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FINAL

SITE EVALUATION
HEALTH AND SAFETY PLAN

OPERABLE UNIT NO. 15 (SITE 88)
MCB CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0356

FEBRUARY 21, 1997

Prepared For:

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

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EXECUTIVE SUMMARY

This Health and Safety Plan (HASP) addresses the Site Evaluation for Operable Unit (OU) No. 15, (Site 88) Marine Corps Base (MCB), Camp Lejeune, North Carolina. Site 88 is the Camp Lejeune MWR Dry Cleaners, which is located at Building 25 on the mainside area of MCB Camp Lejeune. The purpose of this SE is to determine the horizontal direction and extent of releases of dry cleaning fluids waste from OU No. 15. The primary chemical hazards associated with the tasks at these sites are expected to include potential exposure to varying levels of volatile organic compounds (VOCs).

The physical hazards include working around heavy equipment, underground/overhead utilities, heavy traffic areas, and heat and cold stress. The environmental hazards are considered to be low, since Site 88 is located within the industrial area of the base. Each of these hazards is described in Section 3.0.

Section 5.0 describes the environmental monitoring requirements which consist of using a photoionization detector (PID) and oxygen/combustible gas meter.

Based on the amount of information provided by the previous investigation, assigned protection levels at these sites are conservative in nature. The level of personal protection assigned for work tasks and other operations will be Levels D^+, protection upgrades will be dependent on monitoring results and the Site Health and Safety Officer's discretion. Section 6.0 describes the personal protective equipment to be used.

Section 8.0 describes emergency procedures, which includes Table 8-1, identifying the emergency phone numbers, along with first aid procedures, communication procedures, and other site concerns, and Figure 8-2 showing the route to the nearest public hospital.

1.0 INTRODUCTION

This Health and Safety Plan (HASP) is a Site-Specific HASP for Operable Unit No. 15 (Site 88) at MCB Camp Lejeune. Field activities to be conducted will include subsurface soil sampling, groundwater monitoring, temporary well installation and development, and groundwater sampling.

1.1 Policy

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

The HASP is based on an outline developed by the United States Coast Guard (USCG) for responding to hazardous chemical releases (USCG Pollution Response COMDTINST-M16456.30) and by NIOSH, OSHA, USCG, and USEPA's recommended health and safety procedures (Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities). This HASP, at a minimum, meets the requirements under OSHA Standard 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response).

1.2 Project Plans

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

1.3 References

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

- American Conference of Governmental Industrial Hygienists (ACGIH). 1993. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1993-1994.

- The Center for Labor Education and Research, Lori P. Andrews, P.E., Editor. 1990. Worker Protection During Hazardous Waste Remediation, Van Nostrand Reinhold, New York, New York.

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

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

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

- Occupational Safety and Health Administration. 1993. Title 29 Code of Federal Regulations, Parts 1910 and 1926.

- United States Coast Guard. 1991. Policy for Response to Hazardous Chemical Releases. USCG Pollution Response COMDTINST-M16465.30.

- United States Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH. 1990. NIOSH Pocket Guide to Chemical Hazards. June 1990.

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

1.4 Pre-Entry Requirements

During site mobilization, the Site Health and Safety Officer (SHSO) will perform a reconnaissance of the site (work area) as identified in the Work Plan to evaluate and determine the chemical, physical and environmental hazards, establish or confirm emergency points of contact and procedures, and review any other issues deemed necessary to address site safety and health. The SHSO will then conduct a health and safety briefing with site personnel (as identified in Section 2.0) to discuss data obtained from the previous site reconnaissance, provisions outlined in this HASP, and appropriate safety and health related procedures and protocols.

2.0 PROJECT PERSONNEL AND RESPONSIBILITIES

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

PROJECT MANAGER: Matthew Bartman

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

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

PROJECT HEALTH AND SAFETY OFFICER: Ronald Krivan

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

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

SITE MANAGER: To be Determined

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

- Assuring that the appropriate health and safety equipment and personal protective equipment (PPE) has arrived on site and that it is properly maintained.
- Coordinating overall site access and security measures, including documenting all personnel arriving or departing the site (e.g., name, company and time).
- Approving all on site activities, and coordinating site safety and health issues with the SHSO.
- Assisting the SHSO in coordinating emergency procedures with the Naval Activity, emergency medical responders, etc., prior to or during site mobilization activities.
- Assuring compliance with site sanitation procedures and site precautions.
- Coordinating activities with Baker and subcontractor personnel.
- Overseeing the decontamination of field sampling equipment.
- Serving as the backup/alternate Emergency Coordinator.
- Assuming the responsibilities as indicated under "Field Team Leader," in their absence.

SITE HEALTH AND SAFETY OFFICER: To be Determined

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

- Coordinate the pre-entry briefing and subsequent briefings.
- Assure that monitoring equipment is properly calibrated and properly operated.
- Assure compliance with the SOPs in Attachment A.
- Inform personnel of the material safety data sheets (MSDSs) located in Attachment B and emergency procedures for exposure to hazardous materials/waste presented in Attachment C.
- Manage health and safety equipment, including instruments, respirators, PPE, etc., that is used during field activities.
- Confirm emergency response provisions, as necessary, in cooperation with Naval Activity, emergency medical care, etc., prior to or during site mobilization activities.

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

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

- Oversee the decontamination of personnel and determine safe boundary procedures for activities requiring Level C or higher protection levels.

- Act as the Emergency Coordinator.

Subcontractor personnel are responsible for:

- Complying with the conditions as outlined under Field Team Members.

- Complying with all OSHA regulations relevant to their work.

- Obtaining the appropriate training, fit testing, and medical surveillance requirements under 29 CFR 1910.120 and 1910.134 and providing this documentation to the Site Manager prior to or during site mobilization.

- Having a competent safety monitor on site.

- Complying with the training and medical surveillance requirements as outlined in Sections 9.0 and 10.0, respectively, and providing their own PPE that meets or exceeds the level of protection as outlined in this HASP.

SUBCONTRACTOR COMPANIES:

Drilling/Analytical Operations: MicroSeeps
Survey Operations: To be Determined

LANTDIV REPRESENTATIVES:

Ms. Katherine Landman (NTR)	(804) 322-4818

ACTIVITY/STATION/BASE REPRESENTATIVES:

Mr. Neal Paul	(910) 451-5874
Mr. Thomas Morris	(910) 451-5972

FEDERAL/STATE/LOCAL REPRESENTATIVES:

Ms. Gena Townsend (Region IV)	(404) 347-3555
Mr. Patrick Watters (NC DEHNR)	(919) 733-2801

3.0 SITE CHARACTERIZATION

This section provides information on the background, description, and hazard evaluation for each area under investigation.

3.1 Background

Location:	Marine Corp Base (MCB), Main Side
Start-Up Date:	July, 1996 (Phase I) November 4 to December 11, 1996 (Phase II)
Investigation Duration:	Approximately 10 days (Phase I) Approximately 3, 10-day field events (Phase II)

3.2 Description of Area under Investigation

A description of the site under investigation, including surrounding population, topography, and site history is provided below.

3.2.1 Site 88, Camp Lejeune MWR Dry Cleaners

The MWR Dry Cleaners Facility (Site 88) also identified as Building 25 is located on the northern side of Post Lane. Building 25 is a relatively flat area surrounded by barracks, office buildings, and other occupied structures. The surrounding buildings include Building 37 to the north, Building 43 to the west, Building HP57 to the east, and Building 80 to the south. The New River is the nearest water body, located approximately 3,000 feet downgradient (west) of the site.

Building 25 is currently operating as the base dry cleaning facility. Five USTs located adjacent to the building were used to store dry cleaning fluids. The USTs were reportedly installed in the 1940's, at the time the building was constructed. These USTs were used in conjunction with the dry cleaning operations until the early 1970's. During this time, Varsol, a dry cleaning fluid, was stored in the USTs. Because of Varsol's flammability, its use was discontinued in the 1970's and replaced with perchloroethylene (PCE). PCE was stored in 150 gallon aboveground storage tanks outside Building 25 from the 1970's to mid-1980's. Currently, the dry cleaning machines are equipped with containment units, eliminating the need for the aboveground tanks. Presently, there are two dry cleaning units in operation. One unit was brought on-line in December, 1986, and the second in March, 1995. The USTs mentioned above, were removed in November, 1995.

3.3 Hazard Evaluation

The pre-entry briefing and subsequent safety meetings will serve to address the hazards particular to the site under investigation, such as underground utilities, and heavy traffic areas, etc. If new hazards are identified, the SHSO will then add them to the HASP in the field along with the date of modification. Additionally, site personnel are expected to follow "safe" work practices as described in this HASP.

3.3.1 Chemical Hazards

Hazardous chemicals can be absorbed into the body through various pathways. These pathways include:

- Inhalation of vapors, gases, or particulates.
- Ingestion of contaminated particulates from hand-to-mouth contact.
- Dermal and eye contact from direct, unprotected contact.
- Absorption through the eye or skin from exposure to concentrations in the air.

The chemical exposure potential for personnel working at Operable Unit No. 15, MCB, Camp Lejeune, is expected to relate directly to the chemicals detected during the previous investigation at the site. Therefore, Table 3-1 identifies the chemical/physical properties for these previously detected constituents.

The chemicals not included in Table 3-1 are those chemicals that did not exceed federal or state water quality criteria, federal Sediment Screening Values or USEPA Region III Risk-Based Concentrations for soils.

At site 88, an effort will be made to eliminate or reduce potential routes of exposure through the use of engineering controls (i.e., performing investigative activities in an upwind location according to safe sampling techniques), administrative controls (i.e., effective training programs), and PPE (i.e., chemical protective clothing, hard hats, etc.).

MSDSs for constituents that were previously identified at the site have been compiled and are included as Attachment B. They can be used to identify the symptomology for each of the chemicals of potential concern. However, the data presented in an MSDS reflects the chemical and toxicological properties of the specific compound in a pure, non-diluted state. As such, when these compounds are detected in environmental media (i.e, soil, and groundwater), the hazards are anticipated to be substantially less than those associated with exposure to "pure" compounds. This information, therefore, will be utilized as a reference, when questions arise as to a constituents' chemical and toxicological property or measures for emergency response.

3.3.2 Physical Hazards

Physical hazards that are potential concerns for each site at OU No. 15 are discussed in the subsections below.

3.3.2.1 Confined Space Entry

Confined space entry is not anticipated during activities to be conducted at OU No. 15, therefore, confined space entry procedures have not been provided. However, should circumstances arise that may require entry into a confined space, the PHSO will be contacted and entry-specific procedures according to 29 CFR 1910.146 will be provided at that time.

TABLE 3-1

CHEMICAL/PHYSICAL PROPERTIES OF CONSTITUENTS DETECTED DURING PREVIOUS SAMPLING AT SITE 88

Chemical	Source	Maximum Detected Concentration	Exposure Limit (EL)[a]	N.F.P.A. Rating[b]			Carcinogen[c]	IDLH[d]	Ionization Potential
				H	F	R			
Volatiles:									
Acetone	Soil	83 μg/kg	1,000 ppm	1	3	0	No	2,500 ppm	9.69
Methylene Chloride	Soil	53 μg/kg	500 ppm	2	1	0	Yes	2,300 ppm	11.32
1,2-Dichloroethane	Soil	9 μg/kg	50 ppm	2	3	0	Yes	100 ppm	11.05
	Groundwater	10,000 μg/L	50 ppm	2	3	0	Yes	100 ppm	11.05
Trichloroethylene	Groundwater	2,750 μg/L	50 ppm	2	2	0	Yes	1,000 ppm	9.45
Perchloroethylene	Soil	55 μg/kg	25 ppm	2	0	0	Yes	500 ppm	9.32
	Groundwater	29,200 μg/L	25 ppm	2	0	0	Yes	500 ppm	9.32
Semivolatiles:									
Bis(2-ethylhexyl)phthalate	Groundwater	0.624 μg/L	5 mg/m^3	0	1	0	Yes	10 mg/m^3	NA
Naphthalene	Groundwater	0.53 μg/L	10 ppm	2	2	0	No	500	8.12
Inorganics:									
Iron	Groundwater	10,100 μg/L	10 mg/m^3	2	2	1	No	2,500 mg/m^3	NA
Nickel	Groundwater	279 μg/L	1 mg/m^3	2	4	0	Yes	10 mg/m^3	NA

[a] EL - Exposure Limit = A time-weighted average concentration for a normal eight-hour work day and 40-hour work week to which nearly all workers may be repeatedly exposed day after day without expected adverse effect. The EL represents published Exposure Levels according to the following hierarchical order: (1) OSHA PELs; (2) NIOSH RELs; (3) ACGIH TLVs; and, (4) other recognized sources.

[b] National Fire Protection Association rating for Health (H), Flammability (F), and Reactivity (R) from O (insignificant) to 4 (highly significant)

[c] Carcinogen = "Yes" indicates a compound as either a confirmed or suspected human carcinogen.

[d] IDLH = Immediately Dangerous to Life or Health

ppm - parts per million (in air)

NA - Not applicable and/or available

3.3.2.2 Thermal Stress

Provisions for monitoring of heat and cold stress (for both Phases I and II) are outlined in Attachment A - Baker Safety SOPs.

3.3.2.3 Noise

Elevated noise levels may be produced during drilling and other heavy equipment operations; therefore, hearing protection may be required. The SHSO is responsible for making this determination based on past experience with the type of equipment in use, and the proximity of personnel to the equipment.

3.3.2.4 Explosion and Fire

In general, the following items present potential explosion or fire hazards and will be monitored closely as they pertain to each area under investigation:

- Explosion and fire resulting from:
    - Heavy equipment malfunction
    - Penetration into underground utility/service lines (gas, electric, fuel)
    - Ignition of trapped flammable vapors
    - Vehicular accidents
    - Ignition of flammables or combustibles during welding or cutting (To be conducted during intermediate monitoring well installation, Phase II)

Monitoring for potential fire/explosive conditions include the use of an oxygen/combustible gas meter (as indicated in Section 5.2) and the performance of utility checks prior to conducting intrusive activities. Provisions to be followed for welding and cutting operations are outlined in Attachment A - Baker Safety SOPs. As additional concerns are identified changes to the HASP will be presented by the SHSO, as needed.

3.3.2.5 Utilities

Underground utility clearance must be obtained before any intrusive activities are performed; this clearance will be provided by a representative from the Public Works Department. If underground utilities are identified in these areas, the ground above the utility lines will be physically marked (e.g., spray paint or flags). Baker personnel will notify the base representatives at least three days prior to intrusive activities to acquire a utility clearance. A minimum of a 24-inch tolerance zone must be used for underground utilities.

The generally accepted uniform color code for underground utilities is as follows:

- Red - Electric power lines, cables, conduit and lighting cables
- Yellow - Gas, oil, steam, petroleum, or gaseous materials
- Orange - Communication, alarm or signal lines, cables or conduit
- Blue - Water, irrigation, and slurry lines
- Green - Sewers and drain lines
- White - Proposed excavation

Energized overhead electric lines may present a risk of electrocution. OSHA standards require that equipment maintain certain distances from power lines. For lines 0 to 50 kilovolts (kV), the minimum distance is 10 feet. Lines carrying over 50 kV require that equipment maintain 10 feet, plus an additional 0.4 inch for each 1 kV over 50. On very humid days or during episodes of rain, these distances will be doubled.

3.3.2.6 Heavy Equipment

One of the primary physical hazards on the site is associated with the use of heavy equipment, which includes the use of a direct-push rig (Phase I), and a drill rig (Phase II). Only operators trained, qualified, and authorized will be permitted to operate the heavy equipment.

General hazards associated with the direct-push/drill rig include moving parts, such as the hydraulic hammer, auger, and cathead. Personnel must remain clear of moving parts and must avoid loose-fitting clothing that can become entangled in the moving parts. Personnel working near a direct-push/drill rig must be aware of the location and operation of the emergency shut off devices. Personnel are to stand clear of the direct-push/drill rig immediately prior to starting the engine. The drilling subcontractor representatives are to provide any other cautions that need to be observed when working around this equipment during the HASP pre-entry briefing.

Noise from the operation of the heavy equipment will limit verbal warning abilities. Hand signals will be prearranged between operators and personnel working in and around heavy equipment. Backup alarms must operate properly on the heavy equipment.

3.3.3 Radiation Hazards

The potential for exposure to radiological wastes or radioisotopes at Site 88 is considered low (i.e., site history does not indicate the presence/disposal of radioactive materials), therefore, a radiation survey meter will not be assigned. However, the SHSO can request a radiation survey meter, should new concerns arise.

3.3.4 Environmental Hazards

Site 88 is located within an industrialized part of the base. Hazards associated with flora and fauna at this site are not expected.

3.3.5 Task-Specific Hazards

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

3.3.5.1 Task 1 Subsurface Sampling - Soil Boring

Chemical

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

Physical/Environmental

- Elevated noise levels from heavy equipment operations.
- Muscle strain from lifting hazards.
- Contact with underground utilities.
- Heavy objects landing on foot/toe or head.
- Slips/trips/falls from sloped, uneven terrain; crawling over and under obstacles.

3.3.5.2 Task 2 Temporary and Permanent Monitoring Well Installation

Chemical

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

Physical/Environmental

- Heavy objects landing on foot/toe or head.
- Elevated noise levels from heavy equipment operation.

3.3.5.3 Task 3 Temporary and Permanent Monitoring Well Development

Chemical

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

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain.

3.3.5.4 Task 4 Groundwater Sampling

Chemical

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

Physical/Environmental

- Muscle strain from lifting bailers.
- Cuts from using knives to cut bailer rope.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.

3.3.5.5 Task 5 IDW (Tanker/Roll-Off Box) Sampling

Chemical

- Skin contact with potentially-contaminated soil or water.
- Ingestion of contaminated material from hand-to-mouth contact.
- Inhalation of potentially volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Slips/trips/falls from elevated heights (i.e., top of roll-off box or tanker) onto ground.
- Falling into potentially-contaminated material in roll-off box.
- Cuts, abrasions, or sprains from climbing onto roll-off box or tanker.
- Muscle strain when using bailer or hand auger.
- Hazards associated with a potential "confined space" situation.

3.3.5.6 Task 6 Land Surveying

Chemical

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

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Automobile traffic concerns.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Muscle strain from lifting hazards.

3.3.6 Summary

The information provided in the previous section details the potential hazards associated with OU No. 15. This information is used to ascertain what levels of protection will be required for each field activity at each area under investigation. In determining the levels of protection, the following items are considered:

- Quantity of contaminant that is available for absorption
- Exposure time that is available for absorption
- Frequency with which the exposure occurs
- Physical form of the constituents
- Presence of other constituents
- Toxicity of the constituents
- Ventilation, natural or otherwise
- Appropriate hygienic practices
- Protective equipment in use
- HASP training

Based on this section and the information furnished in the previous two sections, levels of protection will be assigned. Refer to Section 6.2, Site-Specific Levels of Protection.

4.0 SITE CONTROL

Measures need to be addressed in the HASP for managing the daily control of the site (i.e., access, site conditions, etc.). The following subsections provide a discussion of each site control measure that will be consistent for site activities at OU No. 15.

4.1 Site Access

The Site Manager is designated to coordinate overall access and security at each site under investigation. Perimeters for activities to be conducted at OU No. 15 will be established according to the site boundary procedures identified in Section 4.3, local conditions, the items listed below, and Navy Activity requirements.

- Personnel will not be permitted within the Work Zone (i.e., Exclusion Zone) or Contamination Reduction Zone without proper authorization from the SHSO.
- All personnel arriving or departing the site will be documented in the site logbook.
- All activities on site must be cleared through the Site Manager and documented in the site logbook.
- The on-site Command Post will be established at Lot 203, and will be in the Support Zone and oriented upwind and away from all Work Zones.
- Figure 4-1 identifies the location of the area under investigation.

