind (including trash, garbage, oil and other liquid pollutants) into the waters of the United States. The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances which may be harmful into U. S. navigable waters. You must immediately notify the U. S. Coast Guard if your vessel discharges oil or hazardous substances into the water. Call toll-free 800-424-8802 (In Washington, D. C. (202) 267-2675). Report the following information:

a. location	c. size	e. substance
b. source	d. color	f. time observed

Avoid flame, physical contact or inhalation of fumes near any source of pollution.

Regulations issued under the Federal Water Pollution Control Act require all vessels with machinery propulsion to have a capacity to retain oily mixtures on board. A fixed or portable means to discharge oily waste to a reception facility is required. A bucket or bailer is suitable as a portable means of discharging oily waste on recreational vessels.

No person may intentionally drain oil or oily waste from any source into the bilge of any vessel.

Vessels 26 feet in length and over must display a placard at least 5 by 8 inches, made of durable material, fixed in a conspicuous place in the machinery spaces, or at the bilge pump control station, stating the following:

DISCHARGE OF OIL PROHIBITED

The Federal Water Pollution Control Act prohibits the discharge of oil or oily waste into or upon the navigable waters of the United States or the waters of the contiguous zone if such discharge causes a film or sheen upon, or discoloration of, the surface of the water, or causes a sludge or emulsion beneath the surface of the water. Violators are subject to a penalty of $5,000.

Marine Sanitation Devices

All recreational boats with installed toilet facilities must have an operable marine sanitation device (MSD) on board. Vessels 65 feet and under may use a Type I, II or III MSD. Vessels over 65 feet must install a Type II or III MSD. All installed MSDs must be Coast Guard certified. Coast Guard certified devices are so labeled except for some holding tanks, which are certified by definition under the regulations.

REPORTING BOATING ACCIDENTS

All boating accidents or accidents resulting from the use of related equipment (which meet the criteria below), must be reported by the operator or owner of the vessel to the proper marine law enforcement authority for the State in which the accident occurred.

IMMEDIATE NOTIFICATION REQUIRED FOR FATAL ACCIDENTS. If a person dies or disappears as a result of a recreational boating accident the nearest State boating authority must be notified without delay, providing the following information:

- Date, time and exact location of the accident;
- Name of each person who died or disappeared;
- Number and name of the vessel; and
- Names and addresses of the owner and operator.

A FORMAL REPORT OF A FATALITY MUST BE FILED WITH IN 48 HOURS. If, as a result of a boating or related equipment accident, a person sustains injuries that require more than first aid, a formal report must be filed.

ACCIDENTS INVOLVING MORE THAN $200 DAMAGE MUST BE REPORTED WITHIN 10 DAYS. A formal report must be made if property damage exceeds $200; or there is a complete loss of a vessel.

If you need further information regarding accident reporting, please call the Boating Safety Hotline, 800-268-5647.

RENDERING ASSISTANCE

The master or person in charge of a vessel is obligated by law to provide assistance that can be safely provided to any individual at sea in danger of being lost, and is subject to a fine and/or imprisonment for failure to do so.

ADDITIONAL EQUIPMENT AND ADVICE

As the operator and/or owner you are responsible for the prudent and safe operation of your vessel, and for the lives and safety of your passengers and others around you. You should become familiar with Federal, State and local rules and regulations regarding safe boat operation and attempt to learn and practice good seamanship, boathandling, navigation and piloting, etc.

Besides meeting the legal requirements, prudent boaters carry additional safety equipment.

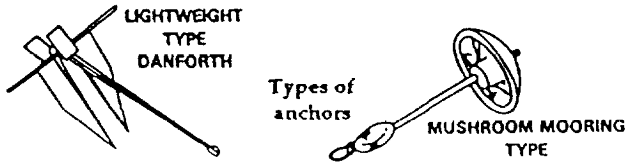
ADDITIONAL MEANS OF PROPULSION

Vessels less than 16 feet should carry alternate propulsion, such as a paddle or oars. If an alternate means of mechanical propulsion is carried it should use a separate fuel tank and starting source than the main propulsion motor.

ANCHORING

All vessels should be equipped with an anchor and line of suitable size and length for the vessel and waters in which it is being operated. Choose the right anchor for your vessel and the type of bottom you expect to be anchoring in.

To anchor, bring the bow into the wind or current and put the engine in neutral. When the vessel comes to a stop, lower, do not throw, the anchor over the bow. The anchor line should be 5 to 7 times the depth of water.



Types of anchors

STERN ANCHORING

Anchoring a small boat by the stern has caused many to capsize and sink. The transom is usually squared off and has less freeboard than the bow. In a current, the stern can be pulled under by the force of the water. The boat is also vulnerable to swamping by wave action. The weight of a motor, fuel tank, or other gear in the stern increases the risk. Do not anchor by the stern!!

BAILER

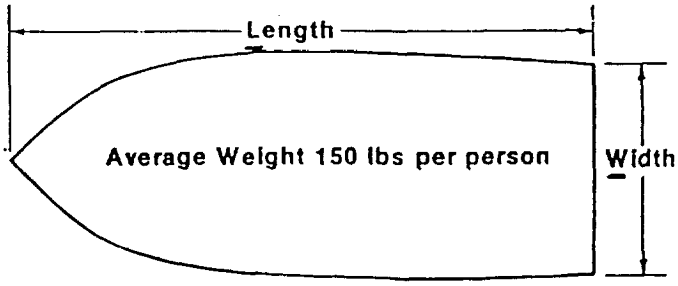
All vessels should carry at least one effective manual device (portable bilge pump, bucket, scoop, etc.) for bailing water, in addition to any installed electric bilge pump.

