FINAL

REMEDIAL INVESTIGATION/FEASIBILITY STUDY QUALITY ASSURANCE PROJECT PLAN

OPERABLE UNIT NO. 16 (SITES 89 AND 93)

CONTRACT TASK ORDER 0344

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Prepared for:

DEPARTMENT OF THE NAVY
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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed for the field investigation at Operable Unit (OU) No. 16 at Marine Corps Base, Camp Lejeune, North Carolina. The following sites are included in this OU.

- Site 89 - STC-868
- Site 93 - TC-942

The preparation of this QAPP, and other related project plans, is being performed under the Navy CLEAN Contract No. N62470-89-D-4814, Contract Task Order 0344. Baker Environmental, Inc., (Baker) is the prime contractor for the implementation of this project.

This QAPP addresses the quality assurance and quality control steps and procedures that will be administered for the sample collection and analysis for this Remedial Investigation (RI). Detailed information regarding sample handling and analytical methods are provided in Sections 6.0 and 9.0, respectively. Sample collection procedures are provided in the Field Sampling and Analysis Plan (FSAP).

2.0 SCOPE OF QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) addresses sample collection and analysis to be conducted for the field investigation of OU No. 16 of Camp Lejeune, North Carolina. The QAPP has been developed for the Department of Navy (DON) in accordance with U.S. Environmental Protection Agency (USEPA) guidelines. Contractors will follow QA/QC practices and procedures, including chain-of-custody procedures, while conducting all sample collection and analysis activities.

In order to provide adequate QA/QC, this investigation will require:

1. The use of a NFESC-certified analytical laboratories;

2. The use of accepted analytical methods for the samples discussed in the FSAP. Analysis of samples for hazardous constituents parameters will be performed using the following documents:

    - "Statement of Work for Organic Analysis," USEPA, OLM01.9, August 1991

    - "Statement of Work for Inorganic Analysis," USEPA, ILM03.0, March 1990

    - "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983

    - "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136

    - "Test Methods for Evaluating Solid Waste," USEPA SW846, November 1986, 3rd Edition and 1996 updates

    - "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886

3. The conducting of field audit(s) during initial sampling activities to verify that sampling is being performed according to the Plan.

The structure of this QAPP and the QA elements addressed are:

- Title Page
- Table of Contents
- Introduction
- QAPP Scope
- Project Description
- Project Organization
- QA Objectives for Data Measurement
- Sampling Procedures

- Sample and Document Custody
- Calibration Procedures and Frequency
- Analytical Procedures
- Data Reduction, Validation, and Reporting
- Internal QC Checks
- Performance and System Audits
- Preventive Maintenance
- Data Measurement Assessment Procedures
- Corrective Action
- QA Reports to Management

3.0 PROJECT DESCRIPTION

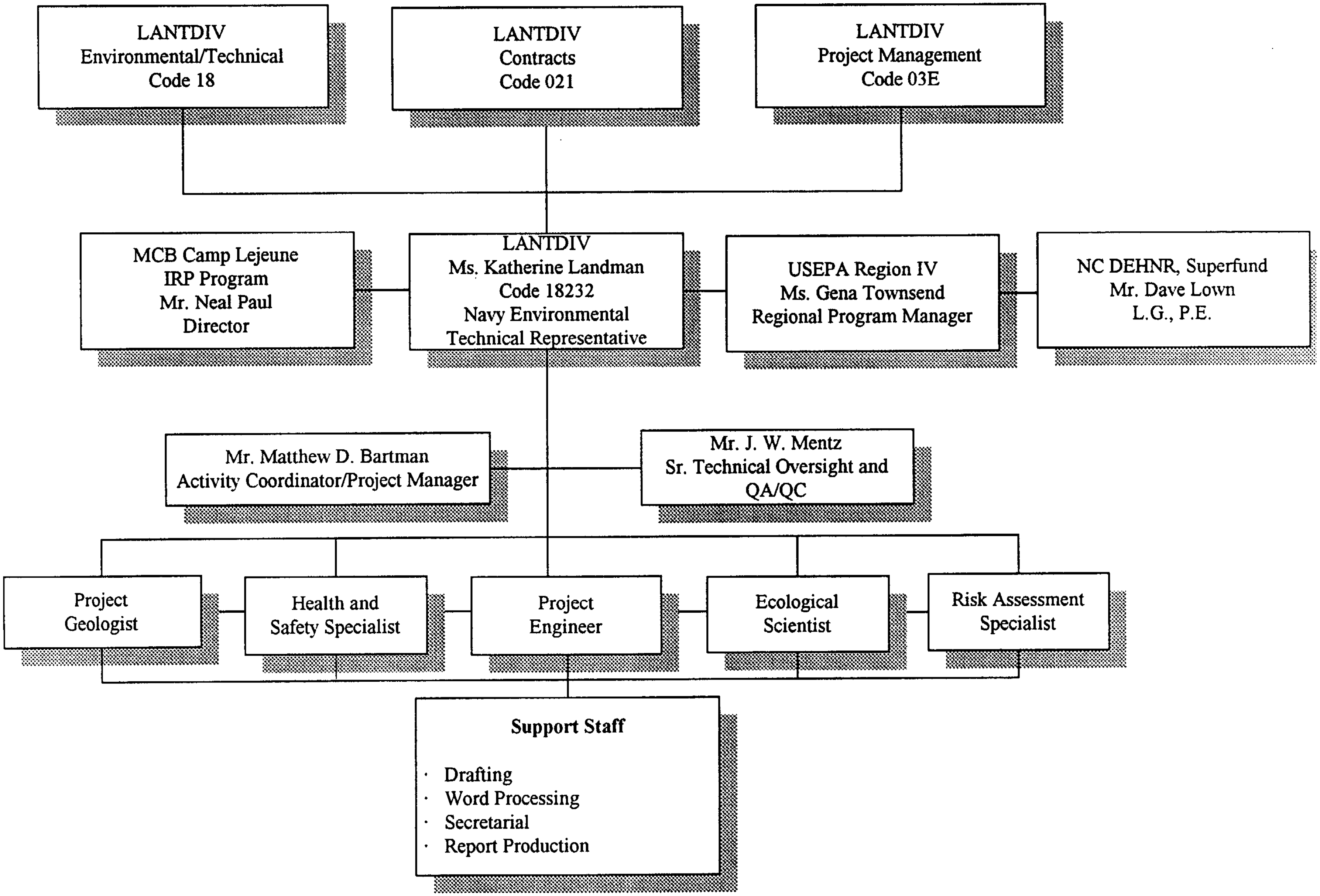
An introduction to the field investigation for OU No. 16 describing the project objectives and scope are given in Sections 3.0 and 4.0 of the RI/FS Work Plan. These sections discuss the objectives of the RI/FS, and the various field sampling and analytical programs. A detailed description of the field investigations, including sample location and designation and sampling procedures and frequency, is presented in Sections 4.0, 5.0, and 6.0 of the FSAP.

4.0 PROJECT ORGANIZATION

Technical performance of the investigation for OU No. 16 at Camp Lejeune and key personnel responsible for quality assurance throughout its duration are described in Section 5.0 of the RI/FS Work Plan. The contractor will utilize subcontractors to perform laboratory analysis, data validation, drilling and monitoring well installation, and surveying. Specific subcontractors have not yet been identified. Figure 4-1 shows the project organization, lines of authority, and support personnel/organizations.

FIGURE 4-1

PROJECT ORGANIZATION



5.0 QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT

The purpose of a QA Program is to establish policies for the implementation of regulatory requirements and to provide an internal means for control and review so that the work performed is of the highest professional standards.

5.1 Project Quality Assurance Objectives

The following is a list of QA objectives which will be implemented at OU No. 16.

- Obtain scientific data of a quality sufficient to meet scientific and legal scrutiny.
- Gather/develop data in accordance with procedures appropriate for its intended use.
- Ensure that data is of acceptable precision, accuracy, completeness, representativeness, and comparability as required by the project.

The fundamental mechanisms that will be employed to achieve these quality goals can be categorized as prevention, assessment and correction where:

- Prevention of errors through planning, documented instructions and procedures, and careful selection and training of skilled, qualified personnel.
- Assessment of all quality assurance sampling reports furnished by the contract laboratory.
- Assessment of data through data validation, and of procedures through laboratory and field audits.
- Correction for prevention of reoccurrence of conditions adverse to quality.

This QAPP, prepared in direct response to these goals, describes the QA Program to be implemented and the quality control (QC) procedures to be followed by field and laboratory personnel during the course of the project.

This QAPP presents the project organization and specifies or references technical procedures, documentation requirements, sample custody requirements, audit, and corrective action provisions to be applied to provide confidence that all activities meet the intent of the QA program. This QAPP has been prepared in accordance with USEPA guidance as presented in "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80.

The procedures contained or referred to herein have been taken from:

- "Statement of Work for Organic Analysis," USEPA, OLM01.9, August 1991
- "Statement of Work for Inorganic Analysis," USEPA, ILM03.0, March 1990
- "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983

- "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136

- "Test Methods for Evaluating Solid Waste," USEPA SW846, November 1986, 3rd Edition and 1996 updates

- "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886

- "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," USEPA, (QAMS 005/80).

5.2 Data Quality Objectives

Data quality objectives (DQOs) are qualitative or quantitative statements developed by the data users to specify the quality of data needed from a particular data collection activity to support a specific decision. The DQOs are expressed in terms of precision, accuracy, representativeness, completeness, and comparability. Definitions for these terms, as well as for the more general term uncertainty, are given in Table 5-1. The Project Manager, in conjunction with the Navy Environmental Technical Representative (NTR), is responsible for defining the DQOs. The intended use of the data, analytical measurements, and the availability of resources are integral in development of DQOs. DQOs define the level of uncertainty in the data that is acceptable for each specific activity during the investigation. This uncertainty includes both field sampling error and analytical instrument error. Ideally, zero uncertainty is the goal; however, the variables associated with sampling and analysis contribute to a degree of uncertainty in any data generated. It is an overall program objective to keep the total uncertainty within an acceptable range, so as not to hinder the intended use of the data. To achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness have been specified.

The data collected will be used:

- To evaluate the presence or absence of contamination resulting from previous disposal activities.

- To assess potential contaminant migration and exposure pathways.

- To monitor health and safety conditions during field activities.

- To identify releases or suspected releases of hazardous waste and/or constituents.

- To screen from further investigation those areas which do not pose a threat to human health or environment.

TABLE 5-1

DEFINITIONS OF DATA QUALITY INDICATORS

PRECISION - A measure of mutual agreement among individual measurements of the sample property, usually under prescribed similar conditions. Precision is expressed in terms of the standard deviation. Comparison of replicate values is best expressed as the relative percent difference (RPD). Various measures of precision exist depending upon the "prescribed similar conditions".

ACCURACY - The degree of agreement of a measurement (or an average of replicate measurements), X, with an accepted reference or true value, T, expressed as the difference between the two values, X-T. Accuracy is a measure of the bias in a system.

REPRESENTATIVENESS - Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental concern.

COMPLETENESS - A measure of the amount of the valid data obtained from the measurement system compared to the amount that was expected under "normal" conditions.

COMPARABILITY - Expresses the confidence with which one data set can be compared with another.

UNCERTAINTY - The unlikelihood of all types of errors associated with a particular decision.

All samples for characterizing the site or qualitatively assessing human health and environmental risks will be analyzed and reported by the laboratory as Level IV data (NFESC Level D). All on-site analyses, which will be used to assist in characterizing contamination, will be performed using EPA approved methods Level (NFESC). Field parameters including temperature (aqueous only) and specific conductance will be Level I (NFESC Level A) data quality.

6.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Descriptions of the procedures to be used for sampling the groundwater and soil at the site are provided in the FSAP. The number of samples, sampling locations, and sampling rationale by media also are presented in Section 4.0 of the FSAP.

Sample custody procedures outlined in this section have been developed from "User's Guide to the Contract Laboratory Program," December 1988, OSWER Directive No. 9240.0-01. These procedures are in accordance with "EPA NEIC Policies and Procedure Manual," May 1978, revised November 1984, EPA 330-78-001-R and "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," December 1980, QAMS-005/80.

The purpose of this section is to outline the sample handling and sample documentation procedures to be used during implementation of the FSAP. The objective of the sample handling procedures is to deliver representative samples to the laboratories for analysis. The objectives of the sample documentation procedures are to: (1) ensure complete analysis of the requested parameters within the required turnaround times; and (2) document the sample from the point of collection to the final data report.

6.1 Sampling Handling

New polyethylene or glass bottles containing the proper preservatives will be provided by the laboratory for sample collection. In addition to the chemical preservatives, samples will be stored on ice at 4°C in a waterproof metal or sturdy plastic cooler, if required (see Tables 6-1 through 6-2 for summaries of containers, preservation, and holding times for water and solids, respectively).

6.2 Chain-of-Custody Procedures

A sample is considered to be in an individual's possession if:

- It is in the sampler's possession or it is in the sampler's view after being in his or her possession.
- It was in the sampler's possession and then locked or sealed to prevent tampering.
- It is in a secure area.