4.2 Site Conditions

Specific site conditions are as follows:

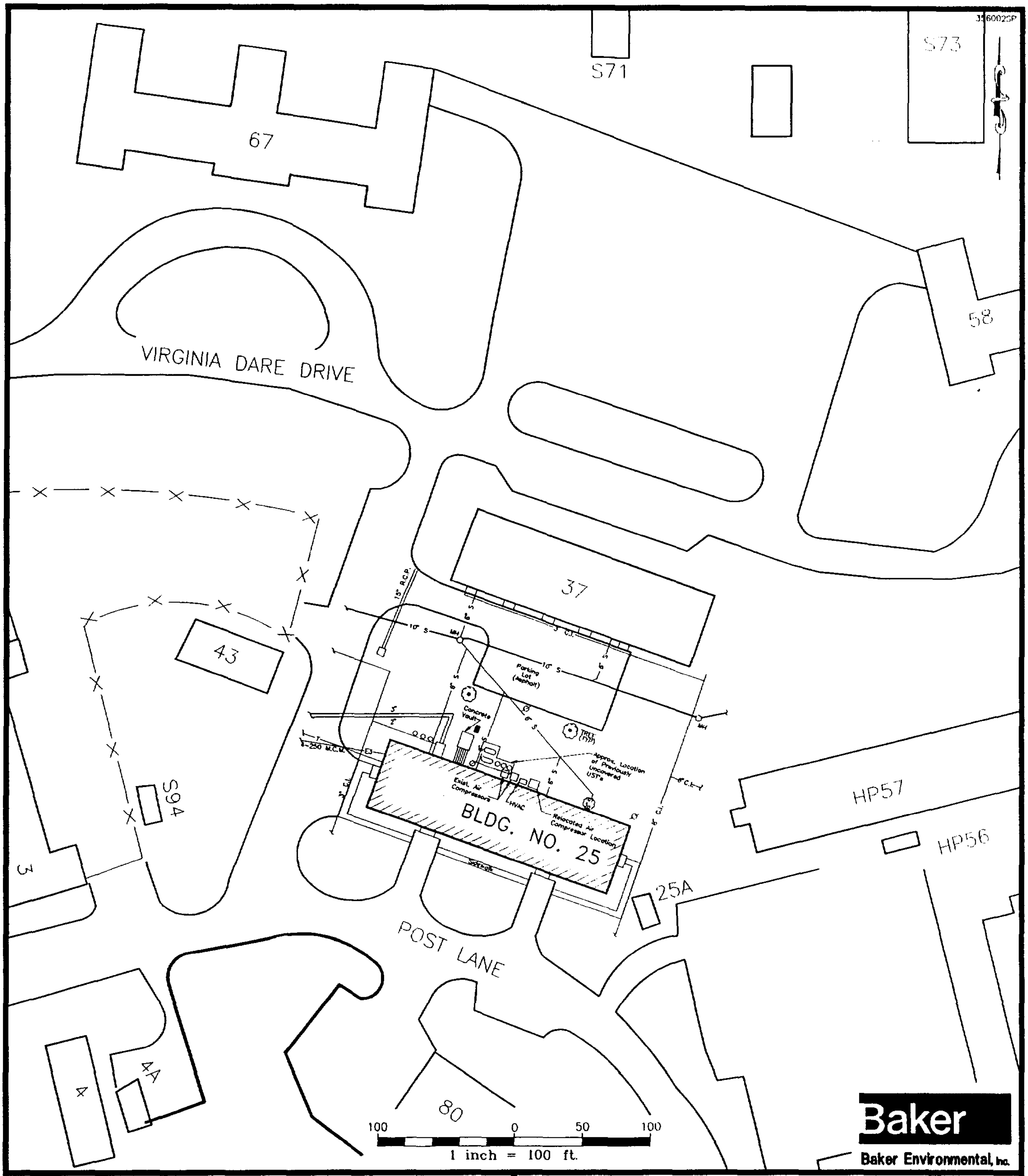
- The prevailing wind conditions are from the west; however, easterly winds are common.
- Anticipated weather conditions include warm to hot temperatures, 75-90°F during Phase I.

Anticipated weather conditions include cool to fair temperatures, 35-50°F during Phase II

- Site topography: Refer to discussion in Section 3.2.

4.3 Work Zones

To reduce the accidental spread of hazardous substances by workers from a potentially-contaminated area to a clean area, zones will be delineated to ensure that work activities and contamination are confined to the appropriate areas, and to keep unauthorized personnel from entering the work zones. The sections below identify the requirements based on the level of protection in use.



LEGEND

▭ BUILDING

×——× FENCE

SOURCE: REVISED MCB CAMP LEJEUNE BASE MAP, 11/10/89

FIGURE 4-1
LOCATION MAP
SITE 88 -MWR DRY CLEANING
FACILITY (BUILDING 25)
CTO-0356
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

4.3.1 Level C Activities (If Needed)

All zones for activities conducted under Level C shall be established utilizing control boundaries between the Work Zone, the Contamination Reduction Zone (CRZ), and the Support Zone (i.e., Clean Zone). These boundaries shall be defined as follows:

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

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

Refer to Figure 4-2 for a "General Contamination Reduction Zone Layout." Exact locations of the demarcated zones will be field determined by the SHSO during site mobilization.

4.3.2 Level D and D+ Activities

All zones for activities conducted under Levels D or D+ shall be established according to the guidelines set forth in the subsections below.

4.3.2.1 <u>Populated Areas</u>

In populated areas, Work Zones for activities conducted under Level D or D+ protection levels shall be established in such a manner as to preclude unauthorized personnel from entering the investigative area. A boundary will be established to separate the Work Zone from the Support Zone using available materials such as the Baker Field Vehicle, natural boundaries (e.g., buildings, structures, fences), or signs/placards, boundary tape, cones, barricades, etc.

4.4 "Buddy System"

All site activities that involve hazards and/or the potential for contact with hazardous materials will be performed by a work team of no fewer than two people (i.e., Buddy System). For potential "high-hazard" activities, a third person located in the Support Zone will serve as an observer or rescue person.

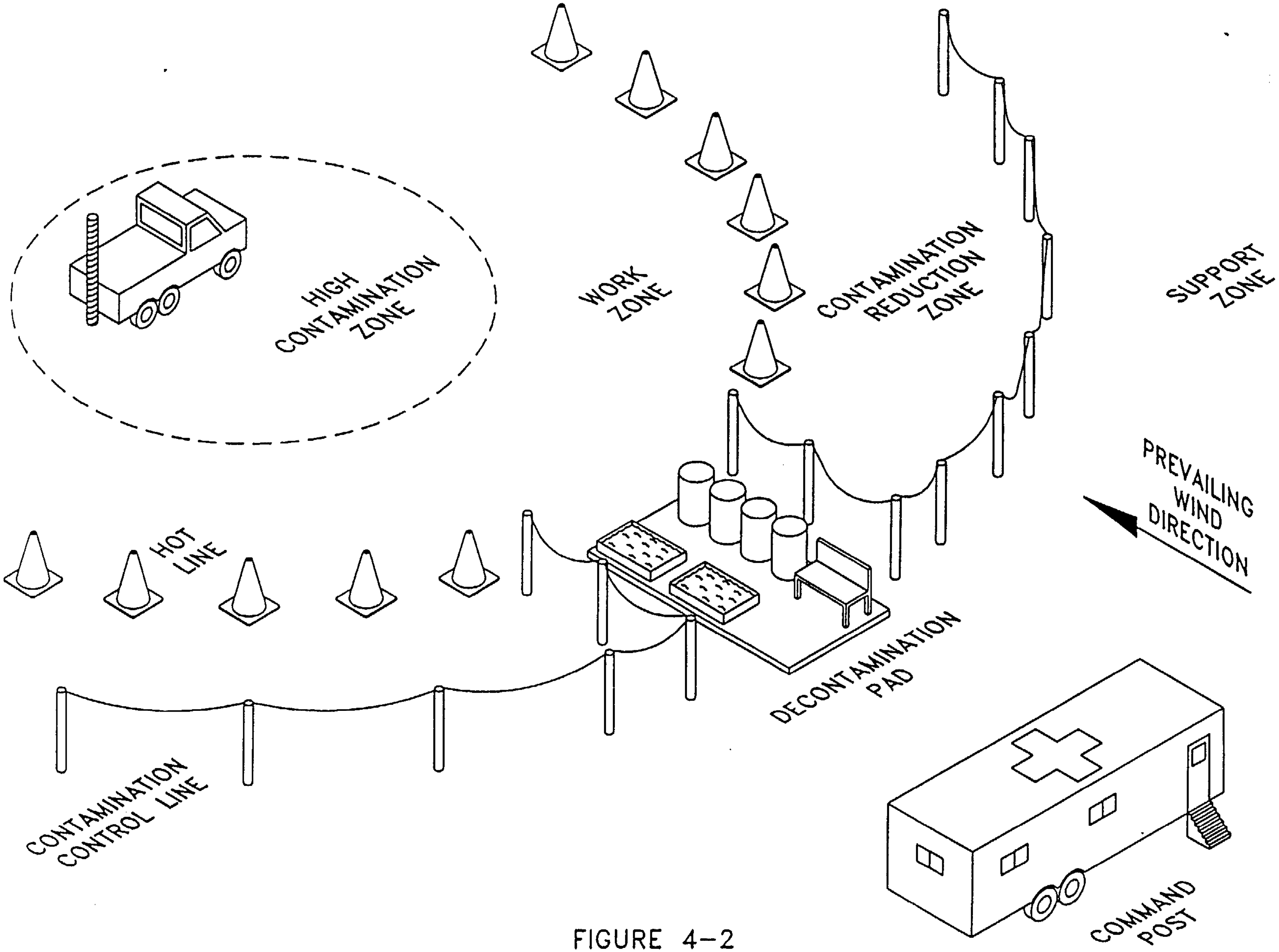


FIGURE 4-2
SCHEMATIC DIAGRAM
GENERAL CONTAMINATION
REDUCTION ZONE LAYOUT

Baker
Baker Environmental, Inc.

CONZONE2

4.5 Safe Work Practices

Routine safe work practices may consist of:

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

4.5.1 Heavy Equipment

The following safe work practices will be adhered to during heavy equipment operations.

- Hard hats will be worn at when working in a work zone with heavy equipment.

- Heavy equipment requiring an operator will not be permitted to run unattended.

- Heavy equipment will not be operated in a manner that will endanger persons or property nor will the safe operating speeds or loads be exceeded.

- Heavy equipment will be shut down and positive means taken to prevent its operation while repairs or fueling are being performed.

- Personnel, other than the operator, should not ride on equipment.

- A "spotter" will be used to help direct the heavy equipment operator.

- Personnel are to remain in the field of vision of the operator and remain clear of moving parts.

- Hand signals will be prearranged between operator and personnel working around the heavy equipment.

- Backup alarms must operate properly on the heavy equipment.

4.5.2 Drilling Operations

The following safe work practices will be adhered to during drilling operations.

- The subcontracting drilling company's supervisor is to provide other cautions to be observed when working around the drill rig during the HASP briefing.

- Hand signals will be prearranged between operator and personnel working around the drill rig.
- Personnel are to remain in the field of vision of the operator and remain clear of moving parts where protective clothing can be entangled, i.e., Tyvek caught in the auger.
- Utility clearances must be secured prior to drilling.
- Personnel working near a drill rig are to be aware of the location and operation of the emergency shut off devices.
- The drill rig boom is to remain a minimum of 10 feet from power lines (see Section 3.3.2.5).

4.6 Sanitation Procedures/Site Precautions

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

- A supply of clearly marked potable water, tightly closed, and equipped with a tap.
- Single service disposal cups.
- Outlets for non-potable water, clearly marked, for fire fighting or other purposes. Cross-contamination of the potable supply shall be prevented.
- One toilet facility for up to 20 personnel which is either chemical, recirculating, combustion, or flush, depending on local code requirements.
- A place for food handling meeting applicable laws or suitable alternatives to such facilities will be provided (i.e., nearby restaurants, food wagons, etc.).
- Clean wash water will be available in the decontamination zone if Level C activities are necessary, and the Baker Field Trailer for all other operations. Disposable towelettes will be available in each Baker Field Vehicle for periodic cleanups.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated. Smoking will also not be allowed in areas where flammable materials are present. Hands and face must be thoroughly washed before breaking for meals and upon leaving the site. "Contaminated" work garments are not to be worn off site.
- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

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

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

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

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

- Alcoholic beverages and firearms are prohibited on site.

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

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

5.0 ENVIRONMENTAL MONITORING

Environmental monitoring will be performed at the area under investigation; the level and degree of monitoring will be dependent on each field activity. Due to the short duration and variability of field tasks only realtime air monitoring (versus integrated air monitoring) will be used to assess action levels. The action levels for the PID, as specified in Section 5.1 below, are based on a "worst-case" contaminated 8-hour TWA-PEL of 1 ppm (i.e., benzene), and are consistent with those listed by the USEPA in Section 6.9, of the Standard Operating Safety Guides (June, 1992).

5.1 Personal Monitoring

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

PID(1)

- Background(2) = Level D/D+
- >1 mu (meter unit) above background for up to 1 continuous minute in the BZ = Level C
- >1 mu above background for up to 15 continuous minutes in the BZ = Level B or stop work and consult the SHSO
- Instantaneous peak concentrations >10 mu in the BZ = Level B or stop work and consult the SHSO

(1) PID with 11.7 eV ultraviolet lamp set on the 1X Scale.
(2) Background is typically 1 to 2 mu

5.2 Point Source Monitoring

Point source monitoring which is monitoring performed at the source of the sampling/investigative activity (i.e., borehole, monitoring well, etc.) will comply at the action levels outlined below. Instrumentation to be used will include a PID, and Oxygen/Combustible Gas Meter.

PID

- If detecting levels greater than background, immediately measure the BZ levels following the action levels set forth in Section 5.1.

- For levels greater than 10 times the background level, retreat upwind, monitor BZ, and return after allowing source to aerate.

- For levels that are sustained, contact the SHSO for guidance.

Oxygen/Combustible Gas Meter[1]

Oxygen Meter

- 19.5% to 23.5% = continue working
- <19.5% or >23.5% = Stop Work immediately and consult the SHSO

Combustible Gas Meter[2]

- <20% of the Lower Explosive Limit (LEL) = continue working
- >20% of the LEL = Stop Work immediately and consult the SHSO

[1] Used to evaluate physical safety in conjunction with PID.
[2] Assigned action levels are for non-confined space entry operations .

As work progresses, 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.

5.3 Perimeter Monitoring

Perimeter monitoring which is defined as monitoring performed at borders beyond the Support Zone and often at the "fence line" will be required based on action levels that will remain consistent for site activities. The PID action levels are outlined below.

- The PID will be used periodically to scan the perimeter as a means of documenting any volatile releases that may extend past the work zone, when volatile concentrations exceed 50 mu (2 X Scale) at the point source or 10 mu (1 X Scale) at the breathing zone.

5.4 Specific Air Monitoring Equipment and Frequency

Monitoring equipment and frequency for each area under investigation can be found in Table 5-1. Action levels that govern changes in levels of protection can be found in Section 5.1.

5.5 Equipment Maintenance and Calibration

Baker's 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. Equipment calibration under the direction of the SHSO will be completed daily before use and calibration information entered onto the equipment calibration form. All forms will be maintained on site for the duration of the project with copies to be given to the Equipment Manager once the equipment has been returned to the office. Procedures for equipment maintenance and calibration follow those guidelines found in the operating manual provided by the manufacturer (included with the equipment) or in Baker's Standard Operating Procedures for Administrative, Field, and Technical Activities Manual.

TABLE 5-1

MONITORING EQUIPMENT AND FREQUENCY FOR EACH FIELD ACTIVITY CONDUCTED AT OU NO. 15

Field Activity	PID(1)	Oxygen/ Combustible Gas Meter(1)
Land Surveying	D	▨
Monitoring Well Installation	C	I&P
Monitoring Well Development	I&P	▨
Groundwater Sampling	I&P	▨
Soil Boring Sampling	C	I&P
IDW Sampling	I	I

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

Note: As air concentrations are measured, they shall be documented in the individual's field logbook. In the case of continuous monitoring, every 15 minutes.

(1) Refer to the manufacturer's operating manual and Baker SOP prior to operation.

5.6 Monitoring Documentation

As environmental monitoring is performed, documentation of the results will be entered into the Field Log Book of the SHSO or other personnel performing the monitoring. Documentation is to include the date, time, instrument result, general location, and specific location such as point source, breathing zone, or area, and weather conditions during the monitoring time period. Copies of the Field Log Book will be placed in a binder and remain in the Baker Field Trailer on site until the end of the field activities, whereby the log sheets will become part of the permanent file.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 Personal Protective Equipment Selection

The personal protective equipment available for the various levels of protection is listed in the table below. The assigned item number will correspond to each field activity as defined in Section 6.2.

Item No.	Personal Protective Equipment
1	Chemical-Resistant Clothing (Polyethylene-coated Tyvek®)
2	Chemical-Resistant Clothing (Saranex®)
3	Uncoated Tyvek®/Kleenguard® Coveralls
4	Normal Work Clothes or Coveralls
5	Air-Line Respirator (ALR) with 5-minute escape pack
6	Self-Contained Breathing Apparatus (SCBA) for rescue
7	NIOSH 5-minute Escape Pack (on standby)
8	Full-face Cartridge Respirator
9	Half-face Cartridge Respirator
10	Full-face Cartridge Respirator (on standby)
11	Half-face Cartridge Respirator (on standby)
12	Chemical-Resistant Gloves (Nitrile inner - double layer)
13	Chemical-Resistant Gloves (Nitrile inner - single layer)
14	Chemical-Resistant Gloves (Rubber/Neoprene outer)
15	Chemical-Resistant Gloves (Nitrile outer)
16	Work Gloves (outer) (as necessary)
17	Chemical-Resistant Overboots (with steel toe and shank)
18	Chemical-Resistant Overboots (w/o steel toe)
19	Steel Toe Boots
20	Safety Glasses
21	Safety Goggles
22	Face Shield
23	Hard Hat
24	Hearing Protection
25	Chest/Hip Waders (as necessary)
26	Safety Vests (as necessary)

6.2 Site-Specific Levels of Protection

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

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

Location(s)	Field Activity	Level of Protection					Personal Protective Equipment (Item No.)
		B	C	D+	D	Other	
Site 88	Subsurface Soil Sampling			X			1, 4, 10, 12, 16, 20
Site 88	Land Surveying				X		4, 16, 19, 26
Site 88	Monitoring Well Installation			X			1, 4, 10, 12, 16, 20
Site 88	Monitoring Well Development			X			1, 4, 10, 12, 16, 20
Site 88	Groundwater Sampling			X			1, 4, 10, 12, 16, 20
Site 88	IDW Sampling			X			1, 4, 10, 12, 16, 20

EXCEPT IN EMERGENCY SITUATIONS, CHANGES TO THE SPECIFIED LEVELS OF PROTECTION SHALL ONLY BE MADE WITH THE APPROVAL OF THE SHSO AND THE SITE MANAGER, IN CONSULTATION WITH THE PHSO AND PROJECT MANAGER.

6.3 Respiratory Protection

Site-specific respiratory protection requirements as outlined below will comply with the procedures in Attachment A - Baker Safety SOPs.

6.3.1 Level C

A NIOSH-certified full face negative pressure Air-Purifying Respirator with an organic vapor/HEPA cartridge is the appropriate cartridge for use with the detected hazardous materials and the measured contaminant concentrations will be used at this level. Upgrades/downgrades in this level of respiratory protection will be based on measured realtime air contaminant concentrations (see Section 5.1) and the SHSO's observations. (Note: Baker personnel are issued either a North or MSA Air-Purifying Respirator).

Cartridge changeover will occur when one or more of the following have been observed: exposure duration greater than eight hours for vapor/gas cartridges; increase in breathing resistance; a noticeable odor or taste; eye/throat irritation; and other indicators such as end-of-service life indicators for specialty filter cartridges.

6.3.2 Level D+

A NIOSH-certified negative pressure Air-Purifying Respirator, meeting all the requirements identified under Level C, will remain on standby at this level.

6.4 Care and Cleaning of Personnel Protective Equipment

Provisions for the care and cleaning of personal protective equipment used on site can be found in Attachment A - Baker Safety SOPs.