FIRST AID

As the operator of a small boat you should consider taking a First Aid course and becoming proficient in its application. A first aid kit and manual, bandages, gauze, adhesive tape, antiseptic, aspirin, etc. is suggested.

LOADING YOUR VESSEL

Keep the load low and evenly distributed. Do not exceed the "U. S. Coast Guard Maximum Capacities" label. If there is no capacity label use the following formula to determine the maximum number of persons you can safely carry in calm weather:



$$\text{People} = \frac{L \times W}{15}$$

Length is determined by measuring in a straight line from the foremost part to the aftermost of the vessel, parallel to the centerline, exclusive of sheer. Bowsprits, rudders, outboard motors and similar fittings are not included in the measurement.

FUELING PRECAUTIONS

Fill portable tanks off the vessel. Close all hatches and other openings before fueling. Extinguish smoking materials. Secure all electrical equipment, radios, stoves and other appliances. Secure all engines and motors.

Wipe up any spilled fuel immediately. Open all hatches to air out the vessel. Run the blower five minutes, and then check the bilges for fuel vapors before starting the engine. NEVER start the engine until all traces of fuel vapors are eliminated.

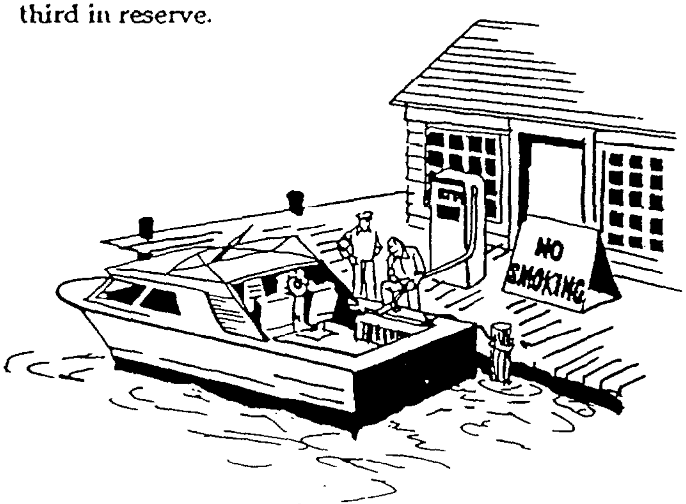
FUEL TANKS

Ensure portable fuel tanks are constructed of sturdy material and in good condition, free of excessive corrosion and do not leak. The vents on portable tanks must be operable and the tanks should have a vapor-tight, leak-proof cap. Do not allow excessive movement of portable tanks.

Permanent fuel tanks and lines should be free of corrosion and must not leak. Tanks must be vented to the outside of the hull. The fill pipe and plate must fit tightly and be located outside of closed compartments.

FUEL MANAGEMENT

Practice the "One-Third Rule" by using one-third of the fuel going out, one-third to get back and one-third in reserve.



CARE AND MAINTENANCE

All equipment and supplies should be properly secured. Keep decks and other spaces clean, free of clutter and trash. The vessel should be free of fire hazards with clean bilges and in good condition. Inspection and required maintenance on a regular schedule will ensure the hull and superstructure remain sound. Ensure all repairs are made properly and with marine rated parts. You should carry a few tools, spare parts and learn how to make minor repairs.

FLOAT PLAN

Tell a friend or relative where you are going and when you plan to return. Make sure they have a description of your vessel and other information that will make identification easier should the need arise. An example is provided on the inside front cover.

WEATHER

Check weather reports before leaving shore and remain watchful for signs of bad weather. Become familiar with National Weather Service Storm Advisory Signals and know where they are displayed.

SMALL BOATS AND WATER ACTIVITIES

Most hunters and anglers do not think of themselves as boaters. But many use small semi-v hull vessels, flatbottom jon boats or canoes to pursue their sport. These boats tend to be unstable and easily capsized. Capsizings, sinkings, and falls overboard account 70% of boating fatalities and are directly related to poor stability. These facts mean care must be used in operating small boats. You must have a greater awareness of the boat's limitations and the skill and knowledge to overcome them.

Standing in a small boat raises the center of gravity, often to the point of capsizing. Standing for any reason or even changing position in a small boat can be dangerous, as is sitting on the gunnels or seat backs or in a pedestal seat while underway. A wave or sudden turn may cause a fall overboard or capsizing because of the raised center of gravity.

SURVIVAL TIPS

It is a common belief that someone dressed in heavy clothing or waders will sink immediately if they fall overboard. This is not true. Air trapped in clothing provides considerable flotation, bending the knees will trap air in waders, providing additional flotation. To stay afloat, remain calm, do not thrash about or try to remove clothing or footwear, this leads to exhaustion and increases the loss of air that keeps you afloat. Keep your knees bent, float on your back and paddle slowly to safety.