Five kinds of documentation will be used in tracking and shipping the analytical samples:

- Field log book
- Sample labels
- Chain-of-Custody (COC) records
- Custody seals
- Commercial carrier airbills

TABLE 6-1

SUMMARY OF CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR AQUEOUS SAMPLES
OPERABLE UNIT NO. 16 (SITES 89 AND 93)
CTO 0344
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Container	Preservation	Holding Time
TCL Volatiles	Two 40-ml vials with teflon septum caps	Cool, 4°C HCl pH <2	14 days (7 days if unpreserved)
TCL Semivolatiles	1-liter amber glass bottle with teflon caps	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
TCL/PCBs	1-liter amber glass bottle with teflon caps	Cool, 4°C	7 days to extraction; 40 days after extraction for analysis
TAL Metals	1-500 ml polyethylene bottle	HNO_3 pH<2 HNO_3 pH<2	6 months; Mercury 28 days
TSS	1-500 ml polyethylene bottle	Cool, 4°C	2 days
TDS	1-500 ml polyethylene bottle	Cool, 4°C	7 days
COD	1-250 ml polyethylene bottle	HCL pH<2	28 days
BOD	1-liter polyethylene bottle	Cool, 4°C	48 hours
Chloride	1-250 ml polyethylene bottle	None Required	28 days
Methane	Two 40-ml vials with teflon septum caps	Cool, 4°C HCl pH <2	14 days (7 days if unpreserved)
Nitrate	1-250 ml polyethylene bottle	$H_2SO_4<2$	28 days
Nitrite	include w/nitrate sample	$H_2SO_4<2$	28 days
Sulfate	1-250 ml polyethylene bottle	Cool, 4°C	28 days
Sulfide	1-250 ml polyethylene bottle	Cool, 4°C	28 days

Notes:

TCL - Target Contaminant List
TAL - Target Analyte List
COD - Chemical Oxygen Demand
BOD - Biological Oxygen Demand
TSS - Total Suspended Solids
TDS - Total Dissolved Solids

TABLE 6-2

SUMMARY OF CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR SOLID SAMPLES
OPERABLE UNIT NO. 16 (SITES 89 AND 93)
CTO 0344
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Container	Preservation	Holding Time
TCL Volatiles	One 4-ounce wide-mouth glass jar	Cool, 4°C	10 days
TCL Semivolatiles	One 8-ounce wide-mouth glass jar	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
TCL Pesticides/PCBs	One 8-ounce wide-mouth glass jar	Cool, 4°C	7 days to extraction; 40 days after extraction for analysis
TAL Metals	One 8-ounce wide-mouth glass jar	Cool, 4°C	6 months; Mercury, 28 days
TCLP Metals	Two 8-ounce wide-mouth glass jars	Cool, 4°C	14 days
Corrosivity	One 4-ounce wide-mouth glass jar	Cool, 4°C	10 days
Ignitability	One 4-ounce wide-mouth glass jar	Cool, 4°C	14 days
Reactivity	One 4-ounce wide-mouth glass jar	Cool, 4°C	10 days
TOC	One 4-ounce wide-mouth glass jar	Cool, 4°C	N/A
Grain Size Bulk Density Permeability	Shelby tube	N/A	N/A

Notes:

TCL - Target Contaminant List
TAL - Target Analyte List
TCLP - Toxicity Characteristic Leaching Procedure
TOC - Total Organic Carbon

At a minimum, the label for each sample bottle will contain the following information:

- Site name
- Sample number
- Date and time of collection
- Sample type (grab or composite)
- Matrix
- Sampler's initials

The sample information, as well as the analysis to be performed on the sample, will be entered in the field log book for each sampling point. Additionally, the following items will be entered:

- Dates and times of entry
- Names of field personnel on site
- Names of visitors on site
- Field conditions
- Description of activities
- Sampling remarks and observations
- QA/QC samples collected
- List of photographs taken
- Sketch of site conditions

Custody of the samples will be maintained by field personnel from the time of sampling until the time they are forwarded to the analytical laboratory.

The sample custody is documented using Chain-of-Custody (COC) records. Field personnel will complete a COC record, in waterproof ink, to accompany each cooler forwarded from the site to the laboratory. Chemical reagents used to preserve the samples will be recorded on the COC record. Any errors on the COC records will not be erased; instead, a line will be drawn through the error and initialed by the person completing the form. The original copy will be placed in a sealable plastic bag and put inside the appropriate cooler, secured to the cooler's lid.

If the sample cooler is to be shipped by commercial air carrier, the cooler must be secured with custody seals so that the seals would be broken if the cooler was opened. The commercial carrier is not required to sign the COC record as long as the custody seals remain intact and the COC record stays in the cooler. The only other documentation required is the completed airbill.

If the sample shipment is hand delivered to the laboratory by field personnel or retrieved by laboratory personnel at the site, then the custody seals are not necessary. The laboratory sample custodian, or his/her designee accepting the sample shipment, whether it is from the air carrier or the field personnel, signs and dates the COC record upon sample receipt. The original COC record will be returned along with the final data report. The laboratory will be responsible for maintaining internal log books and records that provide a custody record during sample preparation and analysis.

Laboratory Chain-of-Custody Procedures

Upon sample receipt the steps below will be performed.

- Samples will be received and unpacked in the laboratory where the staff checks for bottle integrity (loose caps, broken bottles, etc.).
- Samples will be verified with incoming paperwork (packing slip, etc.) by type of bottle and stabilizer. The paperwork must be either signed or initialed.
- Information concerning the sample (from the sampling record, Chain-of-Custody, and observation) will be recorded along with parameters to be analyzed, date of sampling, and date the sample is received in the laboratory.
- Samples will be placed in an appropriate secured storage area until analysis.
- When analysis is complete, samples will be stored for a 30-day period unless otherwise specified.

If collected samples arrive without Chain-of-Custody or incorrect Chain-of-Custody records, the following steps will be taken:

- The laboratory will prepare a nonconformance form stating the problem.
- The site supervisor and Project Manager will be notified.
- If the missing information cannot be provided by the field staff, the samples affected will not be analyzed.

Primary considerations for sample storage are:

- Secured storage.
- Maintain prescribed temperature, if required, which is typically four degrees Celsius.
- Extract and/or analyze samples within the prescribed holding time for the parameters of interest.

6.3 Document Custody Procedures

Project records are necessary to support the validity of the work and to furnish documentary evidence of quality. The evidentiary value of data is dependent upon the proper maintenance and retrieval of quality assurance records. Therefore, procedures will be established to assure that all documents attesting to the validity of work can be accounted for when the work is completed.

Records must be legible, filled out completely, and adequately identified as to the item or activity involved. Records will be considered valid only if initialed, signed, or otherwise authenticated and dated by authorized personnel. These records may either be originals or reproduced copies. Records submitted to the files, with the exception of correspondence, will be bound, placed in folders or binders, or otherwise secured for filing.

Following receipt of information from external sources, completion of analyses, and issuance of reports or other transmittals, associated records will be submitted to the proper file. In addition, transmitted records must be adequately protected from damage and loss during transfer (e.g, hand carrying or making copies prior to shipment).

The following documents will be transferred to the proper files during the course of the project: calculations and checkprints; reports and other data transmittals; copies of proposals, purchase orders for project services, and contracts; correspondence including incoming and outgoing letters, memoranda, and telephone records; and reference material.

All individuals on the project staff will be responsible for reporting obsolete or superseded project-related information to the Project Manager. In turn, the Project Manager will notify the project and laboratory staffs of the resulting status change in project documents, such as drawings and project procedures.

In general, outdated drawings and other documents will be marked "void." However, the Project Manager may request the copies be destroyed. One copy of void documents is maintained in the project files with the reasons, and date of voiding clearly indicated.

Documents will be marked "preliminary" to denote calculations and other material which have not been formally checked, or based on information which has not been checked, or do not contribute to final project information.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

The following section describes calibration procedures and frequency.

7.1 Field Instruments

Two field instruments will be used for health and safety monitoring: the O_2/LEL meter, and the HNu System portable photoionizer. These instruments will be calibrated on site daily according to the manufacturer's instructions in addition to the factory calibration it will receive prior to the start of site sampling. The calibration standards will be recorded in the field log book.

A pH meter and a conductivity meter will be used to analyze groundwater and surface water samples. Procedures from "Test Methods for Evaluating Solid Waste," USEPA, SW846, November 1986, 3rd Edition will be used to calibrate these meters. Specific procedures for the calibration of water quality instruments are presented in the FSAP.

7.2 Laboratory Instruments

The laboratory's procedures for calibration and related quality control measures will be conducted according to the protocols presented in the following documents:

- "Statement of Work for Organic Analysis," USEPA, OLM01.9, August 1991
- "Statement of Work for Inorganic Analysis," USEPA, ILM03.0, March 1990
- "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," USEPA, July 1982
- "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983
- "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136
- "Test Methods for Evaluating Solid Waste," USEPA SW846, November 1986, 3rd Edition and 1996 updates
- "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886

Formal calibration procedures will be established to ensure that instrumentation and equipment used for sample analysis are accurately calibrated and properly functioning. These procedures will apply to all instruments and equipment quantities. All calibrations will be performed by laboratory personnel or external agencies using standard reference materials.

All calibrations will be recorded on in-house calibration forms or instrument vendor forms or in dedicated bound notebooks. The following data will be recorded for all calibrations: the date, target readings, actual readings, instrument identification number, and the analyst's initials. Other data may be recorded depending upon the calibration performed.

Only properly calibrated and operating equipment and instrumentation will be used. Equipment and instrumentation not meeting the specified calibration criteria will be segregated from active equipment whenever possible. Such equipment will be repaired and recalibrated before reuse.

All equipment will be uniquely identified, either by serial number or internal calibration number, to allow traceability between equipment and calibration records. Recognized procedures (ASTM, USEPA, or manufacturer's procedures) will be used for calibration whenever available.

7.2.1 Method Calibration

Method calibration will be performed as part of the laboratory analytical procedure (calibration curves, tuning). Calibration curves will be prepared using five standards in graduated amounts across the appropriate range of analysis. New calibration curves will be prepared whenever new reagents or standards are prepared or yearly, whichever is more frequent.

7.2.2 GC/MS System Calibration Procedure

This section outlines the requirements for the calibration of GC/MS systems for the determination of organic compounds. The following operations will be performed in support of these requirements:

- Documentation of GC/MS mass calibration and abundance pattern
- Documentation of GC/MS response factor stability
- Internal standard response and retention time monitoring

Tuning and Mass Calibration

It will be necessary to establish that a given GC/MS system meets the standard mass spectral abundance criteria prior to initiating data collection. This will be accomplished through the analysis of p-bromofluorobenzene (BFB) for volatile compounds or decafluorotri-phenylphosphine (DFTPP) for semivolatile compounds. The BFB or DFTPP criteria must be met before any blanks, standards, or samples are analyzed.

A GC/MS system used for organic compound analysis will be tuned to meet the criteria specified for BFB analysis (volatile compounds) or DFTPP (semivolatile compounds) for an injection of 50 nanograms (ng) of BFB or DFTPP. The analysis must be performed separately from standard or blank analysis. These criteria will be demonstrated every 12 hours of operation. Professional judgment must be used to determine whether background subtraction is required to eliminate column bleed or instrument background (i.e., noise). Calibration documentation will be in the form of a bar graph spectrum and a mass listing.

GC/MS System Calibration

After tuning criteria have been met and prior to sample analysis, the GC/MS system is initially calibrated at five concentrations utilizing the compounds to be analyzed to determine the linearity of response. Internal and surrogate standards will be used with each calibration standard. Standards will be analyzed under the same conditions as the samples.

- Relative Response Factor (RRF) Calculation - The USEPA specifies the internal standard to be used on a compound-by-compound basis for quantification. The relative response factor (RRF) will be calculated for each compound at each concentration level.

- Continuing Calibration - A calibration check standard containing all semivolatile or volatile compounds and surrogates will be run every 12 hours of analysis. A system performance check will also be performed. The criteria will be the same as for the initial calibration system performance check. A calibration check will also be performed. The percent difference will be determined for each Calibration Check Compound (CCC).

The percent Difference for each CCC must be less than or equal to 25.0 percent. The system performance check and calibration check criteria must be met before sample analysis can be performed. The continuing calibration will be recorded on the continuing calibration forms.

7.2.3 GC System Calibration Procedure for Pesticides/PCBs

This section outlines the requirements for the calibration of GC systems for the determination of pesticides/PCBs. The following operations are performed in support of these requirements:

Three types of analyses will be used to verify the calibration and evaluate instrument performance. The analyses of instrument blanks, Performance Evaluation mixtures (PEMs), and the mid-point concentration of the individual standard mixtures A and B constitute the continuing calibration.

For pesticide/PCB analysis it is necessary to establish resolution criteria by performing a Resolution Check Mixture where the depth of the valley of two adjacent peaks must be greater than or equal to 60.0 percent of the height of the shorter peak.

The breakdown of DDT and Endrin in both of the PEMs must be less than 20.0 percent and the combined breakdown of DDT and Endrin must be less than 30.0 percent. All peaks in both the Performance Evaluation Mixtures must be 100 percent resolved on both columns.

The absolute retention times of each of the single component pesticides and surrogates in both of the PEMs must be within the retention time windows determined from the three point initial calibration.

The relative percent difference of the calculated amount and the true amount for each of the single component pesticides and surrogates in both of the PEMs must be less than or equivalent to 25 percent.

At least one chromatogram between any two adjacent peaks in the midpoint concentrations of Individual Standard Mixtures A and B in the initial calibration must be greater than or equal to 90 percent.

7.2.4 System Calibration Procedure for Metals Analysis

This section outlines the requirements for the calibration of atomic absorption (AA) and Inductively Coupled Plasma (ICP) systems for the determination of metals. The following will be performed in support of these requirements:

- Documentation of standard response
- Correlation coefficient monitoring

The AA system utilized for direct aspiration technique analysis will be initially calibrated with a calibration blank and five calibration standards. The standard concentrations will be determined as follows. One standard will be at a concentration near, but above, the MDL. The other concentrations will correspond to the expected range of concentrations found in the actual samples. This five-point calibration must be performed daily.

The AA system utilized for graphite furnace technique analysis will be initially calibrated with a calibration blank and three calibration standards. The standard concentrations will be determined as follows. One standard will be at a concentration at the Contract Required Detection Limit (CRDL). The other concentrations will correspond to the expected range of concentrations found in the actual samples. This three-point calibration must be performed daily.

For AA systems, the calibration standards will be prepared fresh each time an analysis is to be performed and discarded after use. The standards contain the same reagents at the same concentrations as will result in the samples following preparation.