7.0 DECONTAMINATION PROCEDURES

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

7.1 Personnel Decontamination

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

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

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

The following decontamination equipment is required for Level C and higher protection levels and recommended for Level 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*
- Contaminated liquids disposal drum

- Respirator cleaning solution
- Liquinox and water as the decontamination solution

*Minimum for Level D decontamination.

The decontamination liquids and clothing will be contained and disposed according to policy defined in the Sampling and Analysis Plan (SAP).

7.2 Effectiveness of Personnel Decontamination

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

7.3 Equipment Decontamination

Provisions for the decontamination of equipment will be based on the size and type of equipment used. Specific decontamination procedures for each site within OU No. 15 will be found in the SAP.

7.4 Decontamination Materials

The protocols outlined in the SAP for the handling of materials used for decontamination such as packaging, storing, and disposing will 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. These protocols comply with Baker's SOP on "Handling of Site Investigation-Derived Wastes," located in the Standard Operating Procedures for Administrative, Field, and Technical Activities Manual.

8.0 EMERGENCY PROCEDURES

8.1 Scope

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

8.2 Pre-Emergency Planning

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

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

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

8.3 Emergency Coordinator

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

- Familiarizing all on-site personnel with the emergency procedures and the emergency coordinator's authority.

- Identifying the nearest telephone in the event of an emergency.

- Communicating site emergency procedures and requirements to all Baker and subcontractor personnel.

- Specifying the Site Manager as the backup/alternate Emergency Coordinator.

- Controlling activities of subcontractors and contacting the emergency response groups, as necessary.

- Anticipating, identifying, and assessing fires, explosions, chemical releases, and other emergency situations to the best of the coordinator's ability, and providing this information to the emergency group(s) responding.
- Familiarity with site personnel trained in emergency first aid and adult CPR.

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

8.4 Communications/Telephone Numbers

Internal communications will rely on direct communication (via verbal or two-way radios) between site personnel. External communications will employ a telephone located in the Baker Field Trailer and various telephones located throughout the Base (near the investigation areas). Telephone communication at the Command Post (Baker Field Trailer) will be established during site mobilization. The telephone number is (to be provided) in the Final HASP Submission.

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

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

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

Hand signals, as outlined below, will be used in the event that radio communications fail:

Hand gripping throat	-	Can't breathe (typically Level C/B activities)
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, I do not understand

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

8.5 Assembly Area

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

TABLE 8-1

EMERGENCY TELEPHONE NUMBERS

Facility	Phone Number On-Base Phone(1)	Phone Number Off-Base Phone(2)	Contact*
Security	4555	911 or (910) 451-4555	Response Operator
Fire (Camp Geiger)	0538	(910) 451-0538	Response Operator
Fire (MCAS)	6620	(910) 451-6620	Response Operator
Fire (Hot Work Permit)	3004	(910) 451-3004	Fire Alarm Operator
Ambulance (On-Base)	911	▨	Response Operator
Ambulance (Off Base)	(*9) 455-9119	(919) 455-9119 or 911	Response Operator
Hospital Emergency Room (On-Base)	911 or 4840, 4841, 4842	451-4840 451-4841 451-4842	Response Operator
Onslow County Hospital (Off Base)	(*9) 577-2240	(910) 577-2240	Response Operator
Emergency (One Call)	911	911	Response Operator
On-Scene Commander	911	(910) 451-5815	Fire Chief
Environmental Management Department (EMD)	5068	(910) 451-5068	Mr. Neal Paul Mr. Tom Morris
Public Works (Underground Utilities via EMD Contact)	5068	(910) 451-5068	Mr. Neal Paul Mr. Tom Morris
Duke Regional Poison Control Center	(*2) 1-800-672-1697	1-800-672-1697	Response Operator
National Response Center	1-800-424-8802	1-800-424-8802	Response Operator
CHEMTREC	1-800-424-9300	1-800-424-9300	Response Operator
ATSDR	1-404-639-0615	1-404-639-0615	Response Operator

(1) The following prefixes apply when using on-base telephones:
- *2 - Operator assisted calls including 800 numbers
- *8 - Long distance calls
- *9 - Local calls

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

8.6 Emergency Hospital Route

An emergency hospital route map (Figure 8-1) and written directions to the hospital (Figure 8-2) will be posted in the Baker Field Trailer and maintained in the Baker Field Vehicle. Personnel will be informed of the location of the map and the directions to the hospital during the pre-entry briefing.

8.7 Emergency Medical Treatment

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

Emergency Medical Services

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

Name	Onslow County Memorial Hospital
Address	317 Western Boulevard, Jacksonville, NC
On-Base Telephone No.	(*9) 577-2240 [(*9) 577-2245 - Information]
Off-Base Telephone No.	577-2240 577-2245 - Information]

Local ambulance service is available from:

Name	Naval Ambulance Service or the City of Jacksonville
On-Base Telephone No.	911 for Naval Ambulance Service or (*9) 455-9119 for City of Jacksonville
Off-Base Telephone No.	911 or 455-9119

Contact will be made with emergency personnel prior to the start of activities (see Section 8.2).

8.8 Injuries

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

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

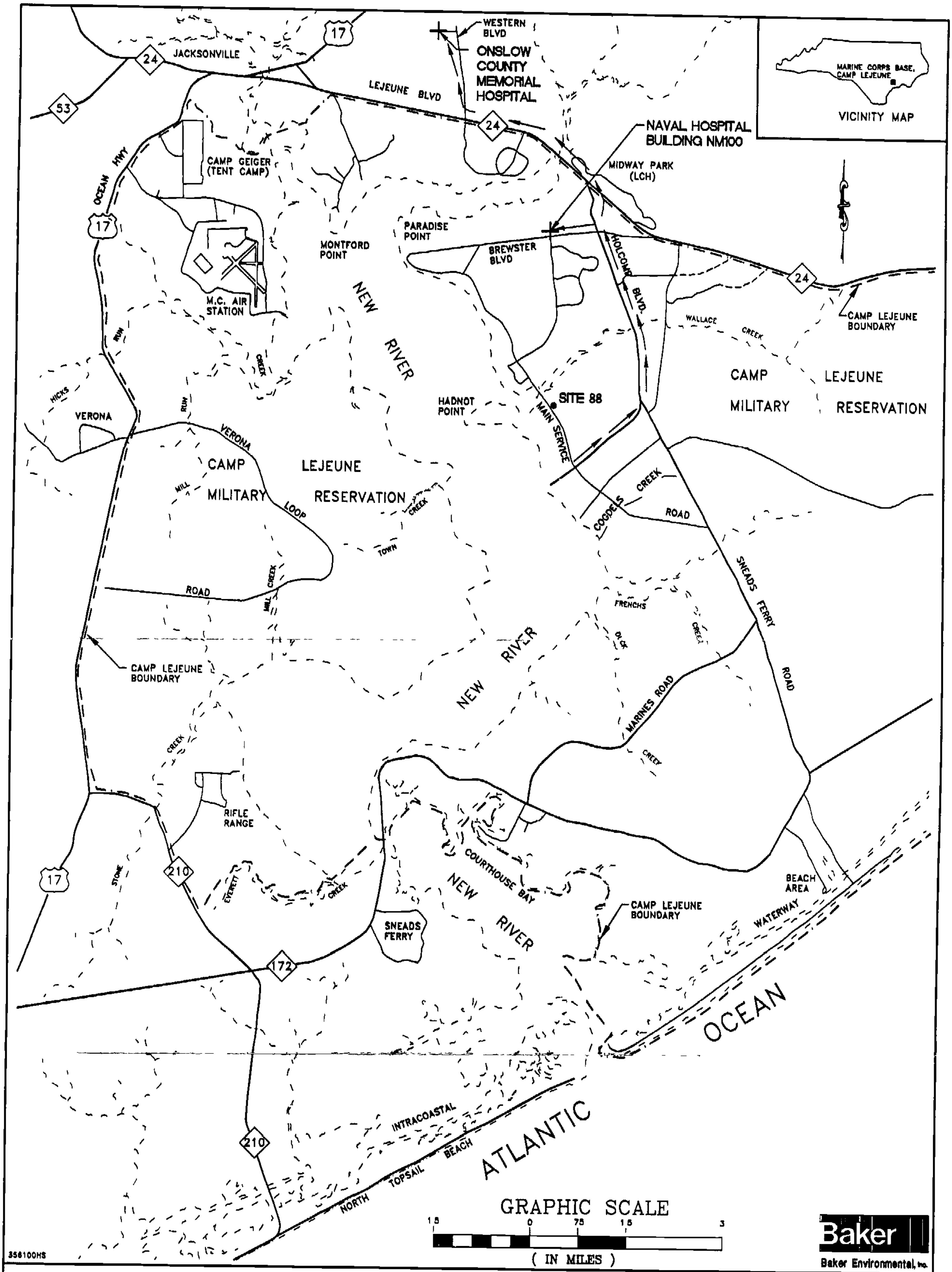


FIGURE 8-1
EMERGENCY HOSPITAL ROUTE
FOR SI ACTIVITIES AT
SITE 88 - MWR DRY CLEANING FACILITY (BLDG. 25)
CTO-0356

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01759E012

FIGURE 8-2

DIRECTIONS TO HOSPITAL

Directions to Onslow County Memorial Hospital are as follows:

1. Proceed north on Holcomb Boulevard until intersecting with Lejeune Boulevard (Route 24).
2. Travel west on Route 24 until intersecting with Western Boulevard.
3. Turn right onto Western Boulevard and proceed along Western Boulevard until the fifth stop light.
4. Hospital is on left hand side.
5. Follow directions to emergency room entrance.

8.8.1 Physical Injury

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

8.8.2 Chemical Injury

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

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

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

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

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

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

Procedures to follow in the event of a chemical exposure are included in Attachment C.

8.8.3 Snakebite Injury

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

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

Provide treatment as follows:

1. Calm the victim and keep affected area still.
2. Contact ambulance if you cannot provide victim with transportation to the nearest hospital.
3. Wash the wound.
4. Keep the affected area below the level of the heart if bite is on the arm or leg.
5. Treat for shock.
6. Monitor airway, breathing, and circulation.
7. Obtain physical description of snake, if possible.
8. Provide the emergency medical responder (either the ambulance attendant or the emergency room at the hospital) with all pertinent information such as how long ago the bite occurred, the type of snake (if known), any known allergic conditions (if known), etc.
9. Inform the SHSO as soon as possible.

8.8.4 Spider Bite Injury

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

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

8.9 Emergency Decontamination Procedures

In the event of a medical emergency, patients are to be adequately decontaminated before transfer (if possible) to prevent contamination of the medical transport vehicle and medical facility. Emergency personnel decontamination will include the following, depending on the level of protection.*

Level D	Level D+	Level C
• Equipment drop • Tape, boot, and glove removal • Coverall removal	• Equipment drop • Tape, outer boot, and glove removal • Coverall removal/ disposal • Inner glove removal/ disposal	• Equipment drop • Tape, outer boot, and glove removal • Coverall removal/ disposal • Respirator removal • 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 personnel are to be immediately informed of the injured person's condition, potential contaminants, and provided with all pertinent chemical data.

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

8.10 Personal Protection and First Aid Equipment

PPE available for emergency response will include the following:

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

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

Fire Extinguisher:	Baker Field Trailer and Contractor Field Vehicle
First aid kit:	Baker Field Trailer and Baker Field Vehicle
Personal eye wash bottle:	Baker Field Trailer and Baker Field Vehicle
Air Horn:	With Personnel
Portable 15-minute Emergency Eye Wash Station:	Near Area With Greatest Potential for Chemical Splash/ Exposure

8.11 Notification

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

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

8.12 Hazard Assessment

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

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

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

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

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

8.13 Security

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

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

8.14 Emergency Alerting

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

Personnel Injury in the Work Zone:

- Initiate a verbal warning or one long airhorn blast and move all unaffected site personnel to the support zone (for Level D/D+) or the CRZ (for Level C or higher).
- Send the rescue team into the Work Zone (if required) to remove the injured person to the hotline.
- Have the SHSO and/or Site Manager evaluate the nature of the injury and assure that the affected person is decontaminated according to Section 8.9.
- If required, contact an ambulance and/or the designated medical facility.

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

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed.
3. The HASP has been reviewed and, if appropriate, modified.
4. Site personnel have been briefed on any changes in the HASP.
5. The SHSO and/or Site Manager has authorized the re-entry.

Personnel Injury in the Support Zone:

- The Site Manager and SHSO will assess the nature of the injury; if the cause of the injury or loss of the injured person does not affect the performance of other site personnel, operations may continue.
- If the injury increases the risk to others, a verbal warning or one long airhorn blast shall be sounded and all remaining site personnel will move to the command post for further instructions.
- Activities on site will stop until the added risk is mitigated.

Fire/Explosion:

- Initiate a verbal warning or one long airhorn blast and move all site personnel to the support zone (for Level D/D+) or the CRZ (for Level C or higher).
- Alert the fire and security departments and move all nonessential personnel to the Baker Command Post to await further instructions.
- Activities will stop until the added risk is mitigated.

Personal Protective Equipment Failure:

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

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

Other Equipment Failure:

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

8.15 Training

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

8.16 Spill Containment Procedures

In the event that a small (less than the reportable quantity), easily-controlled spill of hazardous substances (e.g., gasoline, oil, etc.) occurs during the implementation of field activities, spill containment will be utilized to prevent the additional migration of contaminants through the site area. Large, uncontrolled spills will be handled by qualified response organizations under the direction of qualified Base personnel and/or Navy On-Scene Commander. Any release to soils or surface waters equaling or exceeding the reportable quantities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the USEPA Clean Water Act will be reported to the EMD Contact who in turn will report it to the appropriate authorities.

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

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

9.0 TRAINING REQUIREMENTS

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

9.1 General

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

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

Baker also requires that personnel involved with on-site employee supervision receive, in addition to 40 hours initial training and three days of supervised field experience, at least eight additional hours of specialized training at the time of job assignment. Training topics include, but are not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques. The 8-hour supervisory training is required to ensure that supervisors have the knowledge necessary to understand and use the various Health and Safety Programs and to implement the elements of the HASP. Table 9-1 provides the appropriate OSHA Training History for Baker Project Personnel.

9.2 Site-Specific Training

Site-specific training, as discussed in Section 1.3, will consist of an initial health and safety briefing on the following information:

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

TABLE 9-1

OSHA TRAINING HISTORY OF BAKER PROJECT PERSONNEL*

Personnel	Title/Role	Training Status	
Matthew Bartman	• Project Manager	• 40-hr. training completed:	03/89
		• Supervisory training:	09/91
		• 8-hr. refresher completed:	05/96
		• First Aid Training:	NA
		• CPR Training:	NA
		• Medical surveillance:	05/95
Ronald Krivan	• Project Health and Safety Officer	• 40-hr. training completed:	10/91
		• Supervisory training:	09/91
		• 8-hr. refresher completed:	03/96
		• First Aid Training:	12/96
		• CPR Training:	12/93
		• Medical surveillance:	05/95
To be Determined	• Site Manager	• 40-hr. training completed:	NA
		• Supervisory training:	NA
		• 8-hr. refresher completed:	NA
		• First Aid Training:	NA
		• CPR Training:	NA
		• Medical surveillance:	NA
To be Determined	• Site Health and Safety Officer	• 40-hr. training completed:	NA
		• Supervisory training:	NA
		• 8-hr. refresher completed:	NA
		• First Aid Training:	NA
		• CPR Training:	NA
		• Medical surveillance:	NA

* Training and medical surveillance documentation for Baker and subcontractor personnel will be maintained at the Command Post.
NA - Not Applicable

- Recognition of symptoms and signs of exposure to hazardous materials.
- Site control measures.
- Decontamination procedures.
- Emergency procedures.

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

10.0 MEDICAL SURVEILLANCE REQUIREMENTS

10.1 General

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

All Baker employees that will be engaged in site activities covered by the 29 CFR 1910.120 standard receive a Group III physical examination by an occupational health physician who has been provided information on the individual's site activities and exposure or anticipated exposure levels. This exam is received initially upon hire, then once every 12 months thereafter. More frequent medical examinations, consultations, and/or laboratory testing will be provided if the board-certified occupational health physician determines that an increased frequency of examination is required. A complete Group III medical exam includes parameters such as height, weight, vision, temperature, blood pressure, and a complete review of occupational and medical histories. Other tests in a Group III exam include chest x-rays, electrocardiogram, spirometry, urinalysis, and blood tests. Table 10-1 describes the medical surveillance testing parameters performed annually on Baker employees. The need for additional monitoring depending on site conditions will be evaluated on a case-by-case basis.

10.2 Site Specific

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

1. As soon as possible following the emergency incident or development of signs or symptoms.
2. At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

TABLE 10-1

MEDICAL SURVEILLANCE TESTING PARAMETERS*

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

- Medical History (Physical Exam)
- Eye Exam
- EKG (baseline and for individuals over 40 years of age)
- 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 (Physical Exam)
- Eye Exam
- EKG (baseline then annually for individuals over 40 years of age)
- 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 whom also work with asbestos

- Group III testing with the Asbestos Medical Questionnaire w/Pulmonary Function Test ($FVC_{1.0}$ and $FEV_{1.0}$)

* The Board-Certified Occupational Health Physician has the right to reduce or expand the medical monitoring on an annual basis as he/she deems necessary.

** To be performed for individuals identified by the attending physician as being chronically exposed to organic compounds.

11.0 HEALTH AND SAFETY PLAN APPROVAL

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

Matthew Bartman	Project Manager	______________________________
Name (print)	Title (print)	Signature
Ronald Krivan	PHSO	______________________________
Name (print)	Title (print)	Signature

12.0 DECLARATION OF HEALTH AND SAFETY PLAN REVIEW*

All site personnel indicated below have reviewed and are familiar with this Health and Safety Plan for Operable Unit No. 15 (Site 88) MCB Camp Lejeune.

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

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

Page ___ of ___

ATTACHMENT A
BAKER ENVIRONMENTAL, INC.
SAFETY STANDARD OPERATING PROCEDURES

ATTACHMENT A

BAKER ENVIRONMENTAL, INC.
SAFETY STANDARD OPERATING PROCEDURES

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* Not Applicable

Baker Environmental, Inc.

2.0 - RESPIRATORY PROTECTION PROGRAM

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

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

2.1 PURPOSE

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

2.2 SCOPE

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

2.3 RESPONSIBILITY

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

2.4 HAZARD ASSESSMENT

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

After a task-specific assessment is completed and it is determined that there is a potential for airborne exposure concentrations to exceed the recommended limits, engineering and administrative controls should be implemented. If the exposure cannot be reduced, or it is not feasible to reduce the airborne exposure below the recommended limits, respirators will be selected by the PHSO and/or SHSO on the basis of:

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

2.5 TRAINING

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

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

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

2.6 TYPES OF RESPIRATORS

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

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

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

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

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

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

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

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

2.7 AIR QUALITY

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

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

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

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

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

2.8 CLEANING AND MAINTENANCE

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

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

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

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

2.9 INSPECTIONS

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

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

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

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

2.10 FIT-TESTING

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

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

2.11 MEDICAL SURVEILLANCE

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

2.12 LIMITATIONS

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

2.13 SUBCONTRACTOR REQUIREMENTS

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

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

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

3.0 - CARE AND CLEANING OF PERSONAL PROTECTIVE EQUIPMENT

3.1 INTRODUCTION

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

3.2 INSPECTION

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

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

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

3.2.1 Chemical Resistant Suit (Levels D+ through B)

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

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

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

3.2.3 Chemically Resistant Boots (Levels D+ through B)

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

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

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

3.2.5 Hard Hats (Levels D through B)

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

3.2.6 Safety Glasses/Goggles (Levels D through C)

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

3.2.7 Respirators (Levels D+ through B)

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

3.2.8 Hearing Protection (Levels D through B)

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

3.3 EQUIPMENT CLEANING

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

3.3.1 Gross Physical Removal

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

3.3.2 Physical/Chemical Removal

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

3.3.3 Rinsing/Dilution

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

3.4 EQUIPMENT STORAGE

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

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

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

4.1 PURPOSE

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

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

4.2 SCOPE

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

4.3 RESPONSIBILITY

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

4.4 DEFINITIONS

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

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

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

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

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

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

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

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

4.5 PROCEDURES FOR EXPOSURE TO BLOODBORNE PATHOGENS

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

4.5.1 Exposure Determination

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

Job Classifications

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

Exposure Activities

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

4.5.2 Modes of Virus Transmission in the Workplace

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

4.5.3 Methods of Compliance

4.5.3.1 Universal Precautions

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

The universal precautions will include:

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

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

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

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

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

4.5.3.2 Standard Work Practices

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

Personal Hygiene

All exposed employees will observe the following hygienic practices:

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

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

Personal Protective Equipment

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

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

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

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

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

Decontamination procedures will follow those outlined in each site HASP.