HYPOTHERMIA

Hypothermia is the loss of body heat, immersion in water speeds the loss of heat. If your boat capsizes it will likely float on or just below the surface. Vessels built after 1978 will support you even if full of water or capsized. To reduce the effects of hypothermia get in or on the boat. Try to get as much of your body out of the water as possible. If you can't get in the boat a PFD will enable you to keep your head out of the water. This is very important because about 50% of body heat loss is from the head.

SUDDEN DISAPPEARANCE SYNDROME

Sudden immersion in cold water can induce rapid, uncontrolled breathing, cardiac arrest, and other life-threatening situations which can result in drowning. Wearing a PFD will prevent this. If you must enter the water, button up your clothing, wear a PFD, cover your head if possible and enter the water slowly.

COLD WATER DROWNING

It may be possible to revive a drowning victim who has been under water for considerable time and shows no signs of life. Increasingly numerous documented cases exist where victims have been resuscitated with no apparent harmful effects after long immersions. Start CPR immediately and get the victim to a hospital as quickly as possible.

CONVERSION OF METRIC TO U. S. UNITS

Metric Measure	Feet in Decimals	Feet and Inches
50 Meters (M)	164.0 ft.	164'1/2"
20 Meters (M)	65.6 ft.	65'7 1/2"
12 M	39.4 ft.	39'4 1/2"
10 M	32.8 ft.	32'9 3/4"
8 M	26.2 ft.	26'3"
7 M	23.0 ft.	23'11 1/2"
6 M	19.7 ft.	19'8 1/4"
5 M	16.4 ft.	16'4 3/4"
4 M	13.1 ft.	13'1 1/2"
2.5 M	8.2 ft.	8'2 1/2"
1 M	3.3 ft.	3'3 1/4"

Boating Safety is no accident. To build sound knowledge, proficiency and confidence, the keys to safe boating, take a boating safety course.

Coast Guard

Boating Safety Hotline:

800-368-5647

- ✓ *For Boating Safety Recall Information.*
- ✓ *To Report Possible Safety Defects In Boats.*
- ✓ *For Answers To Boating Safety Questions.*
- ✓ ***Call, Toll Free!***

For more information on boating safety and boating courses, contact your State Boating Agency, local Coast Guard District or call the Boating Safety Hotline.

Section 6.0 - Drum Sampling Procedures

(SOP F108 - Baker's Standard Operating Procedures for Administrative, Field, and Technical Activities, Volume II)

DRUM SAMPLING

1.0 PURPOSE

The purpose of this SOP is intended to provide general information for the sampling of drums in the field. However, due to widely varied (and potentially hazardous) conditions posed by drum sampling, specific SOPs must be determined on a case-by-case basis. Actual drum sampling will be conducted by qualified individuals.

2.0 SCOPE

This SOP provides information to assist in ensuring that safe procedures are followed as applicable to the inspection, opening, and sampling of drums in the field. Levels of protection required during drum sampling will be specific to each location; therefore, protection levels will be addressed in the site-specific Health and Safety Plan (HASP).

3.0 DEFINITIONS

Bung - a threaded metal or plastic plug usually positioned at the top or side of a drum.

Over Pack - a metal or plastic drum-like container that is larger than the container(s) stored therein.

Lab Pack - a drum holding multiple individual containers of laboratory materials normally surrounded by cushioning absorbent material.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures where applicable, or that other approved procedures are developed. The Project Manager is responsible for development of documentation of procedures which deviate from those presented herein.

Site Health and Safety Officer (HSO) - The Site HSO is responsible for ensuring that the proper respiratory and personal protective equipment for each member of the sampling team is selected in compliance with the HASP, and coordinating these efforts with the Field Team Leader.

Field Team Leader - The Field Team Leader is responsible for selecting and detailing the drum sampling techniques and equipment to be used. It is the responsibility of the Field Team Leader to ensure that these procedures are implemented in the field and to ensure that the Field Investigation personnel performing drum sampling activities have been briefed and trained to execute these procedures.

Field Investigation Personnel - It is the responsibility of the Field Investigation Personnel to follow these procedures or to follow documented project-specific procedures as directed by the Field Team Leader and Project Manager. The Field Investigation Personnel are responsible for documenting all sampling data on the appropriate Drum Sample Characterization Sheet and in the Field Logbook.

5.0 PROCEDURES

It is anticipated that the procedures for drum sampling may include a limited degree of handling; therefore, it will be necessary to inspect for certain conditions prior to sampling drums.

5.1 Inspection

Prior to sampling, drums will be visually inspected to gain as much information as possible about their contents. Items to consider during inspection include:

- Symbols, wording, labels, or other marks on the drum indicating that its contents are hazardous, e.g., radioactive, explosive, corrosive, toxic, or flammable.
- Symbols, wording, labels, or other marks on a drum indicating that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume individual containers.
- Signs of deterioration such as corrosion, rust, and leaks.
- Signs of the chemical nature of the contents, such as residue, crystal buildup, etc. at bung opening, etc.
- Signs that the drum is under pressure such as swelling and bulging.

- Special drum types (refer to Table 1).
- Configuration of the drumhead.
- Drum standing upright, tilted, or lying on its side.
- Accessibility of the drum.

Monitoring will be conducted around the drums using instruments such as a gamma radiation survey instrument, organic vapor monitor (OVA or HNu), colorimetric tubes (Dräger tubes), and a combustible gas meter. The results can be used to classify the drums into categories such as radioactive, leaking/deteriorating, bulging, explosive/shock-sensitive, or laboratory packs.