The ICP system will be calibrated initially with a calibration blank and one calibration standard. This calibration must be performed daily. In addition, ICP systems must undergo quarterly linearity checks.

Correlation Coefficient Calculation

The data points of the blank and the five calibration standards will be utilized to calculate the slope, the intercept, and the correlation coefficient of the best fit line. An acceptable correlation coefficient must be achieved before sample analysis may begin. An acceptable correlation coefficient will be >0.995 for AA analyses and >0.995 for ICP analysis.

Calibration Verification

The initial calibration curve will be verified on each working day by the measurement of one mid-range calibration standard. The calibration verification acceptance criterion will be as follows:

- ICEP/GFAA - 90 to 110 percent of true value
- Cold Vapor AA - 80 to 120 percent of true value

When measurements exceed the control limits, the analysis will be terminated, the problem corrected, the instrument recalibrated, and the calibration reverified.

7.2.5 System Calibration Procedure for Inorganic Analyses

This section outlines the requirements that will be used for calibration of calorimetric systems for analyses of inorganic parameters. The following will be performed in support of these requirements:

- Documentation of standard response
- Correlation coefficient monitoring

The system will be initially calibrated with a blank and five calibration standards. Standard concentrations will be at a concentration near, but above, the MDL with additional concentrations corresponding to the expected range of concentrations found in actual samples. Standards contain the same reagents at the same concentrations as will be present in samples following preparation.

Correlation Coefficient Calculation

Data points of the blank and five calibration standards will be utilized to calculate slope, intercept, and correlation coefficient of a best fit line. An acceptable correlation coefficient must be achieved before sample analysis may begin. An acceptable correlation coefficient will be >0.995 for all systems.

Calibration Verification

The initial calibration curve will be verified on each working day by the measurement of two calibration standards.

- ICEP/GFAA - 90 to 110 percent of true value
- Cold Vapor AA - 80 - 120 percent of true value

When measurements exceed control limits, analysis will be terminated, the problem will be corrected, the instrument will be recalibrated, and calibration will be reverified.

7.2.6 Periodic Calibration

Periodic calibration must be performed on equipment required in analyses but not routinely calibrated as part of the analytical methodology. Equipment that falls within this category includes ovens, refrigerators, and balances. The calibration will be recorded either on specified forms or in bound notebooks. Discussed below are the equipment, the calibration performed, and the frequency at which the calibration must be performed.

- Balances will be calibrated weekly with class S weights.

- The pH meter will be calibrated daily with pH 4 and 7 buffer solutions and checked with pH 10 buffer solution.

- The temperatures of the refrigerators will be recorded daily.

- All liquid in glass thermometers will be calibrated annually with the N.B.S. certified thermometer. Dial thermometers will be calibrated quarterly.

- The N.B.S. Certified Thermometer will be checked annually at the ice point.

The following equipment must maintain the following temperatures:

- Sample Storage and Refrigerators - within 2 degrees of 4 degrees Celsius
- Water Bath, Mercury - within 2 degrees of 95 degrees Celsius

8.0 ANALYTICAL PROCEDURES

This next section discusses analytical procedures.

8.1 Field Analysis

A O_2/LEL and HNu PI-101 meters will be used to analyze ambient air for health and safety monitoring, as well as to screen soil during the soil sampling. The O_2/LEL meter detects explosive gases that may be present (i.e., methane). The HNu PI-101 detects total organic vapor. These instruments will be operated in accordance with the manufacturer's instructions.

The pH, temperature, and specific conductivity of aqueous samples also will be measured in the field. These analyses will be obtained in accordance with "Handbook for Sampling and Sample Preservation of Water and Wastewater," September 1982, EPA/600/4-82-029.

8.2 Laboratory Analysis

The samples that will be collected during the investigation and performed by the on-site laboratory will be analyzed for constituents listed in Table 8-1. Parameters will be analyzed using USEPA methods as noted in Tables 8-1 and 8-2. Compounds and the corresponding method performance limits also are listed in Tables 8-1 and 8-2.

TABLE 8-1

ORGANICS METHOD PERFORMANCE LIMITS

Compound	Water CRQL[1] (µg/L)	Soil/Sediment CRQL[1] (µg/kg)	Method
Volatiles			CLP/SOW[2]
Chloromethane	10	10	
Bromomethane	10	10	
Vinyl Chloride	10	10	
Chloroethane	10	10	
Methylene Chloride	10	10	
Acetone	10	10	
Carbon Disulfide	10	10	
1,1 -Dichloroethene	10	10	
1,1 -Dichloroethane	10	10	
1,2 -Dichloroethene	10	10	
Chloroform	10	10	
1,2 -Dichloroethane	10	10	
2-Butanone	10	10	
1,1,1-Trichloroethane	10	10	
Carbon Tetrachloride	10	10	
Bromodichloromethane	10	10	
1,2-Dichloropropane	10	10	
cis-1,3-Dichloropropene	10	10	
Trichloroethene	10	10	
Dibromochloromethane	10	10	
1,1,2-Trichloroethane	10	10	
Benzene	10	10	
trans-1,3-Dichloropropene	10	10	
Bromoform	10	10	
4-Methyl-2-pentanone	10	10	
2-Hexanone	10	10	
Tetrachloroethene	10	10	
Toluene	10	10	
1,1,2,2-Tetrachloroethane	10	10	
Chlorobenzene	10	10	
Ethylbenzene	10	10	
Styrene	10	10	
Xylenes (total)	10	10	

Notes:

(1) Contract Required Quantitation Limit

(2) "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM3.1.

TABLE 8-1 (Continued)

ORGANIC METHOD PERFORMANCE LIMITS

Compound	Water CRQL[1] (µg/L)	Soil/Sediment CRQL[1] (µg/kg)	Method
Semivolatiles Phenol	10	330	CLP/SOW[2]
bis(2-Chloroethyl)ether	10	330	
2-Chlorophenol	10	330	
1,3-Dichlorobenzene	10	330	
1,4-Dichlorobenzene	10	330	
Benzyl alcohol	10	330	
1,2-Dichlorobenzene	10	330	
2-Methylphenol	10	330	
bis(2-Chloroisopropyl)ether	10	330	
4-Methylphenol	10	330	
N-Nitroso-di-n-dipropylamine	10	330	
Hexachloroethane	10	330	
Nitrobenzene	10	330	
Isophorone	10	330	
2-Nitrophenol	10	330	
2,4-Dimethylphenol	10	330	
Benzoic acid	25	1600	
bis(2-Chloroethoxyl)methane	10	330	
2,4-Dichlorophenol	10	330	
1,2,4-Trichlorobenzene	10	330	
Naphthalene	10	330	
4-Chloroaniline	10	330	
Hexachlorobutadiene	10	330	
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330	
2-Methylnaphthalene	10	330	
Hexachlorocyclopentadiene	10	330	
2,4,6-Trichlorophenol	10	330	
2,4,5-Trichlorophenol	25	1600	
2-Chloronaphthalene	10	330	
2-Nitroaniline	25	1600	
Dimethylphthalate	10	330	
Acenaphthylene	10	330	

Notes:

(1) Contract Required Quantitation Limit

(2) "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM3.1.

TABLE 8-1 (Continued)

ORGANIC METHOD PERFORMANCE LIMITS

Compound	Water CRQL[1] (µg/L)	Soil/Sediment CRQL[1] (µg/kg)	Method
Semivolatiles (Continued) 2,6-Dinitrotolune	10	330	CLP/SOW[2]
3-Nitroaniline	25	1600	
Acenaphthene	10	330	
2,4-Dinitrophenol	25	1600	
4-Nitrophenol	25	1600	
Dibenzofuran	10	330	
2,4-Dinitrotoluene	10	330	
Diethylphthalate	10	330	
4-Chlorphenyl-phenyl ether	10	330	
Fluorene	10	330	
4-Nitroaniline	25	1600	
4,6-Dinitro-2-methylphenol	25	1600	
N-nitrosodiphenylamine	10	330	
4-Bromophenyl-phenylether	10	330	
Hexachlorbenzene	10	330	
Pentachlorophenol	25	1600	
Phenanthrene	25	1600	
Anthracene	10	330	
Di-n-butylphthalate	10	330	
Fluoranthene	10	330	
Pyrene	10	330	
Butylbenzylphthalate	10	330	
3.3'-Dichlorobenzidine	10	660	
Benzo(a)anthracene	10	330	
Chrysene	10	330	
bis(2-Ethylhexyl)phthalate	10	330	
Di-n-octylphthalate	10	330	
Benzo(b)fluoranthene	10	330	
Benzo(k)fluoranthene	10	330	
Benzo(a)pyrene	10	330	
Indeno(1,2,3-cd)pyrene	10	330	
Dibenzo(a,h)anthracene	10	330	
Benzo(g,h,i)perylene	10	330	

Notes:

(1) Contract Required Quantitation Limit

(2) "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM03.1.

TABLE 8-1 (Continued)

ORGANIC METHOD PERFORMANCE LIMITS

Compound	Water CRQL[1] (µg/L)	Soil/Sediment CRQL[1] (µg/kg)	Method
Pesticides/PCBs alpha-BHC	0.05	8.0	CLP/SOW[2]
beta-BHC	0.05	8.0	
delta-BHC	0.05	8.0	
gamma-BHC (Lindane)	0.05	8.0	
Heptachlor	0.05	8.0	
Aldrin	0.05	8.0	
Heptachlor epoxide	0.05	8.0	
Endosulfan I	0.05	8.0	
Dieldrin	0.10	16.0	
4,4'-DDE	0.10	16.0	
Endrin	0.10	16.0	
Endosulfan II	0.10	16.0	
4,4'-DDD	0.10	16.0	
Endosulfan sulfate	0.10	16.0	
4,4'-DDT	0.10	16.0	
Methoxychlor	0.5	80.0	
Endrin ketone	0.10	16.0	
alpha-Chlordance	0.5	80.0	
gamma-Chlordane	0.5	80.0	
Toxaphene	5.0	160.0	
Aroclor-1016	1.0	80.0	
Aroclor-1221	2.0	80.0	
Aroclor-1232	1.0	80.0	
Aroclor-1242	1.0	80.0	
Aroclor-1248	1.0	80.0	
Aroclor-1254	1.0	160.0	
Aroclor-1260	1.0	160.0	

Notes:

(1) Contract Required Quantitation Limit
(2) "Statement of Work for Organic Analysis," USEPA Contract Laboratory Program, OLM03.1.

TABLE 8-2

INORGANIC METHOD PERFORMANCE LIMITS

Analyte	CRDL[1] (µg/L)	Method Number[2,3,4]	Method Description
Metals			
Aluminum	200	200.7	Inductively Coupled Plasma
Antimony	60	200.7 204.2	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Arsenic	10	200.7 206.2	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Barium	200	200.7	Inductively Coupled Plasma
Beryllium	5	200.7 210.2	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Cadmium	5	200.7 213.2	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Calcium	5,000	200.7 215.1	Inductively Coupled Plasma Atomic Absorption, Direct Aspiration
Chromium	10	200.7 218.2	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Cobalt	50	200.7	Inductively Coupled Plasma
Copper	25	200.7	Inductively Coupled Plasma
Iron	100	200.7	Inductively Coupled Plasma
Lead	3	200.7 239.2	Inductively Coupled Plasma Atomic Absorption, Furnace Technique

Notes:

[1] Methods taken from "Statement of Work for Inorganic Analysis," USEPA Contract Laboratory Program, ILM03.0, March 1990

[2] Contract Required Detection Limit

[3] Extraction method for arsenic, lead, selenium, and thallium taken from USEPA Method 3020, "Test Methods for Evaluating Sold Waste," USEPA, November 1986, 3rd Edition

[4] Extraction method for all other metals taken from USEPA Method 3010, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition

[5] N/A = Not Applicable

TABLE 8-2 (Continued)

INORGANIC METHOD PERFORMANCE LIMITS

Analyte	Method Number[2,3,4]	CRDL[1] (μg/L)	Method Description
Metals (Continued)			
Magnesium	200.7 242.1	5000	Inductively Coupled Plasma Atomic Absorption, Direct Aspiration
Manganese	200.7	15	Inductively Coupled Plasma
Mercury	245.1 245.2 245.5	0.2	Water by manual cold vapor technique Water by automated cold vapor technique Soil/sediment by manual cold vapor technique
Nickel	200.7	40	Inductively Coupled Plasma
Potassium	200.7 258.1	5000	Inductively Coupled Plasma Atomic Absorption, Direct Aspiration
Selenium	200.7 270.2	5	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Silver	200.7 272.2	10	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Sodium	200.7 273.1	5000	Inductively Coupled Plasma Atomic Absorption, Direct Aspiration
Thallium	200.7 279.2	10	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Vanadium	200.7	50	Inductively Coupled Plasma
Zinc	200.7	20	Inductively Coupled Plasma

Notes:

(1) Methods taken from "Statement of Work for Inorganic Analysis," USEPA Contract Laboratory Program, ILM03.0, March 1990

(2) Contract Required Detection Limit

(3) Extraction method for arsenic, lead, selenium, and thallium taken from USEPA Method 3020, "Test Methods for Evaluating Sold Waste," USEPA, November 1986, 3rd Edition

(4) Extraction method for all other metals taken from USEPA Method 3010, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition

(5) N/A = Not Applicable

TABLE 8-2 (Continued)

INORGANIC METHOD PERFORMANCE LIMITS

Analyte	Method Number	CRDL[1] (μg/L)	Method Description
Inorganics Biological Oxygen Demand	EPA 405.1	N/A[5]	N/A
Chemical Oxygen Demand	EPA 410.4	N/A	N/A
Chloride	EPA 325.2	N/A	N/A
Methane	APHA 6211B	N/A	N/A
Nitrate	EPA 353.3	N/A	N/A
Nitrite	EPA 354.1	N/A	N/A
Sulfate	EPA 375.4	N/A	N/A
Sulfide	EPA 376.1	N/A	N/A
Total Dissolved Solids	EPA 160.1	N/A	N/A
Total Suspended Solids	EPA 160.2	N/A	N/A

Notes:

(1) Methods taken from "Statement of Work for Inorganic Analysis," USEPA Contract Laboratory Program, ILM03.0, March 1990

(2) Contract Required Detection Limit

(3) Extraction method for arsenic, lead, selenium, and thallium taken from USEPA Method 3020, "Test Methods for Evaluating Sold Waste," USEPA, November 1986, 3rd Edition

(4) Extraction method for all other metals taken from USEPA Method 3010, "Test Methods for Evaluating Solid Waste," USEPA, November 1986, 3rd Edition

(5) N/A = Not Applicable

TABLE 8-3

TCLP METHOD PERFORMANCE LIMITS

Parameter	Aqueous PQL[1] (μg/l)	Solid PQL[1] (μg/kg)	Method
TCLP Volatiles			EPA Method 3550/ EPA Method 8240
Benzene	5	10	
Carbon Tetrachloride	5	5	
Chloroform	5	5	
1,2-Dichloroethane	5	5	
1,1-Dichloroethylene	5	5	
Methyl ethyl ketone	NA	NA	
Tetrachloroethylene	5	5	
Trichloroethylne	5	5	
Vinyl Chloride	10	10	
TCLP Semivolatiles			EPA Method 3550/ EPA Method 8240
o-Cresol	10	660	
m-Cresol	10	660	
p-Cresol	10	660	
Cresol	10	660	
1,4-Dichlorobenzene	10	660	
2.4-Dinitrotoluene	10	660	
Hexachlorobenzene	10	660	
Hexachlorobutadiene	10	660	
Hexachloroethane	10	660	
Nitrobenzene	10	660	
Pentachlorophenol	50	3,300	
Pyridine	50	660	
2,4,5-Trichlorophenol	10	660	
2,4,6-Trichlorophenol	10	660	

Notes:

(1) Practical Quantitation Limit, taken from "Test Methods for Evaluating Sold Waste," USEPA, November 1986.