Handling Regulated Wastes

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

Training and Education

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

4.5.4 Medical Monitoring

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

4.5.5 Post-Exposure Procedures and Follow-Up management

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

4.5.5.1 First Aid Incident Report

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

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

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

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

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

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

The confidential medical evaluation and follow-up will include:

1. The circumstances of the exposure.

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

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

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

4.5.5.2 "Good Samaritan" Behavior

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

4.6 REFERENCES

OSHA Title 29 CFR Part 1910.1030

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

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

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

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

Appendix A

SUGGESTED BLOODBORNE PATHOGENS TRAINING OUTLINE

I. Introduction

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

II. Bloodborne Diseases

- A. Types
- B. Modes of Transmission

III. Baker Exposure Control Plan

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

5.0 - HEAT STRESS

5.1 INTRODUCTION

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

5.2 CAUSES AND SYMPTOMS

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

1. *Heat rash* results from continuous exposure to heat or humid air and chafing clothes. The condition decreases the ability to tolerate heat. Symptoms include a mild red rash.
2. *Heat cramps* are caused by heavy sweating and inadequate fluid intake. Symptoms include muscle spasms and pain in the hands, feet, and abdomen.
3. *Heat exhaustion* occurs when body organs attempt to keep the body cool, due to inadequate fluid intake and personnel not acclimated to the environment. Symptoms include pale, cool, moist skin; heavy sweating; dizziness, headaches, and vomiting.
4. *Heat stroke* is the most serious form of heat stress. It is a MEDICAL EMERGENCY. Symptoms are red, hot, dry skin; lack of perspiration; nausea; dizziness and confusion; strong, rapid pulse rate; and coma.

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

5.3 PREVENTION

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

- Monitor for signs of heat stress.

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

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

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

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

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

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

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

5.4 MONITORING

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

5.4.1 Monitoring for Permeable Clothing

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

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

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

2. Fluid intake discipline.

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

4. Attention to work-rest intervals.

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

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

   b. Estimate the work load using the following guidelines:

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

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

      (3) Heavy work = pick and shovel work.

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

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

Special Considerations

- Acclimatization - After approximately one to two weeks, workers should be acclimated to their environment.
- Fitness - Physically fit workers will adjust more readily to a change in environment.
- Medication - Some medications can predispose individuals to heat-induced illnesses.

5.4.2 Semipermeable/Impermeable Clothing Monitoring

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

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

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

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

5.5 CARING FOR HEAT-RELATED ILLNESS

To care for heat-related illness provide the following:

- Remove victim from heat.
- Loosen tight clothing.

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

6.0 - COLD STRESS

6.1 INTRODUCTION

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

6.2 CAUSES AND SYMPTOMS

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

6.2.1 Frostbite

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

DO NOT:

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

6.2.2 Hypothermia

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

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

The need to seek medical attention and the urgency in seeking medical attention depends on the symptoms and the severity of the symptoms displayed by the affected individual. If the latent conditions of hypothermia or frostbite are noted or suspected, medical attention must be sought IMMEDIATELY to prevent permanent injury or death.

6.3 PREVENTION

To prevent conditions from occurring have personnel:

- Dress in a minimum of three layers:
    (1) a skin layer to absorb moisture and keep skin dry
    (2) an insulating layer
    (3) an outer layer of nylon/wind-breaking material or chemical-protective layer
- Avoid touching cold surfaces (especially metal) with bare skin, minimize exposed skin surfaces.
- Keep active, use warm and dry shelter areas during rest cycles; use wind breaks whenever possible.
- Maintain body fluids by consuming warm, sweet, caffeine-free, non-alcoholic drinks.
- Avoid alcohol and medications that interfere with normal body regulation or reduces tolerance to cold.

6.4 CARING FOR COLD-RELATED ILLNESS

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

- Start by treating any life-threatening problems.
- Call the local emergency number for help or transport the victim to the nearest hospital.
- Move the victim to a warm place, if possible.
- Remove any wet clothing and dry the victim.
- Warm the victim slowly by wrapping in blankets or putting on dry clothing.

6.5 MONITORING

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

WIND CHILL INDEX[1]
(under calm conditions)

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

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

8.0 - CUTTING AND WELDING

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

8.1 SAFETY RESPONSIBILITY

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

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

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

8.2 EQUIPMENT

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

8.2.1 Welding Machines

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

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

8.2.2 Compressed Gas Cylinders

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

8.2.3 Oxygen Use

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

8.3 FIRE AND EXPLOSION PREVENTION

8.3.1 Location of Combustibles

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

8.3.2 Fire Watch

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

8.3.3 Fire Extinguishers

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

8.3.4 Prohibited Areas

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

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

8.4 PERSONAL PROTECTION

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

8.4.1 Clothing

- To protect the skin during cutting or welding operations, wear gauntlet type gloves and protective aprons. Depending on the job, it may be necessary to also wear leggings, cape sleeves or shoulder covers, and skull caps under helmets.
- Sleeves and collars should be buttoned, pockets should be removed from the front of clothing or buttoned with a flap, and pants should be uncuffed to prevent the retention of sparks.
- To prevent patter from getting into shoes, use spats or have pants overlap shoes.
- Woolen clothing is preferred but cotton material, preferably flame retardant, is acceptable.
- Keep outer clothing free from oil or grease.

8.4.2 Eye and Face Protection

- Approved eye protection must be worn at all times by welders and their assistants to protect against flying sparks, radiant energy, ultraviolet, visible and infrared radiation.
- Helmets must be designed to protect the face, forehead, neck and ears from radiant heat.
- Where exposure to flash exists for the other personnel, a screen should be used.

8.4.3 Respiratory Protection

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

8.4.4 Noise Protection

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

8.5 HOT WORK PERMIT

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

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

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

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

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AIR-PURIFYING RESPIRATOR INSPECTION FORM

Type (Full or Half-Face)	FACE PIECE					HEADSTRAPS OR HEADBANDS		RESPIRATOR INTERIOR			Inspected By (Initials)	Date Inspected
	Clean and Sanitized?	Cracks, Tears, or Holes?	Proper Shape and Flexibility?	Air Purifying Element Holders Operate Correctly?	Proper Storage Free From Heat, Dirt, Sunlight, etc.?	Signs of Wear or Tear?	Buckles Function Properly?	Foreign Material Under Valve Seat?	Cracks or Tears in Valves or Valve Bodies?	Valve Covers and Bodies in Good Condition and Installed Correctly?		

√ = OK
X = Not OK

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AIR-SUPPLYING RESPIRATOR 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

* "MT" = Empty

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QUALITATIVE RESPIRATOR FIT TEST RECORD

TEST SUBJECT NAME ______________________
(last) (first) (initial)

DATE ______________ SOCIAL SECURITY NUMBER ______________

SEX (M/F) ________ AGE ________ DEPARTMENT ______________

RESPIRATOR MEDICAL DATE ________ RESPIRATOR TRAINING DATE ________

SPECIAL/UNUSUAL CONDITIONS/CONSIDERATIONS:

Yes	No		Yes	No	
☐	☐	Claustrophobia	☐	☐	Scars
☐	☐	Facial hair	☐	☐	Broken or crooked nose
☐	☐	Eyeglasses	☐	☐	Extreme facial dimensions
☐	☐	Contacts	☐	☐	Wrinkles
☐	☐	Other: ______________			

RESPIRATOR SELECTION

Manufacturer/Model	Size	Style	Result
	S ___ M ___ L ___	Half ___ Full ___	Pass ___ Fail ___
	S ___ M ___ L ___	Half ___ Full ___	Pass ___ Fail ___
	S ___ M ___ L ___	Half ___ Full ___	Pass ___ Fail ___

Testing Agent	Qualitative Test	Sensitivity Check
Isoamyl Acetate	Yes: ___ No: ___	Yes: ___ No: ___
Irritant Smoke	Yes: ___ No: ___	Yes: ___ No: ___
Other: ____________	Yes: ___ No: ___	Yes: ___ No: ___

TEST EXERCISES
(Check all that apply)

Normal Breathing	________	Talking	________
Deep Breathing	________	Bending	________
Head, Side to Side	________	Jaw Movements	________
Head, Up and Down	________	Rainbow Passage	________

COMMENTS: ______________________________________

____

Signed: ______________________ (Test Subject)

Signed: ______________________ (Technician/Instructor)

Rev.: 12/94

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE

(under calm conditions)

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

Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Baker

Baker Environmental, Inc.

HOT WORK PERMIT

DATE: ______________________ TIME: ______________________

LOCATION: ______________________

ISSUED TO: ______________________

SITE HEALTH AND SAFETY OFFICER: ______________________

SITE MANAGER: ______________________

Do not cut or use other open flame or spark producing equipment until the following precautions have been taken.

PROTECTIVE EQUIPMENT USED: ______________________

____

____

(Initial Each Item)

______ The location where the work is to be done has been personally examined?

______ Any available fire protection systems are in service?

______ There are no flammable dusts, vapors, liquids or unpurged tanks (empty) in the area?

______ Explosimeter reading <10% LEL?

______ All combustible items have been moved away from the operation, or otherwise protected with fire curtains or equivalent?

______ Ample portable fire suppression equipment has been provided?

______ Arrangements have been made to patrol the area for at least 1/2 hour after the work has been completed?

______ The phone number for the local Fire Department is ________?(1)

______ A fire watch is provided?

(1) Note: For hot work conducted at MCB Camp Lejeune, permission must be obtained from the Fire Department in advance before initiating the work by dialing (910) 451-3004. See Attachment A for a list of telephone numbers in the event that the aforementioned number is not accessible.

______________________ (SHSO Signature)

______________________ (Site Manager Signature)

ATTACHMENT A

FIRE DEPARTMENT EMERGENCY ONLY	**911**
Fire Chief/Headquarters	451-5815
Secretary	451-5815
Headquarters FAX	451-5976
Deputy Fire Chief	451-5956
Assistant Chief, Dispatcher #1	451-5833
Assistant Chief, Dispatcher #2	451-0103
Assistant Chief, Training	451-3314
Assistant Chief, Prevention	451-3320
Fire Prevention Inspector	451-3327
Fire Prevention Inspector	451-0103
Fire Alarm Operator	451-3004
Fire Station #1, MCAS (New River)	451-6620
Fire Station #2, Midway Park (Housing Area)	451-2383
Truck Co. #2	451-2383
Fire Station #3, Hadnot Point	451-5856
Fire Station #4, Paradise Point (Housing Area)	451-2132
Fire Station #5, Industrial Area	451-2131
Fire Station #6, Camp Geiger	451-0538
Fire Station #7, Courthouse Bay	451-7221
Fire Station #8, Camp Johnson (Montford Point)	451-0820
Fire Station #10, Rifle Range	451-7922

ATTACHMENT B
MATERIAL SAFETY DATA SHEETS

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

Sheet No. 420
Acetone Solvent Blend

Issued: 4/79 Revision: A, 9/91

Section 1. Material Identification

35

Acetone Solvent Blend Description: A mixture of acetone and isopropanol. Used as a solvent for fats, oils, waxes, rubber, plastics, varnishes, gums, resins and rubber cements.
Other Designations: Acetone, CAS No. 0067-64-1; isopropyl alcohol, CAS No. 0067-63-0.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

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R 0
PPG†
† Sec. 8

Cautions: Acetone solvent blend is a skin, eye, and mucous membrane irritant. It may be narcotic in high concentrations.

Section 2. Ingredients and Occupational Exposure Limits

Acetone, >60%
Isopropanol, 10 to 30%

1990 OSHA PELs
Acetone: 8-hr TWA: 750 ppm, 1800 mg/m^3
15-min STEL: 1000 ppm, 2400 mg/m^3
Isopropyl alcohol: 8-hr TWA: 400 ppm, 980 mg/m^3
15-min STEL: 500 ppm, 1225 mg/m^3

1990-91 ACGIH TLVs
Acetone: TWA: 750 ppm, 1,780 mg/m^3
STEL: 1000 ppm, 2400 mg/m^3
Isopropyl alcohol: TWA: 400 ppm, 985 mg/m^3
STEL: 500 ppm, 1,230 mg/m^3

1990 NIOSH RELs
Acetone: TWA: 250 ppm, 590 mg/m^3
Isopropyl alcohol: 400 ppm, 980 mg/m^3

1985-86 Toxicity Data*
Acetone: Man, oral, TD$_{Lo}$: 2857 mg/kg
Man, inhalation, TD$_{Lo}$: 440 μg/m^3/6 min
Isopropyl alcohol: Man, oral, LD$_{Lo}$: 5272 mg/kg
Human, oral, LD$_{Lo}$: 3570 mg/kg; toxic effects include central nervous system, pulmonary, and gastrointestinal

Calculated TLV for Acetone (70%) Isopropanol (30%) Mixture: 596 ppm

* See NIOSH, *RTECS* (AL3150000, NT8050000) for additional toxicity data on acetone and isopropyl alcohol, respectively.

Section 3. Physical Data

Boiling Point: 133 to 181 °F (56 to 83 °C) at 1 atm
Vapor Pressure: ca 225 mm Hg at 77 °F (25 °C)
Vapor Density (air = 1): ca 2
Density/Specific Gravity (20 °C/20 °C): 0.79
Water Solubility: Completely soluble
% Volatile by Volume: ca 100*

Appearance and Odor: A clear, colorless liquid with an acetone odor.

* Acetone solvent blend is a very volatile liquid that increases fire/explosion risk, especially at elevated temperatures.

Section 4. Fire and Explosion Data

Flash Point: 0 to 53 °F (-17.8 to 11.7 °C), CC	**Autoignition Temperature:** >750 °F (399 °C)*	**LEL:** 2.0% v/v	**UEL:** 12.0% v/v

Extinguishing Media: Alcohol foam, dry chemical, or carbon dioxide (CO$_2$). Use smothering effect to extinguish fire. Waterspray may be ineffective for extinguishing, but it is useful in cooling fire-exposed containers, in reducing fire intensity, and for diluting and flushing solvent.
Unusual Fire or Explosion Hazards: Acetone solvent blend is an OSHA Class 1B liquid. Fire and explosion hazards exist when this material is exposed to heat or ignition sources. Vapors may travel to an ignition source and flash back.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Stay upwind. 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 equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

* An estimated value.

Section 5. Reactivity Data

Stability/Polymerization: Acetone solvent blend is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Acetone solvent blend is incompatible with strong oxidizing agents, strong acids, and strong alkalies.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of acetone solvent blend can produce carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list acetone solvent blend as a carcinogen.
Summary of Risks: Excessive vapor inhalation can cause mucous membrane and respiratory tract irritation. Eye contact can cause severe irritation. Prolonged or repeated skin contact can defat skin. It may be narcotic in high concentrations.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eyes, respiratory system, and central nervous system (CNS).
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms include respiratory tract irritation, nasal irritation, conjunctiva irritation, cough, headache, fatigue, dizziness, narcosis, and even asphyxiation. Skin contact causes dryness, irritation, and mild dermatitis. Ingestion produces gastrointestinal (GI) tract irritation and nausea. Injury to the kidneys is associated with ingestion of isopropyl alcohol and could potentially occur with significant ingestions of acetone solvent blend. Aspiration of vomitus into the lungs is a hazard and can result in severe illness or even death.
Chronic Effects: None reported.

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 a small amount is ingested, have that *conscious and alert* person drink 1 to 2 glasses of water. Consult a physician.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Accidental or intentional ingestion may result in a state of intoxication difficult to distinguish from ethanol ingestion. Serum acetone and alcohol levels may be necessary to diagnose and monitor such a patient's status. In severe intoxication, arterial blood gases and pH, blood electrolytes, liver function studies, a baseline creatinine, blood counts, and urinalysis may be indicated. Watch for deteriorating CNS and respiratory function.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of large spills, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum, explosion-proof ventilation. Cleanup personnel should protect against inhalation and skin or eye contact. For small spills, 1) absorb liquid with a noncombustible, absorbent material, and dispose; or 2) absorb on paper and burn. For large spills, dike far ahead to contain and collect for recycle or disposal. Use nonsparking tools to place waste liquid or absorbent in closable containers for disposal. Keep waste out of sewers, watersheds, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Environmental Degradation: When released on soil, acetone solvent blend probably both volatilizes and leaches into the ground and probably biodegrades. If released into water, it probably also biodegrades.
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
Acetone is listed as a RCRA Hazardous Waste (40 CFR 261.33)
Acetone is listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Acetone and isopropyl alcohol are listed as SARA Toxic Chemicals (40 CFR 372.65)

OSHA Designations

Acetone and isopropyl alcohol are listed as Air Contaminants (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles where necessary, 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. 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 natural rubber gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below 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 a clean, cool, well-ventilated area away from heat and ignition sources, oxidizing agents, strong acids, and bases. Protect containers from physical damage. Emptied containers may still be hazardous from residual liquid or vapors. Store and handle as an OSHA Class 1B flammable liquid.
Engineering Controls: Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Make sure all engineering systems are of maximum explosion-proof design. Acetone solvent blend presents a dangerous fire and explosion hazard; perform all work operations involving it carefully and in a way that prevents exposing liquid or its vapor to ignition sources. To prevent static sparks, electrically ground and bond all containers and pipelines used in shipping, transferring, reacting, production, and sampling operations. Consider automatic sprinkler systems for fire protection in work areas.

Transportation Data (49 CFR 172.101, .102): See acetone and isopropyl alcohol (*MSDS Collection*, Nos. 300 and 324)

***MSDS Collection* References:** 1, 2, 26, 38, 73, 84-94, 100, 101, 103, 116, 117, 120, 122, 124, 126, 132, 136, 138, 143, 146, 148, 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. 100
Aluminum Metal/Powder

Issued: 12/81 **Revision: B, 4/90**

Section 1. Material Identification

31

Aluminum Metal/Powder Description: The primary sources of aluminum are the ores cryolite and bauxite. Produced by electrolysis of bauxite in a bath of molten cryolite, or made synthetically from fluorspar. As pure metal or as alloys, aluminum is used for aircraft, building and construction materials, die-cast auto parts, highway products, permanent magnets, photoengraving plates, corrosion-resistant chemical equipment, machinery and accessory equipment, and electrical conductors; tubes for ointments, toothpaste, and shaving cream; containers and flexible packaging; in dental alloys, manufacturing printing inks; testing for gold, arsenic, and mercury; the jewelry industry; as reducers for determining nitrates and nitrites; for precipitating copper and coagulating colloidal solutions of arsenic or antimony; and in the manufacture of aluminum powder for aluminum paints, explosives, fireworks, flashlights in photography, and for absorbing occluded gases in the manufacture of steel.

Other Designations: CAS No. 7429-90-5; Al; alumina fibre; aluminum flake; aluminum dehydrated; metana aluminum paste.

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

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* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Aluminum metal/powder, ca 100%*

OSHA PELs	ACGIH TLVs, 1989-90	NIOSH REL, 1987
8-hr TWA: 5 mg/m³ (respirable fraction, pyro powders, welding fumes)	TLV-TWA: 5 mg/m³ (pyro powders, welding fumes)	None established
8-hr TWA: 15 mg/m³ (total dust)	TLV-TWA: 10 mg/m³ (metal dust)	**Toxicity Data†**
		None reported

* Since commercially "pure" Al may contain up to 1% iron (Fe), silicon (Si), and copper (Cu), exposure may also be to a mixture of these and other materials.
† Monitor NIOSH, *RTECS* (BD0330000), for future toxicity data.