When drums exhibit the characteristics of the aforementioned categories, the following procedures will be followed:

- Radioactive Wastes - If the drum exhibits radiation levels above background, normally 0.01-0.02 mrem/hr (milliroentgen equivalent in man per hour), that are less than or equal to 2 mrem/hr, there is a possible radiation source present. Continue the investigation with caution, and inform the Site HSO. If the radiation levels are greater than 2 mrem/hr there is a potential radiation hazard. Work will stop, and the Field Team Leader and Project Manager will be notified so that new procedures can be implemented.

- Explosive or Shock-Sensitive Waste - If handling is necessary, exercise extreme caution, have non-essential personnel move to a safe distance, and use a grappler unit constructed for explosive containment for initial handling. Use non-sparking equipment and/or remote control devices, if available.

- Bulging Drums - Do not move drums under internal pressure unless proper equipment is used, such as a grappler unit constructed for explosive containment.

- Packaged Laboratory Wastes (Lab Packs) - Lab Packs can be an ignition source for fires and sometimes contain shock-sensitive materials. Once a lab pack has been opened, a chemist or other qualified individual should inspect, classify and segregate

TABLE 1

SPECIAL DRUM TYPES

Polyethylene or PVC-lined Drums	Often contain strong acids or bases. If the lining is punctured, the substance will usually corrode the steel, resulting in a significant leak or spill.
Exotic Metal Drums (e.g., aluminum, nickel, stainless steel, or other unusual metal)	Very expensive drums that usually contain an extremely dangerous and/or corrosive/reactive material.
Single-Walled Drums used as a Pressure Vessel	These drums have fittings for both product filling and placement of an inert gas, such as nitrogen. May contain reactive, flammable, or explosive substances.
Laboratory Packs	Used for disposal of expired chemicals and process samples from university laboratories, hospitals, and similar institutions. Individual containers within the lab pack are often not packed in absorbent material. They may contain incompatible materials, radioisotopes, shock-sensitive, highly volatile, highly corrosive, or extremely toxic exotic chemicals. Laboratory packs can be an ignition source for fires at hazardous waste sites.

the bottles (without opening), according to the hazards of the wastes. The objective of such a classification system is to ensure safe segregation of the lab packs' contents (refer to Table 2 for an example of a lab pack classification). If crystalline material is noted at the neck of any bottle, handle it as a shock-sensitive waste due to the potential presence of picric acid, potassium permanganate or explosive mixtures resulting when the aqueous solution crystallizes, or other inimical materials, and obtain advice from qualified personnel prior to handling.

Until drum contents are characterized, sampling personnel will assume that unlabeled drums contain hazardous materials. Personnel also should be aware that drums are frequently mislabeled and may not contain the material identified.

5.2 Drum Opening

Drums are to be opened and sampled in place. For opening drums manually, equipment such as a nonsparking metal (bronze/manganese, aluminum, molybdenum) bung/plug wrench and a drum deheading device will be used for waste contents that are known to be nonreactive and nonexplosive, within a structurally sound drum.

While opening drums manually with a bung wrench, the following procedures will be used:

- Drums will be positioned bung up, or, for drums with bungs on the side, laid on their sides with the bung plug up.
- Use a wrenching motion that is a slow and steady pull across the drum, using a "cheater bar" if the leverage for unscrewing the bung is poor.
- If there is evidence of incompatible chemical reactions, a sudden pressure buildup, or a release of potentially toxic fumes while the bung is being loosened, field personnel will immediately leave the area and arrange for remote drum opening equipment to be used.
- If the drum cannot be opened successfully using a nonsparking hand wrench, then other methods of drum opening (deheading or puncturing) must be considered.

TABLE 2

LAB PACK CLASSIFICATION EXAMPLES

Classification	Examples
Inorganic acids	Hydrochloric Acid Sulfuric Acid
Inorganic bases	Sodium hydroxide Potassium hydroxide
Strong oxidizing agents	Ammonium nitrate Barium nitrate Sodium chlorate Sodium peroxide
Strong reducing agents	Sodium thiosulfate Oxalic acid Sodium sulphite
Anhydrous organics and organometallics	Tetraethyl lead Phenylmercuric chloride
Anhydrous inorganics and metal hydrides	Potassium hydride Sodium hydride Sodium metal Potassium
Toxic organics	PCBs Insecticides
Flammable organics	Hexane Toluene Acetone
Inorganics	Sodium carbonate Potassium chloride
Inorganic cyanides	Potassium cyanide Sodium cyanide Copper cyanide
Organic cyanides	Cyanoacetamide
Toxic metals	Arsenic Cadmium Lead Mercury

- If the drum shows signs of swelling or bulging, perform all steps slowly. From a remote location, relieve excess pressure prior to opening using the devices listed below, if possible. If performing manually, place a barrier such as an explosion-resistant plastic shield between the worker and bung to deflect any gas, liquid, or solids which may be expelled as the bung is loosened.

Whenever possible, use the following remote-controlled devices for opening drums:

- A pneumatically operated impact wrench to remove drum bungs.
- A hydraulically or pneumatically operated drum piercer.
- A backhoe equipped with bronze spikes for penetrating drum tops (typical in large-scale operations).