Note: These methods will be used to analyze the Toxicity Characteristic Leaching Procedure (TCLP) extract. The extract will be prepared using Method 1311, described in "Hazardous Waste Management Systems; Identification and Listing of Hazardous Waste; Toxicity Characteristics revision; Final Rule," USEPA, 52FR 26886.

TABLE 8-3 (Continued)

TCLP METHOD PERFORMANCE LIMITS

Parameter	Aqueous PQL[1] (μg/l)	Solid PQL[1] (μg/kg)	Method
TCLP Pesticides			EPA Method 3550/ EPA Method 8240
Chlordane	0.14	9.4	
Endrin	0.06	4.0	
Heptachlor (and its hydroxide)	0.03	20	
Lindane	0.04	2.7	
Methyoxychlor	1.8	120	
Toxaphene	2.4	160	
TCLP Herbicides			EPA Method 8150
2,4-D	12	240	
2,4,5-TP Silvex	1.7	34	

Analyte	Water PQL[1] (μg/L)	Soil PQL[1] (mg/kg)	Method	Method Description
TCLP Metals				
Arsenic	10	30	6010A 7060	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Barium	20	1	6010A	Inductively Coupled Plasma
Cadmium	1	2	6010A 7131A	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Chromium	20	4	6010A 7191A	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Lead	10	2	6010A 7421A	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Mercury	2	0.002	7470A	Water by manual cold vapor technique Water by automated cold vapor technique
Selenium	20	40	6010A 7740A	Inductively Coupled Plasma Atomic Absorption, Furnace Technique
Silver	2	4	6010A 7760A	Inductively Coupled Plasma Atomic Absorption, Furnace Technique

Notes:

(1) Practical Quantitation Limit, taken from "Test Methods for Evaluating Sold Waste," USEPA, November 1986 and 1996 updates.

Note: These methods will be used to analyze the Toxicity Characteristic Leaching Procedure (TCLP) extract. The extract will be prepared using Method 1311, described in "Hazardous Waste Management Systems; Identification and Listing of Hazardous Waste; Toxicity Characteristics revision; Final Rule," USEPA, 52FR 26886.

TABLE 8-4

RCRA/ENGINEERING PARAMETERS METHOD PERFORMANCE LIMITS

Parameter	Aqueous Performance Limit	Solid Performance Limit	Method
RCRA			
pH/Corrosivity	N/A(1)	N/A(1)	SW-846 9010
Ignitability	N/A(1)	N/A(1)	SW-846 1010
Reactive Cyanide	10 mg/l(1)	10 mg/l(1)	SW-846 9012
Reactive Sulfide	50 mg/l(1)	50 mg/kg(1)	SW-846 9030
Engineering Parameters			
Total Suspended Solids (TSS)	N/A	N/A	EPA 160.1
Total Dissolved Solids (TDS)	N/A	N/A	EPA 160.2
Permeability	N/A	N/A	ASTM D2434-18
Grain Size	N/A	N/A	ASTM D422-63 ASTM D1140-54
Bulk Density	N/A	N/A	ASTM D1587-14
Biological Oxygen Demand (BOD)	N/A	N/A	EPA 405.1
Chemical Oxygen Demand (COD)	N/A	N/A	EPA 410.1
Chloride	N/A	N/A	EPA 325.2
Methane	N/A	N/A	APHA 6211B
Nitrate	N/A	N/A	EPA 353.3
Nitrite	N/A	N/A	EPA 354.1
Sulfate	N/A	N/A	EPA 375.4
Sulfide	N/A	N/A	EPA 376.1

Notes:

(1) Practical Quantitation Limit, taken from "Test Methods for Evaluating Sold Waste," USEPA, November 1986.

N/A - Not Applicable

9.0 DATA REDUCTION, VALIDATION AND REPORTING

The following section presents data reduction, validation, and reporting procedures.

9.1 Field Data Procedures

Data validation practices as described by "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses," USEPA, June 1988, and "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses - Draft," USEPA, June 1991 will be followed to insure that raw data are not altered and that an audit trail is developed for those data which require reduction. The documentation of sample collection will include the use of bound field log books in which all information on sample collection will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including site name (top of each page), sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated).

A rigorous data control program will insure that all documents for the investigations are accounted for when they are completed. Accountable documents include items such as log books, field data records, correspondence, chain-of-custody records, analytical reports, data packages, photographs, computer disks, and reports. The project manager will be responsible for maintaining a project file in which all accountable documents will be inventoried. The project records will be retained for a period of three years after project close-out; then the files will be forwarded to the Navy.

All the field data, such as those generated during field measurements, observations and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made, and the Project Manager or his designee will proof at least ten percent of all data transfers.

9.2 Laboratory Data Procedures

The following procedures summarize the practices routinely used by laboratory staff for data reduction, validation, and reporting. Numerical analyses, including manual calculations, will be documented and subjected to quality control review. Records of numerical analyses must be legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator.

9.2.1 Laboratory Data Validation

Data validation begins with data reduction and continues through to the reporting of data.

Data processing will be checked by an individual other than the analyst who performed the data processing. The checker will review the data for the following:

- Utilization of the proper equations
- Correctness of numerical input
- Correctness of computations
- Correct interpretation of raw data (chromatographs, strip charts, etc.)

The checking process will be sufficient thorough enough to verify the results.

All entries made in benchbooks, data sheets, computation sheets, input sheets, etc. will be made in ink. No entry will be rendered unreadable.

9.2.2 Analytical Reports

The items listed below will be required of analytical reports.

- Data will be presented in a tabular format.
- Analytical reports will be approved by appropriate laboratory personnel.
- The following information will be included on the report: client name and address, report date, sample date, analysis dates, number of samples, purchase order number, project number, and project type. All pages must be numbered.
- The sample numbers and corresponding laboratory numbers will be identified.
- The parameters analyzed, report units, and values will be identified.
- Method, trip, and field blank results will be reported.
- Matrix spike, matrix spike duplicate, and replicate recoveries will be reported.
- Calibration summaries will be reported.
- Surrogate recoveries will be reported.
- Holding times and sample analysis dates will be reported.
- The detection limit of the procedure will be identified.
- Consistent significant figures will be used.
- Referenced footnotes will be used when applicable.
- A letter of transmittal will accompany the report if any anomalies are associated with the data.

9.3 Independent (Third Party) Data Validation

Review of all pertinent analytical data will be performed by Baker personnel and an independent third party data validator.

A preliminary review will be performed by the Project Manager or designee to verify that all necessary paperwork (e.g., chain-of-custodies, traffic reports, analytical reports, and laboratory personnel signatures) and deliverables are present. A detailed and independent data validation will be performed by a data validation subcontractor to verify the qualitative and quantitative reliability of the data presented and adherence to stated analytical protocols. This review will include a detailed review and interpretation of all data generated by the laboratory for Level IV deliverables. The primary tools which will be used by experienced data validation personnel will be analytical method operating practices, statements of work (for CLP), guidance documents, established criteria, and professional judgment.

During the data review, a data support documentation package will be prepared which will provide the back-up information that will accompany all qualifying statements present in the quality assurance review.

CLP data will be validated per the CLP criteria as outlined in the following documents:

- USEPA, Hazardous Site Control Division, Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, 1994.
- USEPA, Hazardous Site Evaluation Division, Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, 1994.

All other data will be validated in accordance with method of analysis using the National Functional Guidelines as a reference.

10.0 INTERNAL QUALITY CONTROL CHECKS

The following section describes internal quality control checks.

10.1 Field Quality Control Checks

Four types of field quality assurance/quality control samples will be submitted to the laboratory: trip blanks, equipment rinsates, field blanks, and field duplicates. The results from the field quality control samples will be used by the data validator to determine the overall quality of the data. A breakdown by type of sample with which the QA/QC samples will be submitted to the laboratories is given in Table 10-1. A summary of the number of environmental and QA/QC samples to be submitted for analysis will be given in the FSAP.

Field Blanks

Field blanks consist of the source water used in decontamination, steam cleaning, and drilling. At a minimum, one field blank from each vent and each source of water must be collected and analyzed for the same parameters as the related samples. Organic-free deionized water is taken to the field in sealed containers and poured into the appropriate sample containers at predesignated locations. This will be done to determine if any contaminants present in the area may have an affect on the sample integrity.

Trip Blank

Analysis of trip blanks will be performed to monitor possible contamination during shipment and collection of samples. Trip blanks are initiated in the laboratory prior to the shipping of sample packs. A corresponding trip blank will be prepared for each set of samples to be analyzed for volatile organic compounds.

Trip blank samples will be prepared by adding four drops of concentrated hydrochloric acid and then filling the container with organic-free deionized water (ASTM Type II). The trip blanks accompany the samples through shipment to the sample site, sample collection, shipment to the laboratory, and storage of the samples.

If the analyses indicate contamination of the trip blank, the sample sources may be resampled. If the extent and nature of the contamination does not warrant such actions, the data will be accepted as valid.

Field Duplicates

Duplicates for soil samples are collected, homogenized, and split. All samples except VOCs are homogenized, and split. Volatiles are not mixed, but select segments of the soil are taken from the length of the core and placed in 4-ounce glass jars. Cores may be sealed and shipped to the laboratory for subsampling if the project deems this appropriate. The duplicate for water samples should be collected simultaneously. Field duplicates should be collected at a frequency of 10% per sample matrix for Levels III and IV. All the duplicates should be sent to the primary laboratory responsible for analysis. The same samples used for field duplicates shall be split by the laboratory

TABLE 10-1

QA/QC SAMPLE FREQUENCY
OPERABLE UNIT NO. 16 (SITES 89 AND 93)
CTO 0344
MCB CAMP LEJEUNE, NORTH CAROLINA

Type of Sample	Metal	Organic
Trip Blank (for volatiles only)	NA(1)	One per cooler or one per shipping day
Equipment Rinsate(2)	One per day	One per day
Field Blank	One per source per event(3)	One per source per event(3)
Field Duplicate(4)	10%	10%

Notes:

(1) Not Applicable

(2) Samples are collected daily; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contamination exists.

(3) Source water includes water used in decontamination, steam cleaning, and drilling.

(4) The duplicate must be taken from the sample which will become the laboratory matrix spike/matrix spike duplicate for organics or for the sample used as a duplicate in inorganic analysis.

and used by the laboratory as the laboratory duplicate or matrix spike. This means that for the duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

Equipment Rinsates

Equipment rinsates are the final organic-free deionized water rinse from equipment cleaning collected daily during a sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining samples must be analyzed. The results of the blanks will be used to flag or assess levels of analytes in the samples. This comparison is made during validation. The rinsates are analyzed for the same parameters as the related samples.

10.2 Laboratory Quality Control Checks

This section provides descriptions of the laboratory quality control checks.

Method Blank

Analysis of method blanks will be performed to verify that method interferences caused by contamination in reagents, glassware, solvents, etc. are minimized and known.

Method blanks will be initiated by the analyst prior to the preparation and/or analysis of the sample set. A method blank consists of a volume of organic-free deionized water equal to the sample volume which is carried through the entire analytical procedure. For solid samples to be analyzed by GC/MS, the method blank consists of a purified solid matrix approximately equal to the sample weight. A method blank will be analyzed with each set of samples or at the very least, daily. If the analytical data of the method blank indicates excessive contamination, the source of contaminant will be determined. The samples may be re-analyzed or the data may be processed "as is" depending upon the nature and extent of the contamination.

Replicate Sample Analysis

Replicate sample analysis will be performed to demonstrate the precision of an analysis. An interlaboratory replicate sample is initiated by the analyst prior to sample preparation and carried through the entire analytical procedure. The frequency of interlaboratory replicate analysis for each analyte is summarized in Table 10-2.

Spike Analysis

Spike analysis will be performed to demonstrate the accuracy of an analysis. The analyst initiates the spike prior to sample preparation and analysis by adding a known amount of analyte(s) to a sample. The spike sample is carried through the entire analytical procedure. The frequency of spike analysis for each analyte(s) is summarized in Table 10-2.