Section 3. Physical Data

Boiling Point: 4221 °F/2327 °C
Melting Point: 1220 °F/660 °C
Vapor Pressure: 1 mm Hg at 2343 °F/1284 °C
Molecular Weight: 26.98 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 2.70
Water Solubility: Insoluble in hot and cold water

Appearance and Odor: Silvery-white, metallic solid, foil, particulate. No odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** 1202 °F/650 °C (cloud); 1440 °F/760 °C (dust layer)*	**LEL:** >0.04 oz/ft³	**UEL:** None reported

Extinguishing Media: If possible, isolate and permit large fires to burn out while controlling smaller fires with sand, talc, or sodium chloride. Use nonsparking tools to ring small fires. *Do not use water, carbon tetrachloride (CCl_4), or halon!* A mixture of aluminum powder and water slowly forms hydrogen that can be hazardous if confined.

Unusual Fire or Explosion Hazards: Bulk aluminum is not combustible, but powdered aluminum can be a severe fire and explosion hazard when exposed to heat and ignition sources or by chemical reaction with powerful oxidizers. Aluminum forms explosive mixtures in air. When bulk dust is damp, it may heat spontaneously. Particles size, coating, and dispersion in air determine reactivity. The hazard increases with fineness.

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. Evacuate all unnecessary personnel upwind and isolate hazard area. Prevent dust clouds and eliminate drafts. Cool exposed containers with water, but be careful not to get water inside container. Be aware of runoff from fire control methods. Runoff to sewers may cause fire, explosion hazard, or pollution. Do not release to sewers or waterways.

* One hundred percent of dust goes through a 44-μm sieve. A 0.05-J spark can ignite an Al dust cloud.

Section 5. Reactivity Data

Stability/Polymerization: Stable at room temperature in closed containers under normal storage and handling conditions, aluminum corrodes rapidly in contact with other metals since it is strongly electropositive. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Aluminum is incompatible with perchlorate/nitrate/water mixtures, powdered silver chloride, ammonium peroxodisulfate + water, peroxides, halocarbons, halogens, acids, hydrogen chloride gas, molten silicon steels, phosphorus, sulfur, selenium, interhalogens, oxidants, perchlorate salts, and chlorates. Potentially explosive reaction with carbon tetrachloride during ball milling operations with chloroform amidinium nitrate, and sodium acetylide. Violent or explosive 'thermite' reaction when heated with metal oxides, oxosalts (nitrates, sulfates), or sulfides; hot copper oxide worked with an iron or steel tool; or with antimony, arsenic, and anitmony trichloride vapor. An explosive reaction (above 1472 °F/600 °C) of Al with iron powder + water releases explosive hydrogen gas; interaction with sodium hydroxide also releases explosive hydrogen gas; and a violent exothermic reaction occurs above (1112 °F/600 °C) with sodium diuranate. Al reacts with diborane to form a pyrophoric product. Bulk Al may undergo dangerous interactions with alcohols. Reaction with arseneic trioxide + sodium arsenate + sodium hydroxide produces the toxic arsine gas.

Hazardous Products of Decomposition: Inhalation of metallic oxide smoke (Al_2O_3) at 15 mg/m³ or greater can cause "metal fume fever."

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists aluminum as a carcinogen.
Summary of Risks: Its powder and dust are the most dangerous forms. Most hazardous exposures to aluminum occur in refining and smelting processes. Aluminum dust is a respiratory and eye irritant. Lung fibrosis is reported in aluminum welders and polishers, aluminum smelting (potroom) workers, and in workers involved in manufacturing alumina abrasives or explosives from stamped aluminum powders. A single case was reported of fibrosis occuring with encephalopathy (alterations of the brain's structure) after 13.5 years of working with fine powder. Death resulted from bronchopneumonia following progressive encephalopathy. Particles of aluminum deposited in the eye may cause necrosis (localized tissue death) of the cornea. Repeated aluminum contact with skin has been associated with skin telangiectases (bleeding into the tissues and mucous surfaces because of the abnormal fragility and dilatation of the capillary vessels and arterioles), delayed hypersensitivity, and granulomas. Acroanesthesia (numbness of the fingers) is reported in cotton mill operations where there is long contact with wet Al during bobbin winding. Mortality analysis of Al production workers showed malignant tumors of the nervous system, cancer of the pancreas, bronchus, and lung, and leukemia, especially in potroom workers.
Medical Conditions Aggravated by Long -Term Exposure: Symptoms of long-term overexposure are weakness, cough, and shortness of breath with generalized interstitial fibrosis and emphysema.
Target Organs: Respiratory tract, eyes, skin.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Signs and symptoms of inhalation of aluminum powder or dust are dyspnea, cough, lethargy, anorexia, and an increased respiration rate.
Chronic Effects: Chronic inhalation of aluminum dust is associated with pulmonary fibrosis, asthma, emphysema, dyspnea, cough, and chronic obstructive lung disease.
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. For cuts, abrasive irritation or thermal burns, 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. Since aluminum is poorly absorbed through the gastrointestinal tract, vomiting is seldom necessary. However, if large amounts of aluminum are ingested, contact a physician.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Chronic exposure may lead to fibrosis with large bleb formation and risk of spontaneous pnuemothorax.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice an aluminum powder spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel upwind and remove all heat and ignition sources. Cleanup personnel must use protection against airborne dust and threat of fire. Promptly clean spill using conductive, nonsparking scoops and soft brushes with natural bristles. Use approved, grounded vacuum cleaners only in final cleanup. Place powder in closed, pressure-vented, dry, metal containers. Mix dry sand with scrap and tightly seal. 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
Listed as a SARA Toxic Chemical (40 CFR 372.65)
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 prolonged or repeated skin contact. Use tight-weave, nonstatic generating, protective clothing (no metallic fasteners, cuffs, or pockets) and nonsparking safety shoes when working with Al powder. Special protective clothing is needed to work with hot or molten aluminum.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs and ACGIH TLVs (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. 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 in sealed containers in a dry, low fire risk area away from all heat and ignition sources, oxidizing agents, combustibles, acids, alkalis, halogens, carbon disulfide, halogenated hydrocarbons, and all other incompatible materials (Sec. 5). Protect containers from physical damage; exclude moisture and humid air.
Engineering Controls: Avoid generation of airborne dust. Use good housekeeping to prevent dust accumulation. Electrically ground and bond all equipment used with aluminum metal powder. Give preemployment and periodic medical examinations, with particular emphasis on the skin, eyes, and lungs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Aluminum metallic, powder
DOT Hazard Class: Flammable solid
ID No.: UN1396
DOT Label: Flammable solid
DOT Packaging Requirements: 173.232
DOT Packaging Exceptions: 173.232

MSDS Collection References: 2, 4-11, 14-20, 26, 37, 38, 41, 73, 84, 85, 87, 89, 100, 103, 109, 124, 126, 127, 133
Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Hardies, MD

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Material Safety Data Sheets Collection:

Sheet No. 296
Arsenic and Compounds

Issued: 4/90

Section 1. Material Identification 31

Arsenic Description: Obtained from flue dust of copper and lead smelters as white arsenic (arsenic trioxide). Reduction with charcoal and sublimation in an N_2 current yields pure arsenic. Metallic arsenic is used for hardening copper, lead, and alloys; as a doping agent in germanium and silicon solid-state products, special solders, and medicine; and to make gallium arsenide for dipoles and other electronic devices. Arsenic compounds are used in manufacturing certain types of glass; in textile printing, tanning, taxidermy, pharmaceuticals, insecticides and fungicides, pigment production, and antifouling paints; and to control sludge formation in lubricating oils. Arsenic trioxide is the source for 97% of all arsenic products.

Other Designations: CAS No. 7440-38-2; arsen; arsenic black; As; gray arsenic; metallic arsenic.

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

Genium

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

Section 2. Ingredients and Occupational Exposure Limits

Arsenic and soluble compounds, as As

OSHA PEL
8-hr TWA: 0.5 mg/m³,* 0.01 mg/m³†

ACGIH TLV, 1989-90
TLV-TWA: 0.2 mg/m³

NIOSH REL, 1987
Ceiling: 0.002 mg/m³

Toxicity Data‡
Man, oral, TD_{Lo}: 76 mg/kg administered intermittently over a 12-year period affects the liver (tumors) and blood (hemorrhage)
Man, oral: 7857 mg/kg administered over 55 years produces gastrointestinal (in the structure or function of the esophagus), blood (hemorrhage), and skin and appendage (dermatitis) changes
Rat, oral, TC_{Lo}: 605 µg/kg administered to a 35-week pregnant rat affects fertility (pre- and post-implantation mortality)

* Organic compounds.
† Inorganic compounds.
‡ See NIOSH, *RTECS* (CG0525000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: sublimes at 1134 °F/612 °C
Melting Point: 1497 °F/814 °C
Vapor Pressure: 1 mm at 702 °F/372 °C (sublimes)
Atomic Weight: 74.92
Density: 5.724 at 57 °F/14 °C
Water Solubility: Insoluble†

Appearance and Odor: A brittle, crystalline, silvery to black metalloid. Odorless.

* This data pertains to arsenic only.
† Arsenic is soluble in nitric acid (HNO_3).

Section 4. Fire and Explosion Data

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

Extinguishing Media: Use dry chemical, CO_2, water spray, or foam to fight fires.
Unusual Fire or Explosion Hazards: Flammable and slightly explosive in the form of dust when exposed to heat or flame.
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. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Arsenic is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Arsenic can react vigorously on contact with powerful oxidizers such as bromates, peroxides, chlorates, iodates, lithium, silver nitrate, potassium nitrate, potassium permanganate, and chromium (VI) oxide. This material is also incompatible with halogens, bromine azide, palladium, dirubidium acetylide, zinc, and platinum.
Hazardous Products of Decomposition: Thermal oxidative decomposition of arsenic and its compounds produces irritating or poisonous gases.

Section 6. Health Hazard Data

Carcinogenicity: The IARC, NTP, and OSHA list arsenic as a human carcinogen (Group 1). This evaluation applies to arsenic and arsenic compounds as a whole, and not necessarily to all individual chemicals within the group. Studies report that both the trivalent and pentavalent compounds are strongly implicated as causes of skin, lung, and lymphatic cancers. Experimental studies have shown that arsenic has tumorigenic and teratogenic effects in laboratory animals.

Summary of Risks: Arsenic compounds are irritants of the skin, mucous membranes, and eyes. The moist mucous membranes are most sensitive to irritation. Prolonged contact results in local hyperemia (blood congestion) and later vesicular or pustular eruption. Epidermal carcinoma is a reported risk of exposure. Peripheral neuropathy (degenerative state of the nervous system) is common after acute or chronic arsenic poisoning. Symptoms include decreased sensation to touch, pinprick, and temperature; loss of vibration sense; and profound muscle weakness and wasting. Other complications of acute and chronic arsenic poisoning are encephalopathy (alterations of brain structure) and toxic delirium.

Medical Conditions Aggravated by Long-Term Exposure: Damage to the liver, nervous, and hematopoietic (responsible for the formation of blood or blood cells in the body) system may be permanent. Pulmonary and lymphatic cancer may also occur.

Target Organs: Liver, kidneys, skin, lungs, lymphatic system.

Primary Entry Routes: Inhalation, ingestion of dust and fumes, via skin absorption.

Acute Effects: Acute industrial intoxication is more likely to arise from inhalation of arsine. However, with corrosive arsenical vapors, conjunctivitis, eyelid edema, and even corneal erosion may result. Inhalation may result in nasal irritation with perforation of the septum, cough, chest pain, hoarseness, pharyngitis, and inflammation of the mouth. If ingested, metallic or garlic taste, intense thirst, nausea, vomiting, abdominal pain, diarrhea, and cardiovascular arrhythmias (heartbeat irregularities) may occur. Symptoms generally occur within 30 minutes, but may be delayed for several hours if ingested with food. Acute poisoning may result in acute hemolysis (breakdown of red blood cells).

Chronic Effects: Chronic symptoms include weight loss, hair loss, nausea, and diarrhea alternating with constipation, palmar and plantar hyperkeratoses (thickening of the corneous layer of skin on palms and soles of feet), and skin eruptions, and peripheral neuritis (inflammation of the nerves). Leukemia, bone marrow depression, or aplastic anemia (dysfunctioning of blood-forming organs) may occur after chronic exposure.

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. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.

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

Physician's Note: *If emesis is unsuccessful after two doses of Ipecac, consider gastric lavage. Monitor urine arsenic level. Alkalinization of urine may help prevent disposition of red cell breakdown products in renal tubular cells. If acute exposure is significant, maintain high urine output and monitor volume status, preferably with central venous pressure line. Abdominal X-rays should be done routinely for all ingestions. Chelation therapy with BAL, followed by D-penicillamine is recommended, but specific dosing guidelines are not clearly established.*

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and contact with skin and eyes. Use nonsparking tools. With a clean shovel, scoop material into a clean, dry container and cover. Absorb liquid material with sand or noncombustible inert material and place in disposal containers. Do not release to sewers, drains, or waterways. 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
Listed as a CERCLA Hazardous Substance† (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [† per Clean Water Act, Sec. 307(a); per Clean Air Act, Sec. 112]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations‡

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

* Designations for arsenic only.
‡ Listed as arsenic organic compounds (as As).

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.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs, ACGIH TLVs, 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 closed, properly labeled, containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and heat and ignition sources. Protect containers from physical damage.

Engineering Controls: Avoid inhalation or ingestion of dust and fumes, and skin or eye contact. Practice good personal hygiene and housekeeping procedures. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program with training, maintenance, inspection, and evaluation. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement and annual physical examination with emphasis on the skin, respiratory system, and blood.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Arsenic, solid
DOT Hazard Class: Poison B
ID No.: UN1558
DOT Label: Poison
DOT Packaging Requirements: 173.366
DOT Packaging Exceptions: 173.364

IMO Shipping Name: Arsenic, metallic
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1558

MSDS Collection References: 7, 26, 38, 53, 73, 85, 87, 88, 89, 100, 103, 109, 123, 124, 126, 127, 130, 136, 138

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Material Safety Data Sheets Collection:

Sheet No. 22
Calcium Oxide

Issued: 9/78 Revision: D, 9/92

Section 1. Material Identification

39

Calcium Oxide (CaO) Description: Derived by kiln roasting limestone ($CaCO_3$) at 2762 °F (1517 °C) to drive off the carbon dioxide (CO_2). Used in manufacture of aluminum, magnesium, steel, glass, paper, industrial chemicals, mortar, plaster, and chlorinated lime for bleaching; in fungicides, insecticides, lubricants and flotation of non-ferrous ores; as a scrubbing agent to remove sulfur dioxide emissions from smoke stacks; for clarification of beet and cane sugars, dehairing hides for leather and for water and sewage treatment.

Other Designations: CAS No. 1305-78-8, burnt lime, calcia, calx, lime, pebble lime, quicklime, unslaked lime.

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

Cautions: Calcium oxide dust is irritating and forms corrosive calcium hydroxide when in contact with moist body surfaces or with water. Serious burns or sight loss may result if treatment is not immediate. The crystal form is less reactive with water than the powder which can generate temperatures as high as 1470 °F (800 °C).

R 1
I 3
S 3
K 0

NFPA
0
1 1
-

HMIS
H 3*
F 0
R 1
PPE†
* Chronic effects
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Calcium Oxide, ca 95%; impurities include calcium carbonate, cobalt, nickel, magnesium, iron, aluminum oxide, and crystalline silica.

1991 OSHA PEL	1990 NIOSH REL	1992-93 ACGIH TLV	1990 DFG (Germany) MAK	1985-86 Toxicity Data*
8-hr TWA: 5 mg/m³	10-hr TWA: 2 mg/m³	TWA: 2 mg/m³	TWA: 5 mg/m³ Category I: local irritants	None reported

† Monitor NIOSH, *RTECS* (EW3100000), for future data.

Section 3. Physical Data

Boiling Point: 5162 °F (2850 °C)
Melting Point: 4737 °F (2614 °C)
Vapor Pressure: ~0 mm Hg
pH: 11.7 to 12.5
Molecular Weight: 56.1
Specific Gravity: 3.37 at 77 °F (25 °C)
Water Solubility: Reacts exothermically to form caustic calcium hydroxide solution. 1g dissolves in 835 mL at 77 °F (25 °C), 1g/1670 mL at 212 °F (100 °C)
Other Solubilities: Soluble in acids, glycerol, and sugar solution.

Appearance and Odor: Odorless crystals, white or grayish-white lumps, or granular powder. Commercial brands may have a yellow or brown tint due to iron content. It becomes incandescent when heated near its melting point.

Section 4. Fire and Explosion Data

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

Extinguishing Media: Calcium oxide is noncombustible but in contact with water can generate sufficient heat to ignite other combustibles (violent ignition of sulfur, straw, gunpowder, and wood are reported). To fight fires use dry chemical, fog, or foam. *Do not* use carbon dioxide or halogenated agents (i.e., Halon). Use water only if there is enough to flood fire and absorb all heat generated by the calcium oxide + water reaction.

Unusual Fire or Explosion Hazards: Calcium oxide crystals react slowly with water but the powder can explode violently. Bulk dust may heat spontaneously on becoming only slightly damp. Use water carefully around calcium oxide!

Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide only limited protection. Apply cooling water to sides of containers until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Calcium oxide will react with water (forming calcium hydroxide) and carbon dioxide [forming calcium carbonate (chalk)] if exposed to air. Containers can swell and burst if moisture gets in. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Reacts with water to form calcium hydroxide and heat [(up to 1470 °F (800 °C)], with carbon dioxide to form calcium carbonate (chalk). Incompatible with ethanol, boric oxide + calcium chloride, and interhalogens such as boron trifluoride, chlorine trifluoride, fluorine, hydrofluoric acid, phosphorus pentoxide, perchlorates, nitrates, and permanganates.

Conditions to Avoid: Avoid excessive dust generation, exposure to air (water and carbon dioxide) and other incompatibles.

Hazardous Products of Decomposition: None known.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list calcium oxide as a carcinogen. One of calcium oxides' impurities, crystalline silica is considered an IARC Class A-2 (sufficient animal evidence, insufficient human evidence) and a NIOSH Class X (carcinogen with no further classification) carcinogen.

Summary of Risks: Calcium oxide powder is highly corrosive to moist skin, eyes, and mucous membranes of the digestive and respiratory tracts. Irritant and corrosive effects are due to the formation of alkaline calcium hydroxide when it contacts water/moisture. If treatment is not immediate, permanent damage can result.

Medical Conditions Aggravated by Long-Term Exposure: Possibly, bronchitis or other chronic respiratory problems. **Target Organs:** Eyes, skin, nails, respiratory system. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Dust inhalation can cause upper respiratory tract inflammation and irritation (lower respiratory tract is usually only affected at high concentrations),

Continue on next page

Section 6. Health Hazard Data

pneumonia, nasal septum perforation, cough, sneezing, and risk of pulmonary edema (fluid in lungs). Skin contact causes itching and if skin is moist symptoms include a slippery, soapy feeling, burning, ulceration, irreparable tissue damage, and state of shock. Ingestion causes immediate, intense burning in the mouth, throat and stomach (white color of mouth mucous membranes), throat swelling, increased salivation and drooling, vomiting (coffee grounds like material due to digestive hemorrhage), stomach cramps, state of shock, diarrhea (possibly blood stained), risk of stomach perforation, unconsciousness, and death. Eye contact produces severe irritation and burns, watering, eye and lid perforation, eyesight or eye loss. **Chronic Effects:** Repeated inhalation of small amounts can cause perforation of the nasal septum (tissue between nostrils), and repeated skin contact can cause dermatitis and fissuring with brittleness and cracking of the nails.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Immediate treatment is necessary; if only one eye is contaminated but first aid is not immediate, the other eye may be lost as well even though the CaO has not contacted it! Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility; pay close attention to the conjunctival sacs where CaO tends to form clumps. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water until slippery-soapy feeling disappears (may take >1 hr). Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water or milk to dilute. *Do not* induce vomiting.