If a supplied-air respiratory protection system is used, the bank of air cylinders must be maintained outside of the work area.

If personnel must be located near the drums being opened, place explosion-resistant plastic shields between them and the drums, in case of detonation. Locate controls for drum opening equipment, monitoring equipment, and fire suppression equipment behind the explosion-resistant plastic shield.

When feasible, monitor air quality continuously during drum opening, and as close as possible to the potential source of contaminants, i.e., placing as close as practical without hindering drum opening operations, and hang or balance the drum opening equipment to minimize exertion.

Do not use picks, chisels, etc. to open drums manually.

Open exotic metal drums and polyethylene or polyvinylchloride-lined (PVC-lined) drums by removing or manually drilling the bung, while exercising extreme caution.

Do not open or sample individual containers within laboratory packs.

Reseal open bungs and/or drill openings as soon as possible, with new bungs or plugs to avoid explosions and/or vapor generation. If an open drum cannot be resealed, place the drum into an overpack. Plug any openings in pressurized drums with pressure venting caps set to a 5-psi release to allow venting of vapor pressure.

Decontaminate and/or dispose of sampling equipment after each use to avoid mixing incompatible wastes and contaminating subsequent samples.

5.3 Drum Sampling

Drum sampling can be a very hazardous activity because it often involves direct contact with unidentified wastes. Prior to collecting any sample, field team personnel will become familiar with the procedures identified in the Sampling Plan.

Certain information can be construed from the drumhead configuration prior to sampling, such as:

- Removable "Whole" Lid = designed to contain solid material
- Bung opening = designed to contain liquids
- Drum Liner = may contain a highly corrosive or otherwise hazardous material

When manually sampling from a drum, use the following techniques:

- Keep sampling personnel at a safe distance while drums are being opened. Sample only after opening procedures are complete.

- Do not lean over or between other drums to reach the drum being sampled.

- Cover drum tops with plastic sheeting or other suitable uncontaminated materials to avoid excessive contact with the drum tops.

- Never stand on drums. Use mobile steps or another platform to achieve the height necessary to safely sample from the drums.

- Obtain samples with either glass rods or vacuum pumps. Do not use contaminated items such as discarded rags during sampling. Glass rods will be removed prior to pumping to minimize damage to pumps.

- Identify each drum with a sample number. Record the number on the Drum Waste Characterization Sheet and permanently on the drum (mark lid and side) using either a label, permanent marker, or spray paint.

6.0 QUALITY ASSURANCE RECORDS

Quality assurance records shall consist of completed Drum Waste Characterization Sheets and data entered into the Field Logbook. A sample Drum Waste Characterization Sheet is attached.

7.0 REFERENCES

NIOSH/OSHA/USCG/EPA, 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health. Publication No. 85-115.

U.S. EPA, 1986. Drum Handling Practices at Hazardous Waste Sites. Wetzel, Furman, Wickline, and Hodge, JRB Associates, McLean, Virginia. Publication No. 86-165362.

NIOSH, 1990. NIOSH Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Cincinnati, Ohio. Publication No. 90-117.

ATTACHMENT A

DRUM WASTE CHARACTERIZATION SHEET

BAKER ENVIRONMENTAL, INC.
DRUM WASTE CHARACTERIZATION SHEET

PROJECT: ____________________
CTO NUMBER: ____________________
INSPECTION DATE: ____________________
WEATHER: ____________________
BAKER REPRESENTATIVE: ____________________

MONITORING EQUIPMENT (Serial Number): ____________________
CALIBRATION DATE/TIME/INITIALS: ____________________
PRE-INSPECTION AIR MONITORING SCAN: ____________________
LEVEL OF PROTECTION: ____________________

1	2		3		4		5	6		7	8
	TYPE		CONDITION		OVERPACKING			CONTENTS			
Drum Number	Size	Opening (bung or ring top)	Structural Integrity	Sealed/Exterior Contamination	Required Y/N	Fit Overpack Y/N	Head-space Reading	Volume	Phases	Sample ID Number	Sample Type (Sludge, Liquid, Sediment)

Attachment E
Environmental Hazards Specialists International, Inc. (EHS) - Standard Operating Procedures

"UXO Work Plan Addendum"

Remedial Investigation

1. INTRODUCTION

The EHS team has extensive with EOD and Ordnance Clearance and survey operations of hazardous contaminated sites. In addition, based on our many years of experience as Explosive Ordnance Disposal Specialists, our personnel are well equipped to deal with the unique challenge of locating UXO. This section provides information on the general management and technical approach that will be implemented to support the survey operations.

The logistic requirements and standard emergency action procedures are discussed.

1..1. MANAGEMENT ORGANIZATION

EHS management will ensure that all operations are carried out correctly, safely and effectively. The responsibilities and authority of the key management and operational personnel identified are discussed in subsections that follow.

1..1..1. Key Management Personnel

The key upper level management personnel is the EHS Program Manager. The general responsibility he has is defined below:

- EHS Program Manager - Charles E. Wharton

Responsible for overall program management and coordination, contract administration, and contract application of necessary resources to ensure project completion.

1..1..2. Key Operational/Safety Personnel

All on-site operations requiring EHS personnel, material, or machines and all authorized personnel will be under direct supervision and control while on site. Because of the extensive EOD training and experience of EHS personnel, the on-site ordnance safety program will be directed and administered by EHS. The key EHS personnel will be responsible for on-site clearance operations and ordnance safety.