TABLE 10-2

QA/QC ANALYSIS FREQUENCY
OPERABLE UNIT NO. 16 (SITES 89 and 93)
CTO 0344
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Replicate	Spike
Organic		
All analyses by GC/MS	5%	5%
All analyses by GC	5%	5%
Metals		
Liquids by flame AA or ICP	5%	5%
Solids by flame AA or ICP	5%	10%
All analyses by furnace AA	5%	10%

Surrogate Standards

Surrogate standard analysis will be performed to monitor the preparation and analyses of samples. All samples and blanks analyzed by GC/MS and GC are fortified with a surrogate spiking solution prior to extraction or purging.

Internal Standards

Internal standard analyses will be performed to monitor system stability. Prior to injection or purging, internal standards are added to all blanks and samples analyzed by GC/MS (refer to Section 5.1.1.).

Matrix Spikes and Matrix Spike Duplicates

A matrix spike is an aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. A matrix spike duplicate is a second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method. A matrix spike and matrix spike duplicate will be performed at a frequency of 1 per 20 samples for organics.

10.3 Laboratory Control Limits

Control limits will be established for QC checks (spikes, duplicates, blanks, etc.). CLP control limits for surrogate standards spikes, and duplicates associated with GC/MS analyses and pesticides/PCB analyses will be applied. Control limits for spikes, duplicates, and reference samples will be determined internally through statistical analysis.

Whenever an out-of-control situation occurs, the cause is determined. Any needed corrective actions must be taken.

Method Blanks

For metals analyses, the criteria below are used for method blank analysis.

- If the concentration of the method blank is less than or equal to the detection level, no correction of sample results is performed.
- If the concentration of the blank is above the detection level for any group of samples associated with a particular blank, the concentration of the sample with the least concentrated analyte must be ten times the blank concentration. Otherwise, all samples associated with the blank and less than ten times the blank concentration must be redigested (reprepared) and reanalyzed, if possible. If the affected samples cannot be reprepared and reanalyzed within method holding times, the flagged sample result and the blank result are both to be reported. The sample value is not corrected for the blank value.

For GC/MS, GC analyses, the criteria below are used for method blank analysis:

- A method blank for volatiles analysis must contain no greater than five times the detection limit of common laboratory solvents (common laboratory solvents are: methylene chloride, acetone, toluene, 2-butanone, and chloroform).

- A method blank for semivolatiles analysis must contain no greater than five times the detection limit of common phthalate esters.

- For all other compounds not listed above, the method blank must contain less than the detection limit of any single compound. If a method blank exceeds the criteria, the analytical system is considered to be out of control. The source of the contamination is investigated and appropriate corrective measures are taken and documented before sample analysis proceeds. All samples processed with a method blank that is out of control (i.e., contaminated), are reextracted/repurged and reanalyzed, when possible. If the affected samples cannot be reextracted/repurged and reanalyzed within method holding times, the flagged sample result and the blank result are both to be reported. The sample value is not corrected for the blank value.

- No positive result for pesticides/PCBs should be reported unless the concentration of the compound exceeds five times the amount in the blank.

- A method blank for pesticides/PCBs must contain no greater than five times the detection limit for any pesticides/PCBs.

Surrogate Standards

For method blank surrogate standard analysis, corrective action will be taken if any one of the conditions below exist.

- Recovery of any one surrogate compound in the volatile fraction is outside the required surrogate standard recovery limit.

- Recovery of any one surrogate compound in the semivolatile fraction is outside surrogate standard recovery limits.

Corrective action will include steps listed below:

- A check of: the calculations for errors; the internal standard and surrogate spiking solutions for degradation, contamination, etc.; and instrument performance.

- Recalculation or reinjection/repurging of the blank or extract if the above corrective actions fail to solve the problem.

- Reextraction and reanalysis of the blank. For sample surrogate standard analysis, corrective action will be taken if any one of the following conditions exist:

    - Recovery of any one surrogate compounds in the volatile fraction is outside the surrogate spike recovery limits;
    - Recovery of any one surrogate compound in either semivolatile fraction is below ten percent; or
    - Recoveries of two or more surrogate compounds in either semivolatile fraction are outside surrogate spike recovery limits.

Corrective action will include the steps listed below.

- A check of: the calculations for errors; of the internal standard and surrogate spiking solutions for degradation, contamination, etc.; and of instrument performance.
- Recalculating or reanalysis the sample or extract if the above corrective action fails to solve the problem.
- Reextraction and reanalysis of the sample if none of the above are a problem.

11.0 PERFORMANCE AND SYSTEM AUDITS

A field audit will be conducted during the field investigation to verify that sampling is being performed according to the plan. A report will be submitted within 30 calendar days of completion of the audit. Serious deficiencies will be reported within 24 hours of the time of discovery of the deficiency, including actions taken or to be taken to correct such deficiencies.

The following table (Table 11-1) is used for audits. At the appropriate time, the Project Manager or Program QA/QC designee will conduct field audits. Additionally, personnel adhere to Baker's Standard Operating Procedures which cover procedures, reporting and quality.

FIELD SITE AUDIT INSPECTION FORM

Legend
X = Yes
O = No
NA = Not Applicable

Site Name ______________________ CTO No. ______________

Location ______________________ Date ______________

SECTION 1 - DOCUMENTATION/SAFETY/QA/QC PROCEDURES

1. Were sampling locations adequately documented in a bound field log book using indelible ink?
Yes ______ No ______
Comments ______________________

2. Were photos taken and a photo log maintained?
Yes ______ No ______

3. What field instruments were used during this study?
____
____

4. Were field instruments properly calibrated and calibrations recorded in a bound field log book?
Yes ______ No ______
Comments ______________________

5. Was sampling equipment properly wrapped and protected from possible contamination prior to sample collection?
Yes ______ No ______
Comments ______________________

6. Was sampling equipment constructed of Teflon®, glass, or stainless steel?
____

7. Were samples collected in proper order (least suspected contamination to most contaminated)?
Yes ______ No ______
Comments ______________________

8. Were clean disposable latex or vinyl gloves worn during sampling?
Yes ______ No ______
Comments ______________________

9. Were gloves changed for each sample station?
Yes ______ No ______
Comments ______________________

10. Was any equipment field cleaned?
Yes ______ No ______

11. Type of equipment cleaned?
____

FIELD SITE AUDIT INSPECTION FORM

FIELD SITE AUDIT INSPECTION FORM

12. Were proper field cleaning procedures used?
Yes ________ No ________
Comments ____

13. Were equipment rinse blanks collected after field cleaning?
Yes ________ No ________
Comments ____

14. Were proper sample containers used for samples?
Yes ________ No ________
Comments ____

15. Were split samples offered to the facility owner or his representative?
Yes ________ No ________
Comments ____

16. Was a receipt for samples form given to facility representative?
Yes ________ No ________

17. Were any duplicate samples collected?
Yes ________ No ________
Comments ____

18. Were samples properly field preserved?
Yes ________ No ________
Comments ____

19. Were preservative blanks utilized?
Yes ________ No ________
Comments ____

20. Were field and/or trip blanks utilized?
Yes ________ No ________
Comments ____

21. Were samples adequately identified with labels or tags?
Yes ________ No ________
Comments ____

22. Were samples sealed with custody seals after collection?
Yes ________ No ________
Comments ____

23. What security measures were taken to insure custody of the samples after collection?
____

24. Were chain-of-custody and receipt for samples forms properly completed?
Yes ________ No ________
Comments ____

25. Were any samples shipped to a laboratory?
Yes ________ No ________

FIELD SITE AUDIT INSPECTION FORM

FIELD SITE AUDIT INSPECTION FORM

26. If yes to No. 25, were samples properly packed?
Yes ______ No ______
Comments ______

27. If shipped to a CLP lab, were Traffic Report Forms properly completed?
Yes ______ No ______
Comments ______

28. What safety monitoring equipment, protection, and procedures were used prior to and during sampling?
______

29. Was safety monitoring equipment properly calibrated and calibrations recorded in a bound field log book?
Yes ______ No ______
Comments ______

FIELD SITE AUDIT INSPECTION FORM

SECTION 2 - SAMPLING - GROUNDWATER WELLS

1. Type of wells sampled (monitoring, potable, industrial, etc.)?

   ____

2. Were wells locked and protected?

   Yes ______ No ______

   Comments ______________________________

3. Were identification marks and measurement points affixed to the wells?

   Yes ______ No ______

   Comments ______________________________

4. What were the sizes and construction materials of the well casings?

   ____

5. Were the boreholes sealed with a concrete pad to prevent surface infiltration?

   Yes ______ No ______

   Comments ______________________________

6. Was there a dedicated pump in the well?

   Yes ______ No ______

7. Was clean plastic sheeting placed around the wells to prevent contamination of sampling equipment and containers?

   Yes ______ No ______

8. Were total depths and depths to water determined before purging?

   Yes ______ No ______

9. What device was used to determine depths?

   ____

10. Were measurements made to the nearest 0.01 foot?

    Yes ______ No ______

11. Was the measuring device properly cleaned between wells?

    Yes ______ No ______

    Comments ______________________________

12. Was the standing water volume in each well determined?

    Yes ______ No ______

13. How was the volume determined?

    ____

14. Was a sufficient volume purged prior to sampling?

    Yes ______ No ______

    Comments ______________________________

FIELD SITE AUDIT INSPECTION FORM

15. How many volumes?

____

16. How was the purged volume measured?

____

17. What was the method of purging?

____

18. Were pH, conductivity, and temperature measurements taken and recorded at least once during each well volume purged?
Yes ______ No ______
Comments ____

19. Were pH, conductivity, and temperature readings stable prior to sampling?
Yes ______ No ______
Comments ____

20. How many wells were sampled? ____ Upgradient? ____ Downgradient? ____

21. How were the samples collected? Bailer ____ Pump ____ Other ____
Comments ____

22. If pump was used, what type?

____

23. If a pump was used, was it properly cleaned before and/or between wells?
Yes ______ No ______
Comments ____

24. What were the cleaning procedures?

____

25. Did bailers have Teflon® coated wire leaders to prevent rope from coming into contact with water?
Yes ______ No ______

26. Were bailers open or closed top?

____

27. Was a clean bailer and new rope used at each well?
Yes ______ No ______
Comments ____

28. Were samples properly transferred from the sampling device to the sample containers (i.e., purgeable sample first - not aerated, etc.)?
Yes ______ No ______
Comments ____

29. Was pH of preserved samples checked to insure proper preservation?
Yes ______ No ______
Comments ____

FIELD SITE AUDIT INSPECTION FORM

30. Were sampled iced immediately after collection?
Yes ______ No ______

31. For what analyses were the samples collected?

____

32. If samples were split, what were the sample/station numbers for these?

____

____

Other comments or observations ______________________________

____

____

FIELD SITE AUDIT INSPECTION FORM

SECTION 3 - SAMPLING - SOIL, SEDIMENT, SLUDGE, ETC. (Non-Containerized)

1. Type of samples collected?
______

2. General description of samples?
______

3. How many samples were collected?
______

4. Were background and/or control samples collected?
Yes ______ No ______
Comments ______

5. Were representative samples collected?
Yes ______ No ______
Comments ______

6. Were grab or composite samples collected?
______

7. Were composite samples areal or vertical?
______

8. How many aliquots were taken for the composite sample?
______

9. What procedures and equipment were used to collect samples?
______
______

10. Were samples thoroughly mixed prior to putting them into the sample containers?
Yes ______ No ______
Comments ______

11. Were samples properly placed into sample containers?
Yes ______ No ______
Comments ______

12. Were samples iced immediately after collection?
Yes ______ No ______

13. For what analyses were the samples collected?
______

14. If samples were split, what were the sample/station numbers for these?
______

15. Was a drilling rig, backhoe, etc., used to collect soil samples?
Yes ______ No ______

FIELD SITE AUDIT INSPECTION FORM

FIELD SITE AUDIT INSPECTION FORM

16. Were the drilling rig(s), backhoe(s), etc., properly cleaned according to the ESD SOP, Appendix B, prior to arriving on site?
Yes ______ No ______
Comments ______________________________

17. What was the condition of the drilling and sampling equipment when it arrived on site?
____

18. Was a decontamination area located where the cleaning activities would not cross-contaminate clean and/or drying equipment?
Yes ______ No ______
Comments ______________________________

19. Was clean equipment properly wrapped and stored in a clean area?
Yes ______ No ______
Comments ______________________________

20. Was the drilling rig(s) properly cleaned between well borings?
Yes ______ No ______
Comments ______________________________

21. Were the cleaning and decontamination procedures conducted in accordance with the ESD SOP?
Yes ______ No ______
Comments ______________________________

22. Other comments or observations
____

____

FIELD SITE AUDIT INSPECTION FORM

SECTION 4 - SAMPLING - SURFACE WATER (Pond, Stream, River, Leachate, etc.)