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

Note to Physicians: Immediate treatment is necessary.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against inhalation and skin/eye contact. Water spray may be used to control dust but measures should be taken to control the resulting heat that will generate. For small spills, do not dry sweep! Scoop spill into suitable container and damp mop residues or vacuum (with a high efficiency particulate filter). For large spills, contain material - waste lime may be used for neutralization of waste acids. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Mosquito fish, TLm = 240 ppm/24 hr; Sunfish, 100 ppm/3 hr is toxic; vector snail, 300 ppm/24 hr is lethal. **Disposal:** In situ amelioration - neutralize with sodium hydrogen carbonate or carbon dioxide. Consider using waste lime for neutralizing facility acid wastes. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. D003, Characteristic of corrosivity

Listed as a CERCLA Hazardous Substance, "Unlisted Hazardous Waste, Characteristic of corrosivity"* (40 CFR 302.4): Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001]

SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 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). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 10 mg/m^3, use a dust mask. For < 50 mg/m^3 use any powered, air purifying respirator with a high efficiency particulate filter or supplied-air respirator (SAR). For < 100 mg/m^3, use any SCBA or SAR with a full facepiece. For < 250 mg/m^3, use any SAR operated in pressure-demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. ***Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*** If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl, rubber, or neoprene or suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in glass rather than plastic containers, in a cool, dry, well-ventilated area away from incompatibles (Sec. 5). Periodically inspect containers for cracks. Keep CaO containers out of reach from safety showers or sprinkler systems because of the dangerous reaction that occurs when CaO contacts water. CaO is not combustible but when contacting water it may generate sufficient heat to ignite other combustibles. Thus, keep CaO away from combustibles and water sources such as safety showers and sprinkler systems. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to keep levels as low as possible. *Enclose* processes and *automatically* transfer CaO from drums or other storage containers to process containers. CaO may be corrosive to some equipment and cause excessive scaling. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the skin, eyes, and respiratory tract (including lung function tests, FEV & FVC).

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Calcium Oxide
DOT Hazard Class: 8
ID No.: UN1910
DOT Packaging Group: III
DOT Label: Corrosive
Special Provisions (172.102): --

Packaging Authorizations
a) Exceptions: 173.154
b) Non-bulk Packaging: 173.213
c) Bulk Packaging: 173.240

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

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 25 kg
b) Cargo Aircraft Only: 100 kg

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 140, 148, 149, 153, 159, 163, 164, 167, 180

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MD

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Material Safety Data Sheets Collection:

Sheet No. 5
Chromic Acid and Chromates

Issued: 10/77 Revision: C, 7/91

Section 1. Material Identification

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Chromic Acid (CrO_3) Description: Produced by roasting chromite ore with alkali or lime, leaching with calcium oxide, crystallizing the chromate or dichromate, and then treating it with an excess of sulfuric acid. Used in ceramic glazes, colored glass, dyes, batteries, explosives, water treatment, wood treatment and preservatives, refractories, copper stripping, aluminum anodizing, photomechanical processing, chromium metal plating, purifying oil and acetylene, hardening microscopic preparations, and manufacturing chromated copper arsenate; and as a corrosion inhibitor, a catalyst, an oxidizing agent in organic chemistry, and an etchant for plastics.

R 1
I 4
S 3*
K 0
* Percutaneous (broken skin)

NFPA
0
3 1
oxy

HMIS
H 3
F 0
R 1
PPG†
† Sec. 8

Other Designations: CAS No. 1333-82-0; chromic acid; chromic acid, solid (DOT); chromium anhydride; chromium (VI) oxide; chromium trioxide; chromium (6+) trioxide; monochromium trioxide; puratronic chromium trioxide. Chromic acid is the commonly used name, although true chromic acid (CrH_2O_4, CAS No. 7738-94-5) cannot be isolated from solution. Chromic acid and chromates (as CrO_3, CAS No. 7440-47-3).

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

Caution: A powerful oxidizer, chromic acid may explode on contact with reducing agents and cause ignition on contact with organic materials. This poison and human carcinogen is corrosive to skin and irritating to mucous membranes. Eye contact may cause permanent blindness.

Section 2. Ingredients and Occupational Exposure Limits

Chromic acid, 99% CrO_3

1990 OSHA PEL
Ceiling: 0.1 mg(CrO_3)/m³

1987 IDLH Level
30 mg/m³

1990-91 ACGIH TLVs
TWA: 0.05 mg(Cr)/m³
Ceiling: 0.1 mg/m³

1990 NIOSH REL
TWA: 0.025 mg(Cr(VI))/m³
Ceiling: 0.05 mg/m³/15 min (Cr(VI))

1985-86 Toxicity Data*
Rat, oral, LD_{50}: 80 mg/kg
Mouse, oral, LD_{50}: 127 mg/kg
Human, inhalation, TC_{Lo}: exposed continuously to 110 µg over 3 years. Toxic effects include tumorigenic (carcinogenic by *RTECS* criteria); sense organs and special senses (olfaction tumors); lungs, thorax, or respiration (tumors).
Dog, subcutaneous, LD_{Lo}: 330 mg/kg

* See NIOSH, *RTECS* (GB6650000), for additional mutative, reproductive, toxicity and tumorigenic data.

Section 3. Physical Data*

Boiling Point: Decomposes at 482 °F (250 °C) to $Cr_2O_3 + O_2$
Melting Point: 385 °F (196 °C)
Molecular Weight: 99.98

Specific Gravity: 2.7
Water Solubility: Soluble
Heat of Fusion: 37.7 cal/g

Appearance and Odor: Dark, purplish-red, prismatic, deliquescent (absorbs all moisture from air) crystals, or a granular powder with no detectable odor.

* These physical data apply only to chromic acid (CAS No. 1333-82-0).

Section 4. Fire and Explosion Data

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

Extinguishing Media: Chromic acid is noncombustible, but accelerates burning of combustibles (wood, paper, oil). For small fires, *use only water*, not dry chemical, carbon dioxide (CO_2), or halon.

Unusual Fire or Explosion Hazards: A powerful oxidizer, chromic acid ignites on contact with acetic acid and alcohol. It may react rapidly enough with organic materials to cause ignition. Containers may explode if involved in fire.

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. Cool fire-exposed containers with flooding amounts of water since the decomposing material may form a hot, viscous foam that can cause containers to rupture and explode. *Use caution!* For large fires, flood area from a safe distance, and cool containers from the side with a water spray until after fire is well out. If possible without risk, move containers. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holder. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

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

Chemical Incompatibilities: This material is incompatible with acetic acid, acetic anhydride, acetone, alcohols, alkali metals, ammonia, arsenic, anthracene, benzene, bromine penta fluorine, butyric acid, camphor, chromous sulfide, diethyl ether, glycerol, hydrogen sulfide, methyl alcohol, naphthalene, peroxyformic acid, phosphorus, potassium hexacyanoferrate, pyridine, selenium, sodium, and turpentine. Chromic acid ignites ethyl alcohol and many hydrocarbons.

Conditions to Avoid: Avoid excess heat and contact with combustible or organic materials.

Hazardous Products of Decomposition: Thermal oxidative decomposition of chromic acid can produce carbon dioxide, smoke, and irritating toxic fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC and NTP list chromic acid and other forms of hexavalent (VI) chromium as human carcinogens.

Summary of Risks: Chromic acid is a poison and a powerful irritant to skin, eyes, and respiratory tract. Skin or lung sensitization (allergic reactions) may occur. Exposure can cause dermatitis (skin rash), asthma, pulmonary edema (fluid in lungs), kidney damage, a "chrome hole," or a perforation of the nasal septum (tissue between nostrils).

Medical Conditions Aggravated by Long-Term Exposure: Any chronic lung or skin condition.

Target Organs: Skin, respiratory tract (including nose, throat, airways, and lungs), and kidney.

Primary Entry Routes: Eyes, skin contact, inhalation, and ingestion.

Acute Effects: Inhalation may cause irritation or burning of nose, throat, and air passages, cough, wheezing, and shortness of breath. Higher exposures may cause pulmonary edema (fluid in lungs). Skin exposure may cause dermatitis (skin rash), irritation, burning, itching, redness, and ulceration (skin destruction) which may penetrate. Eye contact can cause irritation, burning, lacrimation (watering), loss of sight and permanent blindness if not removed quickly.

Chronic Effects: Chronic inhalation of excessive levels may cause epistaxis (nosebleed), "chrome holes," nasal congestion, tooth enamel erosion, chest pain, asthma (via allergic sensitization), bronchitis, or respiratory tract cancer. Chronic eye exposure may cause conjunctivitis. Skin contact

Continue on next page

Section 6. Health Hazard Data, *continued*

can cause irritant or allergic contact dermatitis, or skin ulceration. Chronic systemic absorption could cause liver or kidney damage.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do not let victim rub eyes or keep them tightly shut. Consult a physician immediately.

Skin: Rinse with flooding amounts of water for at least 15 min, and wash with a gentle soap. Promptly remove contaminated clothing. For redness, blistering, or persistent irritation, consult a physician.

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

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water. *Do not induce vomiting* since this worsens the victim's condition. *Do not* neutralize this acid.

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

Note to Physicians: After decontamination and neutralization, treatment of acid burns is similar to that of thermal burns, although bullae and loose necrotic tissue should be debrided. Update tetanus status. *For severe acid burns,* fluid resuscitation is critical to prevent mortality from hypovolemia and renal failure. Monitor serial vital signs, urine output, electrolytes, blood count, and urinalysis as clinically indicated. Neurovascular compromise distal to a circumferential extremity burn may require escharotomy or fasciotomy. *For inhalation exposures to acids,* a CXR, EKG, ABGs, PFTs, SMA, and CBC may aid in treatment. Evaluate and treat as indicated for reactive airways, upper airway obstruction and noncardiogenic pulmonary edema (possibly delayed onset). Although literature documentation is inadequate, a burst of steroids may help prevent development of sequelae such as reactive airways dysfunction syndrome or bronchilitis obliterans. For ocular exposures to acids, ensure adequate decontamination. Determination of pH may be helpful. A Morgan Lens® and topical anesthesia may aid in irrigation. Perform fluorescein staining and slit lamp evaluation and consult an opthamalogist. Antibiotic ointments, mydriatic/cycloplegics, topical corticosteroids (after epithelial recovery), patching, and possibly anterior chamber paracentesis may be indicated depending on clinical presentation. Acutely and in follow-up, evaluate as indicated for intraocular pressure, lacrimal and lid function, corneal integrity and infection. Urinary chromium is of questionable value.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel. Cleanup personnel should protect against dust inhalation and eye contact. Do not handle broken packages unless wearing appropriate personal protective equipment. Keep combustibles (wood, paper, etc.) away from spilled material. Whenever possible, use wet cleanup methods; if not, use vacuum cleanup. Remove spills immediately to prevent dust dispersion. For a water spill, neutralize with agricultural lime, crushed limestone, or sodium bicarbonate. For a land spill, dig a pit, pond, or lagoon to contain material. If time permits, seal these with an impermeable, flexible membrane liner. Dike surface flow with soil, sand or foamed concrete. Follow applicable OSHA regulations (29 CFR 1910.120).

Environmental Transport: If allowed contact with soil, chromic acid, solid, lowers pH and may leach into water sources, causing an effect similar to acid rain's on water sources. This material's carcinogenicity makes it hazardous to the environment in its hexavalent state.

Environmental Degradation: The recommended disposal means are reduction, precipitation, or ion exchange. Landfill disposal is not recommended since it raises soil acidity.

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 261.22): Corrosive waste
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

OSHA Designations

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

† Chromic acid (CAS No. 7738-94-5) is 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 0.5-g/m^3 concentrations (if not fumes), use any dust and mist respirator except single-use and quarter-mask respirators. For 1.25-g/m^3 concentrations, use any powered air-purifying respirator with a high-efficiency particulate filter. For 2.5-m/m^3 concentrations, use any air-purifying full facepiece respirator with a high-efficiency particulate filter. For 30-g/m^3 concentrations, use any supplied air respirator with a full facepiece and operated in a pressure-demand or other positive-pressure mode. All concentrations may require eye protection. 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 ventilation systems to maintain airborne concentrations below occupational exposure levels. Local exhaust ventilation is preferred since it prevents contaminant dispersion into work area by controlling it at its source.(103)

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

Contaminated Equipment: Contact lenses may minimize or worsen eye injuries. In some cases, soft lenses can actually protect eyes, not worsen corneal damage, due to strong chemicals. In other cases, chemical entrapment is presumed a possible hazard. Since contact lens use in industry is controversial, establish your own policy. 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 glass bottles, cans, or drums. Protect against physical damage. Separate from combustible, organic, or other easily oxidizable materials. Protect from excess moisture which could cause containers to rust. Do not store on wooden floors. Store away from foodstuffs and flammable liquids and solids.

Engineering Controls: Avoid dust inhalation and skin or eye contact. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good housekeeping procedures.

Other Precautions: Institute preplacement and periodic medical exams of exposed workers with attention to the skin and respiratory tract. Consider preplacement and periodic chest radiographs.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Chromic acid, solid
DOT Hazard Class: Oxidizer
ID No.: NA1463
DOT Label: Oxidizer
DOT Packaging Exceptions: 173.153
DOT Packaging Requirements: 173.164

IMO Shipping Name: Chromium trioxide, anhydrous
IMO Hazard Class: 5.1
ID No.: UN1463
IMO Label: Oxidizer, Corrosive
IMDG Packaging Group: II

MSDS Collection References: 26, 38, 73, 85, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 139, 140, 143, 142, 145, 148, 159

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Sheet No. 414
Di(2-ethylhexyl)phthalate

Issued: 12/84 Revision: A, 11/90

Section 1. Material Identification 33

Di(2-ethylhexyl)phthalate ($C_{24}H_{38}O_4$) Description: Prepared by acid-catalyzed reaction of 2-ethylhexanol with phthalic anhydride. Used in plasticizing a variety of polymeric materials such natural rubber, synthetic rubber, nitrocellulose, ethyl cellulose, cellulose acetate butyrate, polymethyl methacrylate, polyvinyl butyral, polyvinylidine chloride, and polystyrene; as an organic pump fluid; as a testing agent for air filtration systems, a component of dielectric fluids in electrical capacitors, an inert ingredient in pesticide formulations; in liquid soaps, detergents, rubbing alcohol, decorative inks, lacquers, photographic film, wire and cable, adhesives, industrial and lubricating oils, munitions, and defoaming agents used during paper and paperboard manufactures.

Other Designations: CAS No. 0117-81-7, 1, 2-benzenedicarboxylic acid bis(2-ethylhexyl) ester, DEHP, di-sec-octyl phthalate, dioctyl phthalate, DOP, octyl phthalate.

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

Cautions: Di(2-ethylhexyl)phthalate is a possible human carcinogen. Di(2-ethylhexyl)phthalate is a mild skin, eye, and mucous membrane irritant. It affects the gastrointestinal (GI) tract.

R 0
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S 2
K 1

NFPA

HMIS
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PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Di(2-ethylhexyl)phthalate, ca 100%

1989 OSHA PEL
8-hr TWA: 5 mg/m^3

1990-91 ACGIH TLVs
TWA: 5 mg/m^3
STEL: 10 mg/m^3

1988 NIOSH REL
Reduce to lowest feasible limit

1985-86 Toxicity Data*
Man, oral, TD_{Lo}: 143 mg/kg ingested produces gastrointestinal effects
Rat, oral, LD_{50}: 30600 mg/kg
Rabbit, skin, LD_{50}: 25 gm/kg; toxic effects not yet reviewed

* See NIOSH, *RTECS* (TI0350000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 446 °F (230 °C) at 5 mm Hg
Melting Point: -58 °F (-50 °C)
Vapor Pressure: 1.32 mm Hg at 392 °F (200 °C)
Vapor Density (Air = 1): 16
1 ppm = ~15.94 mg/m^3
Appearance and Odor: Light colored liquid with a slight odor.

Molecular Weight: 390.54
Specific Gravity (20°C/20°C): 0.9861
Water Solubility: <0.01% in water at 77 °F (25 °C)
Viscosity: 81.4 centipoise at 20 °C
Pour Point: -50.8 °F (-46 °C); 8.2 lb/gal at 20 °C

Section 4. Fire and Explosion Data

Flash Point: 420 °F (215 °C), OC	**Autoignition Temperature:** 735 °F (390 °C)	**LEL:** 0.3% v/v at 474 °F (245 °C)	**UEL:** None reported

Extinguishing Media: Use dry powder, carbon dioxide, or foam to fight a fire involving di(2-ethylhexyl)phthalate. Water or foam may cause frothing.

Unusual Fire or Explosion Hazards: This material offers no unusual fire hazards beyond those encountered with ordinary combustible materials.

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. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Di(2-ethylhexyl)phthalate is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: This OSHA Class III-B combustible liquid is incompatible with strong oxidizing agents.

Hazardous Products of Decomposition: Thermal oxidative decomposition of di(2-ethylhexyl)phthalate can produce acrid smoke and fumes including carbon dioxide and carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The NTP and IARC list di(2-ethylhexyl)phthalate as an anticipated human carcinogen and possible human carcinogen (Group 2B), respectively. Experimental studies show that di(2-ethylhexyl)phthalate has teratogenic effects in laboratory animals.

Summary of Risks: Di(2-ethylhexyl)phthalate is a mild skin and eye irritant. It affects the human gastrointestinal tract since it is absorbed intact from the gastrointestinal tract. However, when administered either intravenously or orally, it is rapidly metabolized to derivatives excreted mainly in urine or bile. Central nervous system (CNS) depression may occur, especially with ingestion of large amounts. Skin sensitization does not occur in humans. Inhalation of any significant amount is probably unlikely due to the low vapor pressure. Di(2-ethylhexyl)phthalate has become an environmental contaminant that may accumulate in the food chain.

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

Target Organs: Eyes, upper respiratory system, skin, central nervous system.

Primary Entry Routes: Inhalation, ingestion.

Acute Effects: Symptoms of overexposure include conjunctivitis, keratitis (inflammation of the eye's cornea), bronchial irritation, eczema, staggering, abdominal cramps, nausea, and diarrhea. CNS depression—lethargy, drowsiness, staggering, and sleepiness—can result from absorbing large amounts.

Chronic Effects: None reported.

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*. 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. Contain and pick up spilled material with some noncombustible absorbent material. For large spills, dike far ahead to contain. Place in appropriate containers for disposal. Prevent losses into the environment whenever possible. Do not release to sewers or waterways. This material degrades in fresh water sediments under aerobic conditions; half-life is ~14 days. It does not degrade under anaerobic conditions. It is readily concentrated by aquatic organisms. Clean up trace residues with water and detergent. 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); Waste No. U028
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.45 kg) [* per RCRA, Sec. 3001]
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).

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

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.

Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLVs (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 closed containers in a well-ventilated area away from oxidizing agents and heat and ignition sources. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas.

Engineering Controls: Avoid prolonged or repeated contact with liquid and inhalation of mist or vapors. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures.

Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection **References:** 1-12, 14, 23, 38, 47, 73, 101, 103, 124, 126, 127, 132, 133, 136, 138, 143, 146
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD; **Edited by:** JR Stuart, MS

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

ETHYLENE DICHLORIDE
(Formerly 1,2-Dichloroethane)
(Revision C)
Issued: November 1978
Revised: August 1987

SECTION 1. MATERIAL IDENTIFICATION 23

CHEMICAL NAME: ETHYLENE DICHLORIDE (Changed to reflect common industrial practice)
DESCRIPTION (Origin/Uses): Made from acetylene and HCl. Used as a degreaser, a scavenger in leaded gasoline, as an intermediate in the manufacture of vinyl chloride, in paint removers, in wetting and penetration agents, in ore flotation processes, as a fumigant, and as a solvent for fats, oils, waxes, and gums.
OTHER DESIGNATIONS: 1,2-Dichloroethane; *sym*-Dichloroethane; Dutch Liquid; Dutch Oil; EDC; Ethane Dichloride; Ethylene Chloride; 1,2-Ethylene Dichloride; Glycol Dichloride; $C_2H_4Cl_2$; NIOSH *RTECS* KI0525000; CAS #0107-06-2
MANUFACTURERS/SUPPLIERS: Available from several suppliers, including:
Dow Chemical USA, 2020 Dow Center, Midland, MI 48640; Telephone: (517) 636-1000
COMMENTS: Ethylene dichloride is a flammable, toxic liquid.