All key EHS personnel have been fully EOD-trained at the U.S. Naval School EOD, and have extensive experience in military EOD range clearance operations. Collectively and individually, these personnel have the responsibility and authority to correct problems, stop work, or take appropriate action to prevent accidents (explosive or industrial) whenever an unsafe condition is observed or foreseen. All personnel are familiar with the U.S. Military 60-series EOD publications, identification guides, and associated safety publications.

The specific responsibilities and authority of these personnel are defined below:

- EHS Site Supervisor

Reporting to the EHS Program Manager, the Site

Supervisor is responsible for the direction and coordination of all daily operations, including the assignment and supervision of required personnel to clear and prepare areas for the survey activity. He will ensure that the procedures used comply with Search and Excavation SOP's, including recording required data. In an emergency, the Site Supervisor through the on-site Health and Safety Officer is responsible for directing initial action until the arrival of local emergency response teams. Also in support of the on-site Safety Officer, the EHS Site Supervisor is responsible for the implementation and day-to-day administration of safety procedures and for coordinating and conducting all general, procedural, and safety training specified herein. He will control all procedures pertaining to safety during on-site search/clearance excavation, handling and disposal of ordnance, and any other activities requiring EHS personnel or equipment on-site. Commensurating with this responsibility, he has the authority to stop all on-site activity when an unsafe condition develops and to prevent admittance to the site of unauthorized personnel when operations are in progress. In the event of an accident or other emergency situation, he will coordinate with the Health & Safety Officer all on-site emergency operations and direct the implementation of emergency procedures, including notifying local authorities and submitting required reports. In addition, he will ensure the performance of weekly equipment maintenance checks, update required maintenance and training records, conduct periodic safety inspections of personnel and equipment, and observe survey operations.

- EHS EODHAZMATTECH

  Reporting to the EHS Site Supervisor, the EOD/HAZMATTECH is directly responsible to ensure that areas being investigated are clear of UXO hazards and that safe access is available. He will also inspect and observe operations being undertaken in such areas to ensure adherence to procedures, compliance with safety requirements, and the well-being of the survey team members. In the event of an emergency in their area, they will initiate immediate emergency procedures until relieved by the Safety Officer.

1..2. GENERAL TECHNICAL APPROACH

Based on the experience EHS has gained during Military clearance operations, previous Survey/Clearance projects both for the U.S. Army Corps of Engineers and private industry, EHS will assist this project utilizing the following approach.

1..2..1. Record Review

Using the data, records, and points of contact interviewed, EHS will assess all available information on the use of the project site. The information will be evaluated and combined with the actual clearance data obtained on site to generate as complete a picture as possible of the levels, types, and boundaries of ordnance-related contamination within the project site.

1..2..2. Clearance of Landfills

A surface visual sweep team, consisting of two EOD trained specialists will conduct a visual search and clearance of landfill areas. Unexploded ordnance items and ordnance debris will be collected. Unexploded ordnance that can be safely moved will be placed at a designated ordnance holding area and dealt with in accordance with the Standard Operating Procedures as agreed with the COR.

Site Perimeter Determination and Surface Sweep Procedures

1. Using marking stakes and lines as necessary, mark the

outer perimeter of each site to be surveyed. Additional footage my be added to the perimeter to ensure complete coverage.

2. Clear the area of miscellaneous surface scrap metal and/or ordnance items.
3. Conduct a geophysical survey of the entire area. If necessary, to achieve an effective geophysical survey, scrape off the top 6" to 12" of the surface of the area to be surveyed. Record and mark areas which have the highest concentrations of magnetic and metallic anomalies.
4. Using marking stakes and lines as necessary, mark the outer perimeter of the suspected burial areas.

1..2..3. Geophysical Survey

The geophysical survey team will be assisted by an EOD specialist and will conduct a subsurface electromagnetic search of the landfill site. The Foerster Electromagnetic Detector (MK 26 Ordnance Locator) and White/Eagle will be used for the subsurface survey. The MK 26 is the most recent military approved locator and is in use by the U.S. Military EOD forces for detecting subsurface ordnance items. The locator is a hand-held unit and uses 2 fluxgate magnetometers, aligned and mounted a fixed distance apart to detect changes in the earth's ambient magnetic field caused by ferrous metal or disturbances caused by soil conditions. Both an audio and metered signal are provided to the operator. The metered signal indicates whether the disturbance is geodetic or metal-related. The detection capability of the MK 26 is dependent on the size of the item versus its depth and on the experience of the operator. In general terms. the MK 26 will easily detect a 60 mm projectile to a depth of 3 meters and a 155 mm projectile to 6 meters.

The EOD specialist will use the MK 26 and search along one side of the grid line for subsurface contamination. When a contact is found, the specialist will check with his hand to determine if the contact is on or just below the surface. If the contact is buried, the ordnance locator operator will mark the spot and continue until the fade out zone is established for each landfill. Any excavations deemed necessary will be accomplished by hand or with hand tools and in accordance with standard EOD procedures. An EOD technician will be present to ensure safety and to verify all excavations. The items will then be recorded on the survey grid data sheets.