1. Type of samples collected?
____

2. General description of samples?
____

3. How many samples were collected?
____

4. Were background and/or control samples collected?
Yes ______ No ______
Comments ______________________________

5. Were grab or composite samples collected?
____

6. How many aliquots were taken for the composite sample?
____

7. What procedures and equipment were used to collect samples?
____

____

8. Were samples collected directly into sample containers?
Yes ______ No ______
Comments ______________________________

9. Did the sampler wade in the stream to collect the samples?
Yes ______ No ______
Comments ______________________________

10. Were the samples collected upstream from the sampler?
Yes ______ No ______
Comments ______________________________

11. Did the sampler insure that roiled sediments were not collected along with the water samples?
Yes ______ No ______
Comments ______________________________

12. Were representative samples collected?
Yes ______ No ______
Comments ______________________________

13. Was the pH of preserved samples checked to insure proper preservation?
Yes ______ No ______
Comments ______________________________

14. Were samples iced immediately after collection?
Yes ______ No ______

FIELD SITE AUDIT INSPECTION FORM

15. For what analyses were the samples collected?

____

16. If samples were split, what were the sample/station numbers for these?

____

Other comments or observations

____

____

FIELD SITE AUDIT INSPECTION FORM

SECTION 5 - OTHER SAMPLING - DRUMS, TANKS, BARRELS, ETC. (Containerized)

1. Type of samples collected (oil, sludge, waste)?

2. Description of containers or sources sampled?

3. How many samples were collected?

4. What type of equipment was used to collect the samples?

5. What procedures were used to collect the samples?

6. For what analyses were the samples collected?

7. If samples were split, what were the sample/station numbers for these?

8. Were any special safety measures taken during collection of the samples?

9. What level of safety protection was required for collection of the samples?

FIELD SITE AUDIT INSPECTION FORM

Other comments or observations

FIELD SITE AUDIT INSPECTION FORM

SECTION 6 - MONITORING WELL INSTALLATION

General

1. Were the wells installed in the proper locations in accordance with the study plan and/or project operations plan (POP)?
Yes ______ No ______
Comments ________________________________

2. Were the wells installed starting in the least contaminated area and proceeding to the most contaminated area?
Yes ______ No ______
Comments ________________________________

3. Were proper safety protocols employed during the well installations?
Yes ______ No ______
Comments ________________________________

4. Were samples of the drilling mud, water, bentonite pellets, filter pack materials, etc., collected for quality control analyses?
Yes ______ No ______
Comments ________________________________

Equipment Decontamination

5. Were the drilling rig(s), backhoe(s), etc., properly cleaned according to the ESD SOP, Appendix B, prior to arriving on site?
Yes ______ No ______
Comments ________________________________

6. What was the condition of the drilling and sampling equipment when it arrived on site?
____

7. Was a decontamination area located where the cleaning activities could cross-contaminant clean and/or drying equipment?
Yes ______ No ______
Comments ________________________________

8. Was clean equipment properly wrapped and stored in a clean area?
Yes ______ No ______
Comments ________________________________

9. Was the drilling rig(s) properly cleaned between well borings?
Yes ______ No ______
Comments ________________________________

10. Were the cleaning and decontamination procedures conducted in accordance with the ESD SOP?
Yes ______ No ______
Comments ________________________________

FIELD SITE AUDIT INSPECTION FORM

Drilling

11. What type of drilling method(s) was used to install the wells?

____

12. Was this drilling method(s) the same as proposed in the study plan and/or POP?
Yes _______ No _______
Comments __________________________________

13. Were soil samples collected for logging and analyses as the wells were installed?
Yes _______ No _______

14. If yes to 13, at what intervals and by what method?

____

15. If air rotary was used:
Was an in-line organic air filter employed?
Yes _______ No _______

Was a cyclone velocity dissipator used?
Yes _______ No _______
Comments __________________________________

16. What diameter borehole(s) were installed?

____

17. Were surface outer casings used?
Yes _______ No _______

18. If yes to 17, what size and to what depth?

____

19. Were the wells double cased?
Yes _______ No _______

20. If yes to 19, explain procedure.

____

Well Installation

21. What type of well casing(s) and screen(s) were used?

____

22. What diameter were the well casing(s)? _______ screen(s)? _______

23. Was there a minimum two-inch annulus around the casing (between casing and borehole wall or inside augers)?
Yes _______ No _______
Comments __________________________________

FIELD SITE AUDIT INSPECTION FORM

24. What was the length of the well screen(s)?

____

25. What was the slot size of the well screen(s)?

____

26. Was the well screen(s) commercially manufactured?
Yes ______ No ______
If yes, by whom? ______________________________

27. Was the bottom of the well screen(s) plugged or capped?
Yes ______ No ______
Comments ______________________________

28. Were sand and/or gravel (filter) packs installed?
Yes ______ No ______
Comments ______________________________

29. Specify type of materials in 28 [(play sand, Ottawa sand, etc.) and grain size (20/30, 20/40, etc.)], if known.

____

30. Was a sieve analysis conducted to determine well screen slot size and filter pack grain size?
Yes ______ No ______
Comments ______________________________

31. Were the wells installed to the proper depths?
Yes ______ No ______
Comments ______________________________

32. Were well screens placed at the proper intervals?
Yes ______ No ______
Comments ______________________________

33. Were the filter packs placed a minimum of two feet above the well screens?
Yes ______ No ______
Comments ______________________________

34. Was the tremie tube method used to place the filter packs?
Yes ______ No ______
Comments ______________________________

35. Were seals placed above the filter packs?
Yes ______ No ______

36. If yes to 35, what materials was used for the seals?

____

37. Was the vertical thickness of the seals a minimum of two feet?
Yes ______ No ______
Comments ______________________________

FIELD SITE AUDIT INSPECTION FORM

FIELD SITE AUDIT INSPECTION FORM

38. If bentonite pellets were used for the seals above the filter packs, were they allowed to hydrate a minimum of 8 hours?
Yes ______ No ______
Comments ______

39. Did contractor/driller have documentation from manufacturer stating recommended hydration time?
Yes ______ No ______
Comments ______

40. Was the tremie tube method used to place the bentonite pellets?
Yes ______ No ______
Comments ______

41. Was the annulus grouted from the seal to within two feet of the ground surface, or below the frost line?
Yes ______ No ______
Comments ______

42. Was the tremie tube method used to place the grout in the annulus?
Yes ______ No ______
Comments ______

43. If no to 42, what method was used?
Yes ______ No ______

44. What type of grout was used to seal the annulus (neat cement, cement/bentonite, cement/sand, etc.)?
______

45. What grout mix ratio was used (should be stated in the POP)?
______

46. What was the density of the grout (lb./gal., etc.)?
______

47. If bentonite grout was used, was the density at least 9.4 lb./gal.?
Yes ______ No ______

48. Was the density determined using a mud balance?
Yes ______ No ______

49. Was the grout allowed to set a minimum of 24 hours before the surface pad was installed?
Yes ______ No ______
Comments ______

50. Was a concrete surface pad installed with an outer protective casing and locking cap?
Yes ______ No ______
Comments ______

51. How far below the ground surface did the concrete pad extend?
______

FIELD SITE AUDIT INSPECTION FORM

52. What were the dimensions of the concrete pads?

____

53. Did the well casings extend to a minimum of 2.5 feet above the ground surface?
Yes ______ No ______
Comments ________________________________

54. How far above the ground surface did the outer protective casings extend?

____

55. Did the outer protective casings have weep holes?
Yes ______ No ______
Comments ________________________________

56. Were the wells properly developed?
Yes ______ No ______
Comments ________________________________

57. Describe method of development.

____

58. Give a general evaluation of the activities observed during installation of the wells.

____

____

____

____

12.0 PREVENTIVE MAINTENANCE

The following section outlines preventative maintenance.

12.1 Field Maintenance

The O_2/LEL meter and the HNu PI-101 are to be used in site characterization and will be maintained as described by the manufacturer's instructions. The pH and specific conductance meters to be used during sampling will be maintained according to Baker's Standard Operating Procedure (SOP) F201. A full set of SOPs will be maintained in the field trailer.

12.2 Laboratory Maintenance

Preventive maintenance is an organized program of actions to prevent instruments and equipment from failing during use and to maintain proper performance of equipment and instruments. A comprehensive preventive maintenance program is implemented to increase the reliability of the measurement system. The preventive maintenance program will address the following:

- Schedules of important preventive maintenance tasks that are carried out to minimize downtime.
- Lists of critical spare parts that are available to minimize downtime.

The laboratory maintains histories, in instrument/equipment logs, of all major equipment. Trouble shooting, maintenance, and spare parts inventory will be recorded in the logs. Instruments and equipment will be maintained periodically in accordance with procedures described in individual analytical methods, manufacturer's recommendation, and/or service contracts.

The modern analytical laboratory depends heavily upon instrumentation and equipment; therefore, cleaning and preventive maintenance are primary considerations in the sustained production of satisfactory data. Specific requirements for proper care of laboratory instrumentation and equipment are contained in the manufacturer's instructions; however, some general guidelines are considered, and are listed below.

- Special precautions must be taken to avoid spillage of corrosive chemicals on or around equipment and instrumentation not only to extend the life of the item, but also to eliminate contamination.
- Where available, covers must be placed on instrumentation when not in use.
- Instrument parts must be cleaned as required (i.e., mirrors, probes, detector cells).

13.0 DATA MEASUREMENT ASSESSMENT PROCEDURES

The following section outlines data measurement assessment procedures.

13.1 Overall Project Assessment

Overall data quality will be assessed by a thorough understanding of the data quality objectives. By maintaining thorough documentation of all decisions made during each phase of sampling, performing field and laboratory audits, thoroughly reviewing the analytical data as they are generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, data accuracy, precision, and completeness will be closely monitored.

13.2 Field Quality Assessment

To assure that all field data are collected accurately and correctly, specific written instructions will be issued to all personnel involved in field data acquisition by the Project Manager. The Project Manager will perform field audit(s) during the investigation to document that the appropriate procedures are being followed with respect to sample (and blank) collection. These audits will include a thorough review of the field books used by the project personnel to insure that all tasks were performed as specified in the instructions. The field audits will necessarily enable the data quality to be assessed with regard to the field operations.

The evaluation (data review) of field blanks, and other field QC samples will provide definitive indications of the data quality. If a problem that can be isolated arises, corrective actions can be instituted for future field efforts.

13.3 Laboratory Data Quality Assessment

As part of the analytical QA/QC program, the laboratory applies precision and accuracy criteria for each parameter that is analyzed. When analysis of a sample set is completed, QC data generated will be reviewed and evaluated to ensure acceptance criteria are met. These criteria will be method and matrix specific.

QA/QC data review is based on the following criteria:

- Method Blank Evaluation - The method blank results will be evaluated for high readings characteristic of background contamination. If high blank values are observed, laboratory glassware and reagents are checked for contamination and the analysis of future samples halted until the system can be brought under control. A high background is defined as a background value sufficient to result in a difference in the sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid. A method blank must contain no greater than two times the parameter detection limit for most parameters.

- Trip Blank Evaluation - Trip blank results will be evaluated for high readings similar to the method blanks described above. If high trip blank readings are encountered (i.e. a value sufficient to result in a difference in sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid), procedures for sample collection, shipment, and laboratory analysis are reviewed.

If both the method and the trip blanks exhibit significant background contamination, the source of contamination is probably within the laboratory. Ambient air in the laboratory and reagents will be checked as possible sources of contamination.

- Standard Calibration Curve Verification - The calibration curve or midpoint calibration standard (check standard) will be evaluated daily to determine curve linearity through its full range and that sample values are within the range defined by the low and high standards. If the curve is not linear, sample values are corrected. If average response factors are used to calculate sample concentrations, these factors are verified on a daily basis. Verification of calibration curves and response factors will be accomplished when the evaluated response for any parameter varies from the calibrated response by less than ranges specified in Section 7.0.

- Duplicate Sample Analyses - Duplicate sample analyses will be used to determine the precision of the analytical method for the sample matrix. Two types of duplicate samples will be analyzed for this project, field, and laboratory. Duplicate results will be used to calculate precision as defined by the relative percent difference (RPD). If laboratory duplicate values exceeds the control limit, the sample set may be reanalyzed for the parameter in question. Precision limits will be updated periodically following review of data.

- Reference Sample Analyses - The results of reference sample analysis will be compared with true values, and the percent recovery of the reference sample will be calculated. If correction is required (excessive or inadequate percent recovery), the reference sample must be reanalyzed to demonstrate that the corrective action has been successful.

- Surrogate Standard Analyses - Surrogate standard determinations will be performed on all samples and blanks for GC/MS analyses. All samples and blanks are fortified with surrogate spiking compounds before purging or extraction to monitor preparation and analysis of samples. Recoveries must meet specific criteria. If acceptance criteria are not met, corrective action must be taken to correct the problem and the affected sample must be reanalyzed.

- Matrix Spike Analyses - The observed recovery of spike versus theoretical spike recovery will be used to calculate accuracy as defined by the percent recovery. If the accuracy value exceeds the control limit for the given parameter, the appropriate laboratory personnel notified and corrective action will be taken before the sample set is reanalyzed for the parameter in question.

For completeness, it is expected that the methodology proposed for chemical characterization of the samples will meet QC acceptance criteria for at least 95 percent of all sample data. To ensure this completeness goal, data that does not meet the acceptance criteria will be recollected, reextracted, or reanalyzed, if necessary.

Data representativeness will be ensured through the use of appropriate analytical procedures, and analysis of samples performed within the allowed holding times.

Comparability is a qualitative characteristic of the data. By using standard methods for sampling and analyses, data generated in past or future investigations will be comparable with this investigation data.

14.0 CORRECTIVE ACTION

Corrective action will be taken whenever a nonconformance occurs. A nonconformance will be defined as an event which is beyond the limits established for a particular operation by the plan. Nonconformances can occur in a number of activities. Such activities include sampling procedures, sample receipt, sample storage, sample analysis, data reporting, and computations.

The following personnel will be responsible for detecting and reporting nonconformances:

- Project Staff - during testing and preparation and verification of numerical analyses.
- Laboratory Staff - during the preparation for analyses, performance of analytical procedures, calibration of equipment, and quality control activities.

14.1 Limits of Operation

The limits of operation that are used to identify nonconformances will be established by the contents of the Work Plan, QAPP, and FSAP. Interlaboratory control limits produced by statistical analyses will also be considered as limits of operation.

14.2 Corrective Action

Nonconformances will be identified and communicated to Baker to avoid delays with respect to project schedules and prevent the submission of non-valid data. Documentation will include the following:

- Personnel identifying the nonconformance(s) will be identified.
- The nonconformance(s) will be described and communicated to the Baker Project Manager.
- For serious nonconformances, the site supervisor will have the authority to initiate corrective action.
- For less serious nonconformances, corrective action will be decided upon and signatures will be obtained prior to implementation of corrective action.
- All nonconformances and corrective actions will be documented and reside with the Baker Activity Coordinator. This documentation will be available to LANTDIV.