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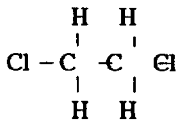
* See Sect. 8	

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
 $\mathrm{Cl-\underset{H}{\overset{H}{C}}-\underset{H}{\overset{H}{C}}-Cl}$ *The maximum allowable peak concentration (above the ceiling level value) of ethylene dichloride is 200 ppm for 5 minutes in any 3-hour period. COMMENTS: Additional data concerning toxic doses and tumorigenic, reproductive, and mutagenic effects is listed (with references) in the NIOSH *RTECS* 1983-84 supplement, pages 865-66.	100	ACGIH Values 1987-88 TLV-TWA: 10 ppm, 40 mg/m³ OSHA PEL* 1986-87 8-Hr TWA: 50 ppm; Ceiling: 100 ppm (15 Min.) NIOSH REL 1986-87 10-Hr TWA: 1 ppm Ceiling: 2 ppm (15 Min.) Toxicity Data Man, Inhalation, TC_{Lo}: 4000 ppm/1 Hr Human, Oral, TD_{Lo}: 428 mg/kg Man, Oral, TD_{Lo}: 892 mg/kg Man, Oral, LD_{Lo}: 714 mg/kg Rat, Oral, LD_{50}: 670 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point ... 182.3°F (83.5°C)
Vapor Pressure ... 87 Torr at 77°F (25°C)
Water Solubility ... Soluble in about 120 Parts Water
Vapor Density (Air = 1) ... 3.4
Evaporation Rate (n-BuAc = 1) ... Not Listed
Specific Gravity ... 1.2569 at 69°F (20°C)
Freezing Point ... -31.9°F (-35.5°C)
Molecular Weight ... 98.96 Grams/Mole

Appearance and odor: Colorless, clear liquid. Sweet, chloroformlike odor is typical of chlorinated hydrocarbons. The recognition threshold (100% of test panel) for ethylene dichloride is 40 ppm. Odor detection probably indicates an excessive exposure to vapor. High volatility and flammability, coupled with its toxicity and carcinogenic potential, make this material a major health hazard.
COMMENTS: Ethylene dichloride is miscible with alcohol, chloroform, and ether.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
See Below	775°F (413°C)	% by Volume	6.2	15.9

EXTINGUISHING MEDIA: Use chemical, carbon dioxide, alcohol foam, water spray/fog, or dry sand to fight fires involving ethylene dichloride. Direct water sprays may be ineffective extinguishing agents, but they may be successfully used to cool fire-exposed containers. Use a smothering effect to extinguish fires involving this material. UNUSUAL FIRE/EXPLOSION HAZARDS: Ethylene dichloride is a dangerous fire and explosion hazard when exposed to sources of ignition such as heat, open flames, sparks, etc. Its vapors are heavier than air and can flow along surfaces to distant, low-lying sources of ignition and flash back. If it is safe to do so, remove this material from the fire area. Ethylene dichloride burns with a smoky flame.
SPECIAL FIRE-FIGHTING PROCEDURES: Wear a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or another positive-pressure mode.
COMMENTS: Flash Point and Method: 56°F (13°C) CC; 65°F (18°C) OC.
OSHA Flammability Class (29 CFR 1910.106): IB. DOT Flammability Class (49 CFR 173.115): Flammable Liquid

SECTION 5. REACTIVITY DATA

Ethylene dichloride is stable. Hazardous polymerization cannot occur.

CHEMICAL INCOMPATIBILITIES include strong oxidizing agents. Explosions have occurred with mixtures of this material and liquid ammonia or dimethylaminopropylamine. Finely divided aluminum or magnesium metal may be hazardous in contact with ethylene dichloride.
CONDITIONS TO AVOID: Eliminate sources of ignition such as excessive heat, open flames, or electrical sparks, particularly in low-lying areas, because the explosive, heavier-than-air vapors will concentrate there.
PRODUCTS OF HAZARDOUS DECOMPOSITION can include vinyl chloride, chloride fumes, and phosgene. Phosgene is an extremely poisonous gas. Products of thermal-oxidative degradation (i.e., fire conditions) must be treated with appropriate caution.

SECTION 6. HEALTH HAZARD INFORMATION

Ethylene dichloride is listed as an anticipated human carcinogen by the NTP and as a probable human carcinogen (Group 2B), by the IARC. It was found to be an animal-positive carcinogen by the IARC. NCI reported positive results (mouse, rat) from its carcinogenesis bioassay. SUMMARY OF RISKS: Ethylene dichloride is considered to be one of the more toxic of the common chlorinated hydrocarbons. Deaths from accidental ingestion of this material have been reported. Inhalation of vapors reportedly caused three fatalities. Excessive inhalation of ethylene dichloride vapors can cause respiratory irritation, intoxication, narcotic and anesthetic effects, vomiting, dizziness, depression, and diarrhea. The hepatoxic (injurious to liver) effects of this material are significant. The systemic effects from overexposure can appear in the liver, kidneys, digestive tract, blood, lungs, adrenal glands, and the central nervous system. Tests on animals have revealed reproductive failure and fetal resorption. There may be increased risk to nursing infants of exposed mothers. TARGET ORGANS: Central nervous system, eyes, kidneys, liver, heart, adrenal glands, and skin. PRIMARY ENTRY: Inhalation, absorption through skin, oral, or eye contact. ACUTE EFFECTS: Skin contact causes irritation, defatting, and, if repeated or prolonged, burning. Eye contact causes irritation and serious injury (clouding of the cornea) if it is not removed promptly. CHRONIC EFFECTS: Injuries to the liver (hepatoxicity) and kidneys, weight loss, low blood pressure, jaundice, oliguria (reduced excretion of urine), or anemia. MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE: Persons taking anticoagulants could experience an increase in tendency to bleed. Persons taking insulin face an increased risk of lowered blood sugar. FIRST AID: Be prepared to restrain a hyperactive victim. EYE CONTACT: Flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Get medical help.* SKIN CONTACT: Immediately flush the affected area with water. Wash thoroughly with soap and water. Remove and launder contaminated clothing before wearing it again; clean material from shoes and equipment. Get medical help.* INHALATION: Remove victim to fresh air; restore and/or support his breathing as needed. Get medical help.* INGESTION: Never give anything by mouth to someone who is unconscious or convulsing. Rinse victim's mouth with water. Oxygen and artificial respiration may be needed. Get medical help.*

* GET MEDICAL ASSISTANCE = IN PLANT, PARAMEDIC, COMMUNITY. Get prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Before using ethylene dichloride, it is essential that proper emergency procedures be established and made known to all personnel involved in handling it. Notify safety personnel of ethylene dichloride spills or leaks and implement containment procedures. Remove and eliminate all possible sources of ignition such as heat, sparks, and open flames from the area. Cleanup personnel should use protection against inhalation of vapors and contact with liquid. Contain spills by using an absorbent material such as dry sand or vermiculite. Use nonsparking tools to mix waste material thoroughly with absorbent and place it in an appropriate container for disposal. Flush trace residues with large amounts of water. Do not flush waste to sewers or open waterways.

WASTE DISPOSAL: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Waste may be burned in an approved incinerator equipped with an afterburner and a scrubber. Follow Federal, state, and local regulations.

Ethylene dichloride is designated as a hazardous substance by the EPA (40 CFR 116.4). Ethylene dichloride is reported in the 1983 EPA TSCA Inventory.

EPA Hazardous Waste Number (40 CFR 261.33): U077

EPA Reportable Quantity (40 CFR 117.3): 5000 lbs (2270 kgs)

Aquatic Toxicity Rating, TLm 96: 1000 - 100 ppm

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Always wear protective eyeglasses or chemical safety goggles. Ethylene dichloride is particularly harmful to the eyes, and direct contact results in corneal opacity (permanent clouding of the eye). GLOVES: Wear impervious rubber gloves to prevent skin contact. RESPIRATOR: Use a NIOSH-approved respirator per the NIOSH *Pocket Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. Any detectable concentration of ethylene dichloride requires an SCBA, full facepiece, and pressure-demand/positive-pressure modes. Warning: Air-purifying respirators will not protect workers from oxygen-deficient atmospheres. OTHER: Wear rubber boots, aprons, and other protective clothing suitable for use conditions to prevent skin contact. Remove contaminated clothing and launder it before wearing it again. Discard contaminated shoes. VENTILATION: Provide maximum explosion-proof local fume exhaust ventilation systems to maintain the airborne concentrations of ethylene dichloride vapors below the exposure limits cited in section 2. Install properly designed hoods that maintain a minimum face velocity of 100 lfm (linear feet per minute). SAFETY STATIONS: Make eyewash stations, washing facilities, and safety showers available in areas of use and handling.

SPECIAL CONSIDERATIONS: Vapors are heavier than air and will collect in low-lying areas. Eliminate sources of ignition in these areas and again provide good ventilation there.

COMMENTS: Practice good personal hygiene. Keep materials off of your clothes and equipment. Avoid transferring this material from hands to mouth while eating, drinking, or smoking. Immediately remove ethylene dichloride-saturated clothing to avoid flammability and health hazards. Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Store ethylene dichloride in tightly closed containers in a cool, dry, well-ventilated area away from sources of ignition. Protect containers from physical damage and from exposure to excessive heat. Avoid direct physical contact with strong acids, bases, oxidizing agents, and reducing agents. SPECIAL HANDLING/STORAGE: Use nonsparking tools. Outside or detached storage is preferred. Store and handle ethylene dichloride in accordance with the regulations concerning OSHA class IB flammable liquids.

ENGINEERING CONTROLS: During transfer operations involving ethylene dichloride, the liquid and its vapors must not be exposed to nearby sources of ignition from engineering systems that are not explosion proof. Preplan emergency response procedures.

TRANSPORTATION DATA (per 49 CFR 172.101-2):

DOT Hazard Class: Flammable Liquid
DOT Label: Flammable Liquid
IMO Class: 3.2

DOT Shipping Name: Ethylene Dichloride
DOT ID No. UN 1184
IMO Label: Flammable Liquid, Poison

References: 1-9, 12, 19, 21, 26, 43, 47, 73, 87-102. CK

Approvals	
Indust. Hygiene/Safety	JW
Medical Review	Geoff Goldsmith MD

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Material Safety Data Sheets Collection:

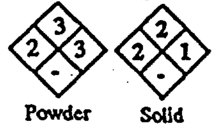
Sheet No. 758
Iron

Issued: 7/91

Section 1. Material Identification

Iron (Fe) Description: Occurs naturally as the second most abundant metal (~5%) in the earth's crust. Its commercial form usually contains some carbon, phosphorus, silica, sulfur, and manganese. It has four naturally occurring isotopes: 54, 56, 57 and 58, and six artificial ones: 52, 53, 55, 59, 60, and 61. Iron is purified by smelting ore with limestone and coke in blast furnaces (purity 91 to 92 %), or by continuous direct reduction of iron ore with limestone heated to 1699 °F (926 °C), melted at 3499 °F (1926 °C), and then reduced to iron at 2998 °F (1648 °C) with powdered coal (purity 99%). The powder form is obtained by treating ore or scrap metal with hydrochloric acid to give ferrous chloride solution, then filtrating, vacuum crystallizing, dehydrating, and reducing it at 1472 °F (800 °C) to metallic iron (briquettes or powder); or by thermal decomposition of iron carbonyl. Solid iron is used to alloy with carbon, manganese, chromium, nickel, and other elements to form steel. Its radioisotopes (^{55}Fe and ^{59}Fe) are used in biological tracer studies. The powder form is used in metallurgy products, magnets, high-frequency cores, and auto parts; and as a catalyst in ammonia synthesis.
Other Designations: CAS No. 7439-89-6, Ancor En 80/150,® Armco iron,® carbonyl iron, Loha,® Suy B-2.®
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*™ for a suppliers list.

Genium



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* Sec. 8

Cautions: Iron is moderately toxic by ingestion and inhalation of iron dusts and powder. The powder form is pyrophoric (ignites spontaneously upon exposure to air and other substances).

Section 2. Ingredients and Occupational Exposure Limits

Iron, ca 91 to 99%

1990 OSHA PEL	1990-91 ACGIH TLV	1990 NIOSH REL	1985-86 Toxicity Data†
8-hr TWA: 10 mg/m³*	TWA: 5 mg/m³*	5 mg/m³*	Rabbit, intraperitoneal, LD_{Lo}: 20 mg/kg; no toxic effect noted

*As iron oxide fumes.
† See NIOSH, *RTECS* (NO4565500), for additional toxicity data.

Section 3. Physical Data

Boiling Point: 4982 °F (2750 °C)
Melting Point: 2795 °F (1535 °C)
Vapor Pressure: 1 mm Hg at 3248 °F (1787 °C)
Electrical Resistivity: 9.71 μΩ/cm at 68 °F (20 °C)
Molecular Weight: 55.847
Density/Specific Gravity: 7.86 at 68 °F (20 °C)
Water Solubility: Insoluble

Appearance and Odor: Pure, solid iron is a silvery-white or gray, soft, ductile, malleable (can be rolled, hammered, or bent), slightly magnetic (becoming more so as it is alloyed; for example, steel) metal. It is available as ingots, wire, sheets, or powder. The powder form is black-gray.

Section 4. Fire and Explosion Data

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

Extinguishing Media: For small fire, use water spray, carbon dioxide (CO_2), or regular foam. For large fires, use water spray or regular foam. Apply cooling water spray to fires-exposed container sides until fire is well out. If possible with no risk, remove containers from area.
Unusual Fire or Explosion Hazards: Since finely divided iron powder is pyrophoric and ignites upon exposure to air at normal temperatures, fires and dust explosions can occur in ducts or separators used to remove the dust during grinding and polishing operations.
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. Fight fire from as far a distance as possible. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

*Although no flash point or autoignition temperature is reported, remember that the powder form is pyrophoric and can ignite spontaneously in air at room temperatures.

Section 5. Reactivity Data

Stability/Polymerization: Iron is stable in dry air, but readily oxidizes in moist air to form rust. Highly divided powder forms are very unstable and can ignite spontaneously in air.
Chemical Incompatibilities: Solid or powdered iron ignites or explodes on contact with acetaldehyde, ammonium peroxodisulfate, chloroformamidinium, chloric acid, ammonium nitrate, halogens, dinitrogen tetraoxide, nitryl fluoride, polystyrene, sodium acetylide, potassium dichromate, peroxyformic acid, and nitryl fluoride. Hot iron wire burns in chlorine gas and iron with water forms rust.
Conditions to Avoid: Avoid generation of iron dusts and contact with the materials listed above.
Hazardous Products of Decomposition: Thermal oxidative decomposition of iron can produce toxic iron oxide fumes.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list iron as a carcinogen although the mining of one particular ore, hematite, may be associated with an increased risk of lung cancer in miners. No other iron ores are identified specifically as a carcinogen.
Summary of Risks: Occupational exposures usually result from dust or fume inhalation during mining, ore preparation, production, and refining of the metal and its alloys. Acute and chronic toxicity can occur. Although rare, occupational toxicity by ingestion has occurred. Its effects are the same as those by ingestion of large amounts of iron tablets.
Medical Conditions Aggravated by Long-Term Exposure: Chronic respiratory diseases.
Target Organs: Eyes, respiratory tract, liver, and pancreas.
Primary Entry Routes: Eyes, inhalation, and ingestion.
Acute Effects: Inhalation may be irritating to the respiratory tract. Eye contact may cause conjunctivitis (inflammation of the eye's lining), and deposition of iron particles can leave a "rust ring" or brownish stain on the cornea. Iron's acute toxicity results primarily from accidental or suicidal ingestions (e.g., overdose of iron-containing vitamin pills). Initially, the patient may have vomiting, abdominal pain, bloody diarrhea, hematemesis (vomiting blood), lethargy, and shock. After several hours, the patient may improve, but should be observed carefully, as toxicity may progress to development of profound shock, severe acidosis (increased acidity in blood), cyanosis (bluish skin discoloration), and fever. Two to four days after exposure, liver damage may occur. Within several weeks after exposure, in several rare cases, gastrointestinal fibrosis (scarring) has occurred with obstruction of the digestive tract. Iron overdose may be fatal.
Chronic Effects: Chronic inhalation can produce mottling (spotting) of lungs (siderosis). This condition is often without symptoms and has been referred to as "benign radiopaque pneumoconiosis." Ingestion of greater than 50 to 100 mg of iron per day may result in pathological iron deposition in body tissues. Symptoms include fibrosis (scarring) of the pancreas, diabetes mellitus, and liver cirrhosis. Repeated iron ingestion can produce cardiac toxicity.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Consult poison control center.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Management of iron poisoning by ingestion is complex and beyond this MSDS's scope. Consult a medical toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind. Shut off all ignition sources–no flares, smoking, or flames in hazard area. Avoid dust generation by cleaning small spills with a damp mop. Since finely divided iron powder is explosive, take special care during cleanup. For large spills, flush material with a stream of water and dike 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
Listed (as iron oxide fumes) 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.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent any skin contact.
Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (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: Avoid physical damage to containers. Store in a cool, dry, well-ventilated area away from flammable gases or liquids, oxidizing materials, or organic peroxides (Sec. 5).
Engineering Controls: Avoid dust inhalation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Regularly service the ducting at grinding and polishing machines and finishing belts to maintain efficiency of exhaust ventilation and prevent explosion. Remote control operations of machinery is advisable when at all possible.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Iron mass *or* sponge, *not properly oxidized*
DOT Hazard Class: Flammable solid
ID No.: NA1383
DOT Label: Flammable solid
DOT Packaging Exceptions: None
DOT Packaging Requirements: 173.174

MSDS Collection References: 26, 73, 103, 124, 126, 127, 132, 136, 138, 139, 143, 146, 148, 149, 159
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

Section 1. Material Identification

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Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.

Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.

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

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* Sec. 8

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 µg/m^3
Action Level TWA*: 30 µg/m^3

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 µg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 µg/m^3

1988 NIOSH REL
10-hr TWA: <100 µg/m^3

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 µg/m^3 affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 °F (1740 °C)
Melting Point: 621.3 °F (327.4 °C)
Vapor Pressure: 1.77 mm Hg at 1832 °F (1000 °C)
Viscosity: 3.2 cp at 621.3 °F (327.4 °C)
Molecular Weight: 207.20
Specific Gravity (20 °C/4 °C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*

Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

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

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
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. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 °C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system. The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.

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. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. 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, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
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, 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. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local 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: 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 washing hands 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 incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

MSDS Collection References: 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Material Safety Data Sheet
from Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 256

MANGANESE TETROXIDE

Issued: April 1989

SECTION 1. MATERIAL IDENTIFICATION

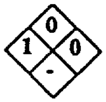
•28

Material: MANGANESE TETROXIDE

Description (Origin/Uses): Pouring and casting of molten ferromanganese generate fumes consisting largely of manganese tetroxide. Whenever manganese oxides are strongly heated in air, manganese tetroxide is produced. In fact, X-ray diffraction analysis has determined that ferromanganese fume consists primarily of manganese tetroxide.

Other Designations: Manganese Oxide; Trimanganese Tetraoxide; Trimanganese Tetroxide; Mn_3O_4; CAS No. 1317-35-7

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



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*See sect. 8		K	-

SECTION 2. INGREDIENTS AND OCCUPATIONAL EXPOSURE LIMITS

Manganese Tetroxide, ca 100%

OSHA PEL	ACGIH TLVs, 1988-89	NIOSH REL
8-hr TWA: 1 mg/m^3* as Mn	TLV-TWA: 5 mg/m^3† as Mn	None Established
	TLV-TWA: 1 mg/m^3‡ as Mn	Toxicity Data §
	TLV-STEL: 3 mg/m^3‡ as Mn	Mouse, Oral, TD_{Lo}: 23 g/kg

*Defined for fume and compounds by the OSHA.
†Defined for dust and compounds by the ACGIH.
‡Defined specifically for fume by the ACGIH.
§See NIOSH, *RTECS* (OP0895000), for additional data on toxicity with references to reproductive effects.

SECTION 3. PHYSICAL DATA

Melting Point: 2847 °F (1564 °C)
Molecular Weight: 229 g/mol
Solubility in Water (%): Insoluble*
Specific Gravity (H_2O = 1): 4.876

Appearance and Odor: A brownish black powder; odorless.