1..3. WELL INSTALLATION, SAMPLING AND TRENCH EXCAVATIONS

EHS will be present during all field operations and will clear access to all locations where activity is taking place. Site/pit excavations and scrapings will be conducted using standard EOD procedures and safety precautions. Many of the sites have had explosive, or incendiary ordnance detonated, burned or buried throughout the many years of operations. The general approach for preparing and excavating a site for collecting survey data required will be as follows:

1..3..1. Well Locations

In advance of well installation, EHS EOD specialists will surface sweep the access to the well sites, a minimum access way of 10' and well site area of approximately 60 feet in diameter will be cleared of any UXO as per the Standard Operating Procedures. Both ferrous and nonferrous locators will be used to assist in achieving a high effectiveness of the surface sweep. Mechanized equipment will be used and operated by EHS personnel to clear scrub and any underground obstacles to enable well drilling equipment to have access and be operated at the designated site. Wells that are to be installed on Demolition/Burn ranges or impact ranges will be surface cleared initially . Every (2) two feet after, the auger will be removed and the probe of the MK26 lowered to clear another (2) two feet. This procedure will be followed at a minimum to a depth of (20) feet on all impact ranges and ranges that ordnance was buried before being detonated.

1..3..2. Trench Excavations

1..3..2..1. General

EHS personnel will conduct the excavations at the designates sites. The mechanized equipment used will excavate in a precise manner at the locations, (about 6" per sweep until contact is made with dumped material). At this point, if required, hand digging will be initiated to identify the contact, and depending upon the outcome, the excavation may continue until the surface of the waste dump is explored. On identification of the nature of the waste, the appropriate SOP will be activated to take waste samples. Should the nature of the waste be highly hazardous or toxic, a remote method (can) will be used to extract the sample and place it in an appropriately designed container.

1..3..2..2. Site/Pit Excavation Procedures

1. Plan and mark out a path for a trench to be dug out through the middle of the burial site. The trench will be the width of the back hoe/bucket and will continue down until the bottom/or water of the burial site is determined.
2. Initial excavation will be conducted by hand or using hand tools to carefully remove the dirt surrounding the suspected UXO until positive identification can be

made. If deemed necessary, remote handling equipment may be required.

3. Once located, carefully identify the exposed UXO to determine safety factors to be considered for removal.
4. Remove all unnecessary personnel from the area.
5. Slowly lift the UXO from the excavation and place it on the surface next to the trench.
6. Follow on Excavation - following positive identification/determination of explosive/chemical hazard of UXO removed from a pit, and upon recommendation by EHS, excavation procedures may be modified to permit use of mechanical equipment for the excavation of dirt surrounding the UXO. In this instance, the following procedures will be used.
    - Position the equipment such that the UXO to be uncovered can be approach from the side.
    - Carefully remove dirt from the side of the UXO until it is partially or nearly exposed.
    - Revert to hand tools for final excavation.

If, during the course of the excavation/removal of UXO from the pit area, other UXO or bulk explosive/propellant/ chemical materials are found, they will be removed and handled in accordance with the approved SOP.

7. The excavated material will be placed in an isolated

area within the existing site. EHS will catalog all ordnance related metal found and estimate the various types and quantities found. The excavation activities will take place on a day when the winds are calm to minimize dispersion of the materials.

8. If any drums are discovered, normal excavation activities will stop. Unnecessary personnel will retreat at least 30 feet up wind from the vicinity of the drums. OVA and/or HNU analyzers will monitor the air near the drums. If any unusual readings are exhibited, then necessary personnel will wear protective clothing appropriate for the hazard. The dirt around the drums will be removed. Personnel will carefully move the drum from the excavation pit. The drum will be overpacked. Qualified personnel will identify the contents and properly store the drum at a designated location on site or at any other appropriate location at the work site.
9. Safety of personnel and equipment is foremost in the EHS International, Inc. management and operational philosophy. Fully trained supervisory personnel are directly involved in all operations. They have the experience and responsibility to identify potentially hazardous situations. The Site Manager, Safety

Officer, and EOD Technicians have the authority and responsibility to immediately stop work and take corrective action when an unsafe situation is encountered. Standard EOD procedures will be employed in the investigation/handling of ordnance related items until it is determined that no explosive hazard exists.

10. Restoration

After each burial pit has been cleared of exposed UXO and metallic debris, the area will be filled in to conform with the surrounding terrain.

1..3..2..3. Personal Protective Clothing and Vapor Monitoring Procedures

1. The level of protective clothing required for an operation is dependent upon the hazard analysis. The level required for scraping and excavating in areas not known or suspected of having been contaminated with army chemical agents or chemical munitions will be determined in accordance with the Health and Safety Plan. This will normally be either Level D or C, with the provision for upgrading/downgrading as necessary.
2. All trenching/excavating/soil movement in work areas will be accomplished in (Level C). Continuous monitoring with OVA/HNU will be required. Negative

results will not automaticlly be used to justify downgrading of protective clothing. Elevated readings on the OVA/HNU will result in the stopping of work and a decision whether to evacuate or continue work in elevated levels of protective clothing.

1..3..2..4. If required EHS will escort personnel doing soil and water sampling to ensure maximum safety during the operations. In the case of soil sampling, ordnance locators will be used in sample areas prior to a soil sample being extracted.

1..4. FACILITIES AND EQUIPMENT

To support the overall project, facilities and equipment will be marshalled as indicated in the following paragraphs.