The Baker Project Manager will be notified of laboratory or field nonconformances and corrective actions taken if:

- A nonconformance causes a delay in work beyond the schedule completion date.
- A nonconformance affects information already reported.
- A nonconformance affects the validity of the data.

If the nonconformance(s) are serious and corrective action cannot resolve the problem(s), NFESC Contract Representatives (NCRs) and the LANTDIV NTR may be notified by Baker.

15.0 QUALITY ASSURANCE REPORTING PROCEDURES

The Project Manager will be responsible for assessing the performance of measurement systems and data quality related to the field investigation. A written record will be maintained of: the results of laboratory QC reports and other periodic assessments of measurement, data accuracy, precision, and completeness; performance and system audits; and any significant QA problems and recommended solutions. Each deliverable will contain a QA/QC assessment section. Also, a QA/QC assessment will be performed any time a significant problem is identified.

The Project Manager will keep in contact with the LANTDIV NTR through informal, verbal reports during the project as well as through monthly progress reports.

FINAL

REMEDIAL INVESTIGATION/FEASIBILITY STUDY HEALTH AND SAFETY PLAN

OPERABLE UNIT NO. 16 (SITES 89 AND 93)
MCB CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0344

FEBRUARY 21, 1997

Prepared For:

DEPARTMENT OF THE NAVY
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ATTACHMENTS

EXECUTIVE SUMMARY

This Health and Safety Plan (HASP) addresses the Remedial Investigation/Feasibility Study (RI/FS) for Operable Unit (OU) No. 17, Marine Corps Base (MCB), Camp Lejeune, North Carolina. The purpose of this RI/FS is to determine the nature, rate, direction and extent of releases of hazardous waste from each site within OU No. 17. 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), semivolatile organic compounds (SVOCs), and inorganics.

The physical hazards include working around heavy equipment, underground/overhead utilities, uneven/sloped terrain, cold strees, and heat stress. The environmental hazards may include potentially hazardous flora and fauna. 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.

Due to the limited amount of information provided by previous investigations and record searches, 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 through D+ with protection upgrades/downgrades 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 Figure 8-1, showing the route to the nearest public hospital, and Figure 8-2 identifying the written directions to the hospital, along with first aid procedures, communication procedures, and other site concerns. Table 8-1 identifies the emergency phone numbers.

1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed by Baker Environmental, Inc. (Baker) to accompany the Project Plans, which include a Work Plan, Field Sampling Plan, Quality Assurance Project Plan, and HASP, for Contract Task Order (CTO) 0344. The Work Plan, Field Sampling Plan, and Quality Assurance Project Plan are bound as separate documents, and will accompany the HASP in the field. The objective of the project is to conduct a Remedial Investigation/Feasibility Study (RI/FS) at Operable Unit No. 17 (Sites 90, 91, and 92) at Marine Corps Base (MCB) Camp Lejeune, Jacksonville, North Carolina. The purpose of this HASP is to comply with the safety and health regulations of the OSHA General Industry and Construction Standards and to define the requirements and designate protocols to be followed during RI/FS activities involving potentially contaminated soil, groundwater, surface water, and sediment.

1.1 Policy

It is the policy of 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 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.

1.2 Scope

The provisions of this HASP are applicable to Baker personnel involved with the RI/FS activities during the Phase I activities and possible Phase II activities. During Work Plan development for Phase II investigation activities, if required, additional applicable provisions will be added to this HASP as required.

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 the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), USCG, and the United States Environmental Protection Agency's (USEPA's) recommended health and safety procedures (Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities). This site-specific HASP, at a minimum, meets the requirements under OSHA Standard 29 CFR 1910.120 and 1925.65 (Hazardous Waste Operations and Emergency Response [HAZWOPER]).

1.3 Site Description

A description of each of the sites is presented in the subsections below. The sites will be investigated as one investigation area.

1.3.1 Site 90 (BB-9)

The study area is located near the intersection of Middle Road and Peach Street between Buildings BB-9 and BB-16 in the Courthouse Bay area of MCB Camp Lejeune. Building BB-9 currently operates as a steam generation and heating plant. Three steel 1,000-gallon heating oil underground storage tanks (USTs) were located adjacent to Building BB-9. A dry cleaning facility (Building BB-16) is located northeast of the site (no dry cleaning on the premises, drop-off and pick-up point only; however, previously there was a 250-gallon above ground storage tank [AST] in the building which contained dry cleaning fluid). The New River is the nearest surface water body, located approximately 800 feet south of the former UST basin. The nearest known water supply well (BB-45) is located approximately 1,275 feet west of the site.

The site is a relatively flat area. There are buildings located in the area in addition to paved areas.

1.3.2 Site 91 (BB-51)

The study area is located at the northern dead end of Clinton Street east of Building BB-51 in the Courthouse Bay area of MCB Camp Lejeune. Two steel 300-gallon waste oil USTs were formerly located in an unpaved area at the edge of a treeline, approximately 200 feet east of Building BB-51. The New River is the nearest surface water body, located approximately 2,975 feet south-southwest of the former UST basin. The nearest known water supply well (BB-44) is located approximately 1,275 feet northwest of the site.

The site is relatively flat. Much of the area surrounding Building BB-51 is unpaved and wooded. There are a few buildings located in the area.

1.3.3 Site 92 (BB-46)

The study area is located at the end of Front Street in the Courthouse Bay area of MCB Camp Lejeune. Building BB-46 has been dismantled. Building BB-246 has been constructed nearby to replace Building BB-46. One steel 1,000-gallon regular gasoline USTs (for retail use) was formerly located northwest of Building BB-46. The site is directly adjacent to Courthouse Bay. The nearest known water supply well (BB-45) is located approximately 2,350 feet southeast of the site.

The site is relatively flat. Much of the area surrounding Building BB-246 is unpaved and wooded. There are a few buildings located in the area.

1.4 Project Description

The work tasks that will be conducted during Phase I investigation activities at Sites 90,91, and 92 by Baker personnel include the following:

- Advancement of soil borings
- Installation of temporary monitoring wells to include the collection of groundwater samples
- Collection of surface water/sediment samples (Site 92 only)

1.5 References

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

- American Conference of Governmental Industrial Hygienists (ACGIH). 1995. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indicies for 1995-1996.
- Genium Publishing Corp, Genium's Reference Collection, MSDSs
- 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-Heinemanne, Stoneham, Massachusetts.
- National Institute for Occupational Safety and Health/Occupational Safety and Health Administration/U.S. Coast Guard/U.S. Environmental Protection Agency. 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October 1985.
- Occupational Safety and Health Administration. 1995. Title 29 Code of Federal Regulations, Parts 1910 and 1926.
- United States Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH. 1994. NIOSH Pocket Guide to Chemical Hazards. June 1994.
- United States Environmental Protection Agency, Office of Emergency and Remedial Response, Emergency Response Division. 1992. Standard Operating Safety Guidelines. June 1992.

2.0 PROJECT PERSONNEL AND RESPONSIBILITIES

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

PROJECT MANAGER: Mr. Matt Bartman

The Baker 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 exposed to harmful agents. In addition, the Project Manager is responsible for:

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

PROJECT HEALTH AND SAFETY OFFICER: Mr. Ron 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 also will:

- Develop new protocols or modify the HASP as appropriate and issue amendments.
- Resolve issues which 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 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: Ms. Heather DeBolt

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 health and safety equipment and personal protective equipment (PPE) has arrived on-site and it is properly maintained.

- Coordinating overall site access and security measures, including documenting all personnel arriving or departing the site (i.e., name, company, and time).
- Approving all on-site activities and coordinating site safety and health issues with the Site Health and Safety Officer (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 prior to mobilization)

The SHSO will be responsible for the on-site implementation of the HASP. The SHSO also has the immediate authority to suspend field activities if the health and 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 Field Trailer. The SHSO also will:

- Coordinate the pre-entry briefing and subsequent briefings.
- Assure that monitoring equipment is properly calibrated and properly operated.
- Assure compliance with the Baker 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, evaluate if more stringent procedures or a higher level of PPE should be implemented, and keep the PHSO and Project Manager informed.
- Document, as necessary, pertinent information such as accident investigation and reporting, designated safety inspections, a record of site conditions, personnel

involved in field activities, and any other relevant health and safety issues. This information will become part of the official site records.

- Act as the Emergency Coordinator.

Field team members will be responsible for:

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

Subcontractor personnel will be responsible for:

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

Subcontractor Companies:

- Drilling Operations: (to be provided in the Final HASP Submission)
- Survey Operations: (to be provided in the Final HASP Submission)
- Analytical Services: (to be provided in the Final HASP Submission)

LANTDIV Representatives:

● Kate Landman, NTR	(804) 322-4818

MCB Camp Lejeune Representatives:

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

Federal/State/Local Representatives:

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

3.0 SITE CHARACTERIZATION

This section provides information on the site history, previous investigations, and health and safety concerns for the physical and health hazards associated with the sites.

3.1 Site History

Information regarding the history of Sites 90, 91, and 92 is presented in the following subsections.

3.1.1 Site 90 (BB-9)

Building BB-9 is currently operating as a steam generation and heat plant. The integrity of the three 1,000-gallon steel USTs reportedly used for heating oil storage (the tanks were removed in 1993) is suspected as being the source for a release of petroleum products to the soil and subsequently to the underlying groundwater in this area. The site area, in addition to the former UST location, also includes: three active ASTs of unknown capacity reported to store diesel fuel #2 east of Building BB-9; an active oil/water separator for stormwater runoff from the active AST pad southeast of the former UST basin; and two active 250-gallon ASTs which are used for solvent storage west of the former UST basin.

3.1.2 Site 91 (BB-51)

Building BB-51 was constructed, and is currently used, as an instruction building for the Marine Corps Engineering School. The integrity of the two 300-gallon steel USTs reportedly used for waste oil (the tanks were removed in 1992) is suspected as being the source for a release of petroleum products to the soil and subsequently to the underlying groundwater in this area. Another possible source of contamination is the school which has a photograph development laboratory for the topographic engineering course. The site area, in addition to the former UST location, also includes: a vehicle storage area west of the former UST basin and directly north of Building BB-51; a bermed petroleum, oil, and lubricants area 300-feet north of Building BB-51 and northwest of the former UST basin; an active lube-oil drum storage pad approximately 250-feet north of Building BB-51 and west of the former UST basin; an active vehicle/equipment wash pad approximately 170-feet north-northwest of Building BB-51 and west of the former UST basin; and an active temporary hazardous /potentially hazardous materials storage area west of the former UST basin and northeast of Building BB-51.

3.1.3 Site 92 (BB-46)

Building BB-46, which was used as a boat house, has been replaced by Building BB-246. A concrete pad, in the vicinity of where Building BB-46 was located, is now used as a covered picnic area. The integrity of a 1,000-gallon steel UST reportedly used to store regular gasoline for retail use from 1980 to 1989 (the tank was removed in 1994) is suspected as being the source for a release of petroleum products to the soil and subsequently to the underlying groundwater in the area. The site area, in addition to the former UST location, also includes: a playground 100-feet west to southwest from the former UST basin; and a metal storage shed, used to store 5-gallon gas cans, 10-feet northwest from the former UST basin. The site is directly adjacent to Courthouse Bay.

3.2 Previous Investigations

A brief description of the finding of the previous investigations is included in the following subsections.

3.2.1 Site 90

At Site 90, as a follow-up to the tank removals, a three well site check was conducted in April 1993 by Groundwater Technology Government Services, Inc. The analytical results included detected concentrations of TPH-diesel, TPH-lubrication oil, and total oil and grease in subsurface soil samples collected and detected concentrations of benzene, toluene, ethylbenzene, and total xylene (BTEX) in groundwater samples collected.

A leaking underground storage tank comprehensive site assessment was conducted in December 1994 by Richard Catlin & Associates, Inc. The analytical results included detected concentrations of 1,1,1-trichloroethane, toluene, tetrachloroethene, ethylbenzene, xylenes, n-propylbenzene, and trimethylbenzene in subsurface soil samples collected. Concentrations of benzo(a)anthracene, chloroform, and benzene were detected in groundwater samples collected which exceeded Federal Maximum Contaminant Levels (MCLs) and the North Carolina Water Quality Standards (NCWQS).

The following inorganics were detected at levels above the Federal MCLs and/or NCWQS: cadmium, chromium, lead, and silver.

3.2.2 Site 91

At Site 91, as a follow-up to the tank removals, a three well site check was conducted in April 1993 by Groundwater Technology Government Services, Inc. The analytical results included detected concentrations of total oil and grease in subsurface soil samples collected and a detected concentration of toluene in the groundwater samples collected.

A leaking underground storage tank comprehensive site assessment was conducted in September 1994 by Richard Catlin & Associates, Inc. The analytical results included detected concentrations of 1,1-dichloroethene, 1,1,2-dichloroethene, 1,1-dichloroethane, 2,2-dichloropropane, 1,1,1-trichloroethane, benzene, trichloroethene, 1,2-dichloropropane, dibromomethane, toluene, 1,1,2-trichloroethane, ethylbenzene, 1,1,1,2-tetrachloroethane, xylenes, isopropylbenzene, 1,1,2,2-tetrachloroethane, n-propylbenzene, 1,3,5-trimethylbenzene, 2-chlorotoluene, 1,2,4-trimethylbenzene, sec-butylbenzene, 1,4-dichlorobenzene, n-butylbenzene, naphthalene, chloroform, p-isopropyltoluene, and hexachlorobutadiene in subsurface soil samples collected. Concentrations of chloroform, 1,1-dichloroethane, and benzene were detected in groundwater samples collected which exceeded Federal MCLs and the NCWQS.

The following inorganics were detected at levels above the Federal MCLs and/or NCWQS: arsenic, cadmium, and silver.