*Soluble in hydrogen with the evolution of chlorine.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point: *	Autoignition Temperature: *	LEL: *	UEL: *

Extinguishing Media: *Manganese tetroxide is an inorganic salt that is not likely to burn. Occupational exposure to it is very likely to occur as a by-product of cutting, welding, or grinding operations. These operations can generate significant amounts of heat and exposed workers must be protected from heat stress. Use extinguishing agents that will put out the surrounding fire.

Unusual Fire or Explosion Hazards: None reported.

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

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Manganese tetroxide is a stable inorganic compound that is formed during certain industrial operations. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Manganese tetroxide may react vigorously with strong reducing agents, acids, or bases.

Conditions to Avoid: Welding, cutting, grinding, casting, pouring, or finishing operations are most likely to provide a source of occupational exposure to manganese tetroxide; perform them carefully with the correct personal protective equipment (see sect. 8).

Hazardous Products of Decomposition: Thermal oxidative degradation of manganese metal itself from cutting, grinding, or welding operations produces manganese tetroxide fume as well as other oxides of manganese (Mn_xO_y).

SECTION 6. HEALTH HAZARD INFORMATION

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

Summary of Risks: Small manganese tetroxide particles embedded into the skin of workers can cause localized inflammatory reactions. Inhalation of manganese tetroxide fume can cause metal fume fever, where 4 to 6 hours after exposure, the patient experiences coughing, fever, chills, and a tight feeling in the chest. These symptoms should subside in less than 24 hours.

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

Target Organs: Skin, eyes, respiratory system.

Primary Entry: Inhalation, skin contact.

Acute Effects: Irritation of the skin, eyes, nose, throat, and respiratory system; pleuritus and/or severe or fatal pneumonia.

Chronic Effects: Some manganese salt exposures can cause a Parkinson Disease-like syndrome or psychosis.

FIRST AID

Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes.

Skin: Rinse the affected area with flooding amounts of water; wash it with soap and water. Carefully remove any manganese metal or manganese tetroxide particles embedded in the skin.

Inhalation: Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required.

Ingestion: Unlikely to be toxic because it is poorly absorbed.

Get in-plant, paramedic, or community medical help for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel and provide adequate ventilation in case of a manganese tetroxide spill. Cleanup personnel must wear proper personal protective equipment (see sect. 8) to avoid overexposure.

Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

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

EPA Designations

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

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Work operations that may expose workers to heated by-products of manganese metal should be carefully evaluated by qualified personnel to determine what protective measures are necessary to prevent excessive inhalation of airborne manganese fume, dust, and compounds. Wear a NIOSH-approved respirator per Genium reference 88 for the maxiumum-use concentrations and/or exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). **Other:** Wear protective gloves and aprons to prevent solid manganese metal shavings from coming into contact with your skin. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne concentrations of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in work areas.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Comments: Pouring and casting of molten ferromanganese metal are the primary sources for occupational exposure to manganese tetroxide. Grinding, welding, and cutting may also lead to exposure. A qualified person should evaluate the particular work operation to make certain that airborne concentrations of manganese compounds, including manganese tetroxide, are not above the exposure limits cited in section 2.

Transportation Data (49 CFR 172.101-2): Not Listed

References: 1, 6, 7, 84-94, 100, 116, 117, 119, 120, 122

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

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Material Safety Data Sheet Collection

Mercury **MSDS No. 26**

Date of Preparation: 1/77 Revision: D, 6/94

Section 1 - Chemical Product and Company Identification 44

Product/Chemical Name: Mercury
Chemical Formula: Hg
CAS No.: 7439-97-6
Synonyms: colloidal mercury, hydrargyrum, liquid silver, Quicksilver
Derivation: Obtained by roasting cinnabar (mercury sulfide) and purified by distillation, or as a by-product of gold mining.
General Use: Used in agricultural poisons, anti-fouling paint, dental amalgams, mining amalgamation (to remove gold and other metals from ore), thermometers, barometers, dry cell batteries, chlorine and caustic soda production, electrical apparatus, and as a neutron absorber in nuclear power plants.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Mercury, ca 100 %wt

OSHA PEL
Ceiling: 0.1mg/m^3 (vapor and inorganic Hg)
8-hr TWA: 0.05 mg/m^3 (vapor), skin; (Vacated 1989 Final Rule Limit)

ACGIH TLVs
TWA: 0.025 mg/m^3 (inorganic compounds), skin

NIOSH REL
10-hr TWA: 0.05 mg/m^3 (vapor), skin

DFG (Germany) MAK
TWA: 0.01 ppm (0.1 mg/m^3)
Category III: Substances with systemic effects
Onset of Effect: > 2 hr
Half-life: > shift length (strongly cumulative)

Peak Exposure Limit:
0.1 ppm (1 mg/m^3), 30 min. average value, 1/shift

IDLH Level
28 mg/m^3

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Mercury exists as a heavy, odorless, silver-white liquid metal. It is highly toxic by both acute and chronic exposure. Exposure can cause corrosion of the eyes, skin, and respiratory tract and may result in irreversible nervous system damage. It readily forms amalgamations with most metals except iron.

Wilson Risk Scale
R 1
I 4
S 2*
K 1
*Skin absorption

HMIS
H 4*
F 0
R 0
*Chronic effects
PPE†
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, eye and skin contact/absorption.
Target Organs: Central nervous system, eyes, skin, respiratory system, liver, kidneys.
Acute Effects
Inhalation: Exposure to high vapor concentrations can cause severe respiratory damage. Other symptoms include wakefulness, muscle weakness, anorexia, headache, ringing in the ear, headache, diarrhea, liver changes, fever, gingivitis, chest pain, difficulty breathing, cough, inflammation of the mouth (stomatitis), salivation, bronchitis, and pneumonitis. Acrodynia (pink or Swifts disease), characterized by redness and peeling of the skin on the toes and fingers, was commonly seen in children in the 1950s and is still *infrequently* seen in workers.
Eye: Irritation and corrosion.
Skin: Skin can become severely irritated if allowed to remain in contact with mercury. Skin absorption will occur at 2.2% of the rate of absorption through the lungs.
Ingestion: Mercury generally passes through the digestive tract uneventfully. However, large amounts may get caught up in the intestine and require surgical removal. If an abscess or other perforation is present along the digestive tract, absorption into the blood stream with subsequent mercury poisoning is possible.
Carcinogenicity: IARC, NTP, and OSHA do not list mercury as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Central nervous system disorders.
Chronic Effects: Chronic exposure appears more common than acute and is primarily associated with central nervous system damage which can be permanent (ex. paresthesia of the hands, lips, feet). Early signs of toxicity include weakness, fatigue, anorexia, weight loss, and gastrointestinal disturbances. If exposure levels are high, characteristic tremors of the fingers, eyelids, and lips occur with progression to generalized tremors of the entire body. Psychic disorders are noticeable and characterized by behavior and personality changes, increased excitability, memory loss, insomnia, and depression. In severe cases, delirium and hallucinations may occur. Kidney damage is observed with oliguria (decreased urine output) progressing to anuria (urine cessation) and may require dialysis. The cornea and lens of the eyes may take on a brownish discoloration and the extraocular muscles may be damaged. This syndrome has been termed *Asthenic-Vegetative Syndrome* or *Micromercurialism.* Chronic symptoms occur increasingly with exposures to 0.1 mg/m^3 or higher. *Mutation:* Aneuploidy and other chromosomal aberrations

have been observed in the lymphocytes from whole blood cultures in workers exposed to mercury. *Reproductive:* Mercury has been detected in stillborn babies of women treated with mercury for syphilis. In a study of six men acutely exposed (occupationally) to mercury levels as high as 44 mg/m^3, all suffered impaired sexual function. Repeated skin contact may cause allergic dermatitis in some individuals.

NOTE: Spilled mercury will release sufficient vapor over time to produce chronic poisoning.

Section 4 - First Aid Measures

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

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

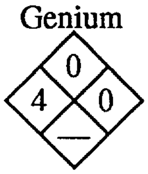
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water and then wash exposed area with soap. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. In general, mercury will pass through the digestive tract uneventfully.

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

Note to Physicians: BEI: *blood* (15 µg/L), *urine*: (35 µg/g creatinine). Extremely high urine levels of 0.5 to 0.85 mg Hg/L are indicative of polyneuropathy. 0.4 to 22 µg/L is reported to be the human lethal blood level. Obtain urinalysis including at a minimum: albumin, glucose, and a microscopic examination of centrifuged sediment. Use BAL or 2, 3-dimercaptosuccinic acid as chelators. *Do not* use calcium sodium EDTA because of nephrotoxicity. An electromyograph may determine extent of nerve dysfunction. It has been noted that exposure to mercury may predispose persons to development of carpal tunnel syndrome.

Section 5 - Fire-Fighting Measures



Flash Point: Nonflammable

Autoignition Temperature: Nonflammable

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use agents suitable for surrounding fire.

Unusual Fire or Explosion Hazards: None reported.

Hazardous Combustion Products: Toxic mercury vapor and mercuric oxide.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Keep a mercury spill kit readily available in areas where mercury is used. Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind.

Small and Large Spills: Follow instructions on mercury spill kit. Most kits come with an aspiration-driven vacuum trap with a mercury "sweeper" (copper or copper-plated brush). Wash spill area with a dilute calcium sulfide or nitric acid solution. If spill cannot be taken up readily, dust the top of the spill with flowers of sulfur or preferably, calcium polysulfide. This will produce a surface coating of mercury sulfide which will reduce mercury vapor dispersion into the air.

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

Section 7 - Handling and Storage

Handling Precautions: Use appropriate PPE when working with mercury. *Do not* use on porous work surfaces (wood, unsealed concrete, etc.) to prevent spills from lodging in cracks.

Storage Requirements: Store in a cool, dry, well-ventilated area away from heat and incompatibles (Sec. 10). Store on non-porous floors and wash them regularly with a dilute calcium sulfide solution. Because mercury will form amalgamations with most metals except iron, metal shelves should be painted with a sufficiently thick coating to prevent this from happening.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Wherever possible, enclose processes to prevent mercury vapor dispersion into work area.

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

Administrative Controls: Consider pre-placement and periodic medical exams of exposed workers with emphasis on the skin, eyes, central nervous system, liver, and kidneys.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For $\leq$ 0.5 mg/m^3, use any chemical cartridge respirator with cartridges providing protection against mercury and equipped with an ESLI (end of service life indicator), any SCBA, or any SAR (supplied-air respirator). For $\leq$ 1.25 mg/m^3, use any SAR operated in continuous-flow mode, any PAPR (powered, air-purifying respirator) with an ESLI. For $\leq$ 2.5 mg/m^3, use any SCBA or SAR with a full facepiece, any SAR with a tight-fitting facepiece and operated in continuous-flow mode, or any chemical cartridge respirator with a full facepiece, chemical cartridges providing protection against mercury, and equipped with an ESLI. For ≤ 28 mg/m^3, use any SAR operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA with full facepiece and operated in pressure-demand or other positive pressure mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets made of butyl rubber, nitrile rubber, fluorocarbon rubber, neoprene rubber, polyvinyl chloride, chlorinated polyethylene, or polycarbonate to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

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

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.

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

Section 9 - Physical and Chemical Properties

Physical State: Liquid metal
Appearance and Odor: Silvery-white, odorless
Vapor Pressure: 0.0018 mm Hg at 77 ˚F (25 ˚C)
Formula Weight: 200.59
Density (H_2O=1): 13.534 g/cm^3 at 77 ˚F (25 ˚C)
Boiling Point: 674.09 ˚F (356.72 ˚C)
Freezing Point: -37.97 ˚F (-38.87 ˚C)
Viscosity: 15.5 mP at 77 ˚F (25 ˚C)
Electrical Resistivity: 95.76 µohm at 68 ˚F (20 ˚C)
Water Solubility: 0.28 µmol/L at 77 ˚F (25 ˚C)
Other Solubilities: Soluble in boiling sulfuric acid, nitric acid (reacts); slightly in lipids, and 2.7 mg/L in pentane. Insoluble in alcohol, ether, cold sulfuric acid, hydrogen bromide, and hydrogen iodide.
Surface Tension: 484 dyne/cm at 77 ˚F (25 ˚C)
Critical Temperature: 2664 ˚F (1462 ˚C)
Critical Pressure: 1587 atm

Section 10 - Stability and Reactivity

Stability: Mercury does not tarnish at ordinary temperatures but when heated to near its boiling point, it slowly oxidizes to mercuric oxide.

Polymerization: Hazardous polymerization does not occur.

Chemical Incompatibilities: Mercury forms alloys (amalgamates) with most metals except iron. It is incompatible with oxidizers such as bromine, 3-bromopropyne, methylsilane + oxygen, chlorine, chlorine dioxide, nitric acid, or peroxyformic acid; tetracarbonyl nickel + oxygen, alkynes + silver perchlorate, ethylene oxide, acetylenic compounds (explosive), ammonia (explosive), boron phosphodiiodide, methyl azide, nitromethane, and ground sodium carbide.

Conditions to Avoid: Exposure to high temperatures, metal surfaces or incompatibles.

Hazardous Decomposition Products: Thermal oxidative decomposition of mercury can produce mercuric oxide.

Section 11- Toxicological Information

Toxicity Data:*

Reproductive:
Rat, inhalation: 890 ng/m^3/24 hr for 16 weeks prior to mating had an effect on spermatogenesis.

Acute Dermal Toxicity:
Man, skin, TD_{Lo}: 129 mg/kg for 5 continuous hours caused ringing in the ears, headache, and allergic dermatitis.

Acute Oral Toxicity:
Man, oral, TD_{Lo}: 43 mg/kg caused tremor and jaundice or other liver changes.

Acute Inhalation Effects:
Woman, inhalation, TC_{Lo}: 150 $\mu g/m^3$/46 days caused anorexia, diarrhea, and wakefulness.
Man, inhalation, TC_{Lo}: 44300 $\mu g/m^3$/8 hr caused muscle weakness, liver changes, and increased body temperature.

Chronic Effects:
Rat, inhalation: 1 mg/m^3/ 24 hr for 5 continuous weeks caused proteinuria.

* See NIOSH, *RTECS* (OV4550000), for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Catfish, LC_{50} = 0.35 mg/L/96 hr; mollusk (*Modiolus carvalhoi*), LC_{50} = 0.19 ppm/96 hr: tadpole (*Rana hexadactyla*), LC_{50} = 0.051 ppm/96 hr. Mercury is transformed to methyl mercury by bacteria in the environment and undergoes bioaccumulation readily. BCF for freshwater fish = 63,000; for saltwater fish = 10,000; and for marine and freshwater invertebrates = 100,000.

Environmental Degradation: Mercury is expected to volatilize rapidly when deposited on soil surfaces. Once in the air, it can be transported long distances before being redeposited on soil or in water. In water, mercury appears to bind to particulates where it eventually becomes deposited on the bed sediment. In general, mercury entering the environment can be deposited and revolatilized several times.

Section 13 - Disposal Considerations

Disposal: Incineration is *not* an appropriate disposal method. Wastewater may be treated by addition of chlorine to oxidize the mercury to its ionic state. The water can then be passed through an absorbent (an activated charcoal concentrate with a sulfur coating or peanut shell charcoal) to collect the ionic mercury, followed by distillation to recover the mercury. Sodium borohydride, a reducing agent, can be used to precipitate mercury from waste solutions. Bioremediation, using *Pseudomonas putida*, has also been suggested. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Mercury
Shipping Symbols: A, W
Hazard Class: 8
ID No.: UN2809
Packing Group: III
Label: Corrosive
Special Provisions (172.102): –

Packaging Authorizations
a) Exceptions: 173.164
b) Non-bulk Packaging: 173.164
c) Bulk Packaging: 173.240

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 35 kg
b) Cargo Aircraft Only: 35 kg

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: 40, 97

Section 15 - Regulatory Information

EPA Regulations:
Listed as a RCRA Hazardous Waste (40 CFR 261.33): U151
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001; CWA, Sec. 307(a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ), 1 lb (0.454 kg)
SARA 311/312 Codes: 1, 2
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed
OSHA Regulations:
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A)

Section 16 - Other Information

References: 73, 103, 124, 132, 136, 148, 149, 159, 167, 176, 187, 189

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Medical Review .... T Thoburn, MD, MPH

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ATTACHMENT C
EMERGENCY PROCEDURES FOR EXPOSURE TO HAZARDOUS MATERIALS/WASTE

ATTACHMENT C

EMERGENCY PROCEDURES FOR EXPOSURE TO HAZARDOUS MATERIALS/WASTE

1. Call ambulance or transport individual to hospital/clinic immediately. Monitor airway, breathing and circulation during trip to hospital or while waiting for the ambulance. Administer first aid or CPR, as necessary. Don't forget to take the HASP with you; it contains information on the contaminants expected to be found on site and will assist the physician in his/her assessment of the exposure.

2. Fill in Potential Exposure Report, answering each of the questions to the best of your ability.

3. Contact our physician(s) at EMR as soon as possible. The procedure is as follows:

   a. **Call EMR at 1-800-229-3674!**

   b. Ask to speak with:

      Dr. David L. Barnes;
      Dr. Elaine Theriault; or
      Ms. T.J. Wolff, R.N.

Note: During nonbusiness hours (after 6 p.m.) call 1-800-229-3674 and follow directions for paging the aforementioned individuals.

4. Once in contact with any of these individuals, explain what has happened (they will review the information on the form with you and may ask you to fax the form to them, if possible), and allow either of them to speak with the attending physician.

5. When asked about payment (and they will ask), inform the Hospital/Clinic/Physician that this is a "work related injury" and have them contact the Benefits Coordinator at (412) 269-2744. Have invoices sent to:

   Michael Baker Jr. Inc.
   Attn: Benefits Coordinator
   Airport Office Park, Bldg. 3
   Coraopolis, PA 15108

6. Contact the Project Manager and the Project Health and Safety Officer as soon as it is feasible, but wait no longer than 24 hours.

Baker
Baker Environmental, Inc.

POTENTIAL EXPOSURE REPORT

Name: ____________________ Date of Exposure: ____________________

Social Security No.: ____________________ Age: __________ Sex: __________

I. Exposing Agent

Name of Product or Chemicals (if known) ____________________

____

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing? ____________________

How long did individual work in area before signs/symptoms developed?

____

Was protective gear being used? If yes, what was the PPE?

____

Was there skin contact? ____________________

Was the exposing agent inhaled? ____________________

Were other persons exposed? If yes, did they experience symptoms?

____

III. Signs and Symptoms (check off appropriate symptoms)

<u>Immediately with Exposure</u>:

- ☐ Burning of eyes, nose, or throat
- ☐ Tearing
- ☐ Headache
- ☐ Cough
- ☐ Shortness of breath
- ☐ Delirium
- ☐ Chest tightness/pressure
- ☐ Nausea/vomiting
- ☐ Dizziness
- ☐ Weakness
- ☐ Heat flashes
- ☐ Other ____________________

<u>Delayed Symptoms</u>:

- ☐ Weakness
- ☐ Nausea/vomiting
- ☐ Shortness of breath
- ☐ Cough
- ☐ Loss of appetite
- ☐ Abdominal pain
- ☐ Headache
- ☐ Numbness/tingling
- ☐ Other ____________________

IV. Present Status of Symptoms (check off appropriate symptoms)

☐ Burning of eyes, nose, or throat
☐ Tearing
☐ Headache
☐ Cough
☐ Shortness of breath
☐ Chest tightness/pressure
☐ Cyanosis (bluish skin color)
☐ Nausea/vomiting
☐ Dizziness
☐ Weakness
☐ Loss of appetite
☐ Abdominal pain
☐ Numbness/tingling
☐ Other ____________

Have symptoms (please check off appropriate response and give duration of symptoms):

Improved ________ Worsened ________ Remain Unchanged ________

V. Treatment of Symptoms (check off appropriate response)

None ________ Self-medicated ________ Physician treated ________

VI. Name ______________________________
(Attending physician)

VII. Hospital/Clinic ______________________________

Source: EMR, Inc.