1..4..1. Support Equipment

The equipment listed below will be utilized for general operations support and emergency support:

- Communications - On site communications for normal or emergency operations will be provided by portable transceivers provided to key personnel. A commercial land line or mobile telephone will be available for direct communications.
- Vehicles - One passenger vehicle will be available on-

site for general administration and logistic use.

- Field Decontamination Trailer - On site Emergency and operational, prevent cross contamination and clean bucket and tools for Soil samples.

1..4..2. Detection/Excavation, and Clearance Equipment/Material

Ordnance detection will be accomplished using the Foerster (MK 26) ordnance locator, plus a White/Eagle low frequency locator. Excavation of recorded contacts will be accomplished using hand tools. Where deep excavation is required, EHS will Lease a LS-2800 tracked backhoe and any other necessary equipment, i.e., back hoe, front end loader, Case 580 or equivalent, or case W-20 front end loader

1..4..2..1. Miscellaneous Equipment List

Gloves

Boots

Mosquito Lotion

Safety Glasses

Helmets/Hard Hats (Note: hard hats will not be worn when dealing with suspected UXO's)

Tools, Hand

Tape, black

Chain with hooks

Shovels, spade and flat, short and long handle

Support for both diesel and gas

Tire repair, equipment repair

Phone service

Surveyor's tape, all colors

3 pkgs of stakes

2 coils of line, 1/2 inch

starting fluid

250' surveyor's tape

Decon tubs, 2 cases bleach

1..4..2..2. Clothes for Working

	Day / Size	
Yellow boots	2 Pr	Large
Tyvex	2 Pr	Large
Saranex	2 Pr	Large
Filters	1 Pr - Purple	
Respirators	1 Ea	
Tape	1 Case	
Coveralls	1 Ea	
Boots, Knee	3 Pr	
Inner gloves	2 Pr	
Outer gloves	2 Pr	

SCBA's with a dedicated mask. One extra bottle per rig.

Airlines with sufficient hoses and air supply for level B operations

1..5. STANDARD PROCEDURES

The following paragraphs provide general information on routine administrative and operating procedures to be used by EHS while on site.

1..5..1. Personnel Employment

Equal employment opportunity will be provided for the local area laborers if required for this project. However, due to the nature of the task and the hazards expected, consideration of the areas listed below will be necessary:

- Physical Conditioning - Potential hires will be thoroughly briefed as to the physical nature of the work and the potential hazards.
- Known allergies - Personnel will be asked to list all known allergies or previous reactions to insect bites or medication.

Following employment, the conditions listed below constitute grounds for termination and will result in dismissal:

- Failure to attend training sessions immediate dismissal with no pay) or daily briefings (dismissal after one warning).
- Possession of or being under the influence of

alcohol or drugs at the site (immediate dismissal).

- Failure to comply with prescribed safety procedures/regulations (i.e., smoking in an unauthorized area, failure to wear protective clothing, etc.) (dismissal after one warning).
- Malingering (dismissal after one warning).
- Unexcused absence (dismissal after one warning).

1..5..2. General Procedures and Daily Routine

The general procedures and daily routine prescribed below will be followed while working on the site. These procedures and routines (except those that concern safety) may be altered by the Safety Officer as deemed appropriate to maximize productivity and to facilitate additional personnel training, if required.

1..5..2..1. On-Site Restrictions

During on-site operations, several restrictions will be imposed on the contractor and authorized visitors. These restrictions are:

- Access - Will be limited to the contractor or authorized visitors and only via the office facilities.
- Vehicles - Only contractor vehicles will be

permitted on the site where ordnance-related activities are in progress.

- Unauthorized Vehicles/Personnel - Any observed on the site will be reported to the Safety Officer via radio. If continuation of work poses a hazard to unauthorized personnel, work will be stopped. Note: It is recognized that control of unauthorized personnel on site will be difficult and subject to the cooperation of the Range Control authorities.

1..5..2..2. Daily Routine

The on-site daily routine to be used is as follows: (tentative)

- Working Hours

  0730-1730 Sunday-Friday

  Saturday off
- Rest Periods - two fifteen minute rest periods and a 30-minute lunch break. (Additional on-station rest periods at the discretion of the Site Supervisor.
- Daily Briefings

  - The designated Safety Officer will brief the Team members on work planned for that day and provide other pertinent information.

1..5..2..3. Safety and Maintenance Inspections

Several types of safety and maintenance inspections will be conducted on-site by the EHS Site Supervisor, Safety Officer at varying frequencies. Table 1-1 provides information on the types and frequency of these inspections. Checklists for these inspections will be provided at the work site.

In addition to the inspection listed, the Site Supervisor/Safety Officer will conduct random inspections of all types at least once each week.

Table 1-1

SAFETY AND MAINTENANCE INSPECTIONS

		FREQUENCY				
TYPE	NAME	DAILY	WEEKLY	MONTHLY	RESPONSIBILITY	REMARKS
M	Vehicle	X			Operator	Each vehicle
S	Protective clothing	X			Site Supervisor	
M	First Aid Equipment		X		Site Supervisor	Each Kit
M	ABC Extinguisher			X	Site Manager	
S	Fire	X			All Key	

	Hazards		Personnel
S	Operational	X	All Key Personnel
M	MK 26	X	Operator
M	White/Eagle	X	Operator

S = Safety
M = Maintenance