3.2.3 Site 92

At Site 92, as a follow-up to the tank removal, a three well site check was conducted in August 1994 by R. E. Wright Associates, Inc. The analytical results included a detected concentration of tetrachloroethene in groundwater samples collected which exceeded Federal MCLs and NCWQS.

3.3 Physical Hazards

The identified potential physical hazards associated with this project during the site activities include thermal stress, explosion and fire, underground utilities, heavy equipment operations, and noise. The following presents a description of these potential hazards. General physical hazards that may be present during the project activities are listed in the following subsections.

3.3.1 Thermal Stress

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

3.3.2 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:

- Heavy equipment malfunction or refueling operations
- Penetration into underground utility/service lines (gas, electric, fuel)
- Ignition of trapped flammable vapors
- Vehicular accidents
- Puncturing of drums, tanks, or other containers during drilling operations
- Ignition of flammables or combustibles from open flames during welding or cutting (where needed during well installations)

Hazard Prevention

Explosion and/or fire hazards can be prevented by proper grounding, approved safety cans, compressed gas cylinder safety, leak repair, vehicle maintenance, availability of fire extinguishers, no smoking, and no incendiary or igniter devices.

Site personnel should be trained in the proper use of portable fire extinguishing equipment. Site personnel should respond to fires as follows:

- Evacuate all personnel
- Call 911
- If the fire is small or confined, attempts to fight the fire with portable fire extinguishers is authorized
- Support the Fire Department response forces as appropriate (e.g., providing information regarding site activities, hazards, and missing personnel, if any)

3.3.3 Utilities

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

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), a minimum distance of 10 feet must be maintained. Lines carrying over 50 kV require that the equipment location be at least 10 feet plus an additional 0.4 inch for each 1 kV over 50.

3.3.4 Heavy Equipment

One of the primary physical hazards associated with the site work is the use of heavy equipment, which may include the use of a drill rig and/or hydraulic-operated direct push equipment for temporary monitoring wells. Only operators trained, qualified, and authorized will be permitted to operate the heavy equipment.

Hazards generally associated with drilling operations include the following:

- Motor vehicle exhaust products (e.g., carbon monoxide and nitrogen oxides) from the drill rig engine.
- Overhead utility wires (i.e., electrical and telephone) can be hazardous when the drill rig boom is in the upright position.
- Underground pipelines and utility lines can be ruptured or damaged during active drilling operations.
- Moving parts, i.e., augers, on the drill rig may catch clothing. Free or falling parts from the cat head may cause head injury.
- Moving the drill rig over uneven terrain may cause the vehicle to roll over or become stuck in a rut or mud. Be aware of hazards associated with moving heavy machinery and other associated injury.
- High pressure hydraulic lines and air lines used on drill rigs are hazardous when they are leaking, worn or incorrectly assembled.

Hazard Prevention

- Review the contaminants suspected to be on site and perform air monitoring as required. Shut down drill rig and/or divert exhaust fumes.
- All chains, lines, and cables should be inspected daily for weak spots, frays, etc.
- Ear muffs and/or ear plugs effectively reduce noise levels.
- At a minimum, personal protective equipment will include safety boots, eye protection, and hard hats, which will be worn at all times while working around a drill rig. Secure loose clothing. Check boom prior to approaching drill rig.
- To avoid contact with any overhead lines, the drill rig boom should be lowered prior to moving the rig. Overhead utilities should be considered "live" until determined to be otherwise.

- The rig mast will not be erected within 10 feet of an overhead electrical line until the line is deenergized, grounded, or shielded and an electrician has certified that arcing cannot occur.

- A thorough underground utilities search will be conducted before the commencement of a drilling project. Proper utility clearances must be obtained prior to intrusive work.

- All high pressure lines will be checked prior to and during use.

- The subcontracting drilling company's site supervisor will provide, during the HASP briefing, a description of cautions to be observed when working around the drill rig.

- Hand signals will be prearranged between the operator and personnel working around the drill rig.

- Personal will remain in the field of vision of the operator and remain clear of moving parts, especially where loose-fitting clothing can become entangled.

- Personnel working near a drill rig will be aware of the location and operation of the emergency shut off devices.

- Establish appropriate work zone around the drill rig of a radius of at least equal to the height of the drill boom, and delineate work zone with construction warning tape, barricades, cones, or the like.

3.3.5 Noise

Elevated noise levels may be produced during drilling and other heavy equipment operations; therefore, hearing protection will be made available. 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. Employees can receive hearing protection upon request.

3.4 Chemical Hazards

Hazardous chemicals can be absorbed into the body through various pathways, such as:

- Accidental inhalation of vapors, gases, or particulates
- Accidental ingestion of contaminated material from hand-to-mouth contact
- Accidental dermal and eye absorption from direct, unprotected contact

The identification of the primary chemical hazards that may be encountered at the site is based on previous soil and groundwater investigations. A previous investigation at Site 90 identified subsurface soil contaminated with 1,1,1-trichloroethane, toluene, tetrachloroethene, ethylbenzene, xylenes, n-propylbenzene, and trimethylbenzene and groundwater contaminated with benzo(a)anthracene, chloroform, benzene, cadmium, chromium, lead, and silver. Each of the aforementioned constituents exceeded available Federal and/or state criteria.

A previous investigation at Site 91 identified soil contaminated with 1,1-dichloroethene, 1,1,2-dichloroethene, 1,1-dichloroethane, 2,2-dichloropropane, 1,1,1-trichloroethane, benzene, trichloroethene, 1,2-dichloropropane, dibromomethane, toluene, 1,1,2-trichloroethane, ethylbenzene, 1,1,1,2-tetrachloroethane, xylenes, isopropylbenzene, 1,1,2,2-tetrachloroethane, n-propylbenzene, 1,3,5-trimethylbenzene, 2-chlorotoluene, 1,2,4-trimethylbenzene, sec-butylbenzene, 1,4-dichlorobenzene, n-butylbenzene, naphthalene, chloroform, p-isopropyltoluene, and hexachlorobutadiene and groundwater contaminated with chloroform, 1,1-dichloroethane, benzene, arsenic, cadmium, and silver. Each of the aforementioned constituents exceeded available Federal and/or state criteria.

A previous investigation at Site 92 identified groundwater contaminated with tetrachloroethene which exceeded available Federal and/or state criteria.

During each sampling event or well installation, an effort will be made to eliminate or reduce potential routes of exposure through the use of engineering controls (e.g., performing investigative activities in an upwind location according to safe sampling techniques), administrative controls (e.g., effective training programs), and the proper use of PPE.

Table 3-1 located in the "Tables" section at the end of this HASP, identifies chemical/physical properties for No. 2 fuel oil, BTEX, 1,1,1-trichloroethane, 1,1-dichloroethane, tetrachloroethane, and metals detected during previous investigations at Sites 90, 91, and 92, respectively. The chemicals listed in Table 3-1 represent the most significant potential health concern to the personnel conducting this field program. A MSDS is available in Attachment B for each of the chemicals in Table 3-1. It is important to note that the information presented in each MSDS reflects the chemical and toxicological properties of the specific compound in a pure, undiluted, and untransformed condition. As such, when these compounds are detected in environmental media the hazards are anticipated to be substantially less that those associated with exposure to "pure" compounds. Therefore, the data presented in the MSDS will be utilized as reference information when questions arise as to a constituents's chemical, physical, and toxicological properties, or measures to be employed in an emergency situation.

Other chemical hazards that may be present include preservative chemicals that will be in some of the sample containers (e.g., hydrochloric acid and nitric acid), decontamination fluids, and materials brought to the site by the subcontractors. For the aforementioned materials, an MSDS will be obtained and made readily available to the field sampling team, in compliance with 29 CFR 1910.1200.

3.5 Environmental Hazards

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

3.5.1 Hazardous Flora

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

While attempting to cut into dense underbrush, hazards exist from the sharp machete and gas-powered weed cutter; therefore, care should be taken when using such devices. (Note: Hearing protection, steel toe boots, gloves, and safety glasses are required when using weed cutters.) Rashes or other injuries will be reported to the SHSO as soon as they occur or are recognized.

3.5.2 Hazardous Fauna

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

Poisonous snakes such as the rattlesnake, copperhead, and cottonmouth (water moccasin), all known as pit vipers, are common to the United States. Snakes typically do not attack people, but will bite when provoked, angered, or accidentally injured (as when stepped on). When encountering a snake, avoid quick/jerky motions, loud noises, and retreat slowly; do not provoke the snake. If bitten, follow emergency procedures outlined in Section 8.8.3.

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

The brown recluse spider is a little bit smaller than the black widow spider and is dull brown in color. It has a violin-shaped mark on its back, which can be seen when you are looking at the spider from above. The spider gets its name because it tends to live in dark areas, corners, and old unused buildings. The bite from this animal produces local rather than systemic manifestations. The venom of the brown recluse spider causes severe local tissue damage and can lead to an ulcer and gangrene. The bitten area becomes red, swollen, and tender within a few hours after the bite. A small blister forms, and several days later, this may form a large scab, covering a deep ulcer. Death is rarely reported. If a spider bite by a black widow or brown recluse is suspected, follow emergency procedures in Section 8.8.4.

There is a potential to come in contact with other dangerous insects; these include fire ants, chiggers, bees, wasps, hornets, mites, fleas, spiders, and ticks. All personnel should perform "checks" on each other periodically and at the end of the work shift, especially when working in grassy or forested areas. Insect bites must be reported to the SHSO. Insect bite emergency procedures are outlined in Section 8.8.5.

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

3.6 Task-Specific Hazards

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

3.6.1 Land Surveying

Chemical

- Skin contact with potentially contaminated soil or surface water.
- Accidental ingestion of contaminated material from hand-to-mouth contact.

Physical/Environmental

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

3.6.2 Subsurface Sampling - Soil Boring

Chemical

- Potentially contaminated mud, soil, or groundwater to be splashed onto body or in eyes.
- Skin contact with potentially-contaminated soil.
- Ingestion of potentially-contaminated soil 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 and heat exhaustion while lifting heavy objects.
- Skin irritation from contact with insects and vegetation.
- Contact with underground utilities.
- Interaction with native and feral animal life.
- Heavy objects landing on foot/toe or head.
- Slips/trips/falls from sloped, uneven terrain; crawling over and under obstacles.

3.6.3 Temporary 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

- Elevated noise levels from heavy equipment operation.
- Muscle strain and heat exhaustion from lifting.
- Skin irritation from contact with insects and vegetation.
- Contact with underground utility lines.
- Interaction with native and feral animal life.
- Overhead hazards from drill rig operations.
- Heavy objects landing on foot/toe or head.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.

3.6.4 Monitoring Well Development

Chemical

- Potentially 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.
- Adsorption of groundwater through the skin.

Physical/Environmental

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

3.6.5 Groundwater Sampling

Chemical

- Potentially contaminated groundwater and sample preservatives 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 and heat exhaustion during sampling.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.
- Cuts from sharp edges of the well casing.
- Cuts from using knives to cut bailer rope.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.

3.6.6 Surface Water/Sediment Sampling (Site 92 only)

Chemical

- Potentially contaminated material and sample preservatives to be splashed onto body or in eyes.
- Ingestion of contaminated material from hand-to-mouth contact.
- Inhalation of volatile constituents or volatile fraction of semivolatile constituents within the sediments or surface water.
- Absorption of constituents through the skin.

Physical/Environmental

- Muscle strain and heat exhaustion when using sample collection equipment.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.
- Sampling operations that occur from boats. These operations must comply with Baker's Safety SOP for Safe Boat Operations.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.

3.6.7 Equipment Decontamination

Chemical

- Potentially contaminated mud, soil, or groundwater to be splashed onto body or in eyes.
- Skin contact with potentially-contaminated soil.
- Ingestion of potentially-contaminated soil from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Adsorption of decontamination water through the skin.

Physical/Environmental

- Muscle strain and heat exhaustion from lifting and bending.
- Skin irritation from contact with insects and vegetation.
- Heavy object (i.e., split spoon) landing on fingers, hand, toes, foot and/or leg.
- Slips/trips/falls

3.6.8 IDW (Tanker/Rolloff Box) Sampling

Chemical

- Potentially contaminated mud, soil, or water to be splashed onto body or in eyes.
- Skin contact with potentially-contaminated soil or water.
- Ingestion of potentially-contaminated soil from hand-to-mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Adsorption of decontamination/purge water through the skin.

Physical/Environmental

- Muscle strain and heat exhaustion from using bailer or hand auger.
- Skin irritation from contact with potentially-contaminated soil or water.
- Cuts, abrasions, or sprains from climbing onto rolloff box or tanker.
- Falling into potentially contaminated material in rolloff box.
- Hazards associated with a potential "confined-space" situation.
- Slips/trips/falls from elevated heights (i.e., top of rolloff box or tanker) onto ground.

4.0 SITE CONTROL

Measures for daily control of the site (i.e., access, site conditions, etc.) are addressed in the following subsections including a discussion of each site control measure. Refer to Section 6.0 for a definition of the protection level requirements.

4.1 Site Access

The Site Manager is designated to coordinate overall access and security at each area under investigation. Perimeters for activities to be conducted at Sites 90, 91, and 92 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 (CRZ) without proper authorization from the SHSO.
- All personnel arriving or departing the site will be documented in the site log book.
- All activities on site must be cleared through the Site Manager and documented in the site log book.
- The on-site Command Post will be established at the Baker Field Trailer, which will be in the Support Zone and oriented upwind from all Work Zones.
- Figure 4-1 identifies the location of each area under investigation.

4.2 Site Conditions

Specific site conditions are as follows:

- The prevailing wind conditions will be established daily
- Site topography consist of the following:
  - Small trees and brush
  - Relatively flat

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 following subsections identify the requirements based on the level of protection in use.

4.3.1 Level C Activities

Although activities are expected to be conducted in Level D/D+ attire, if air monitoring indicates the presence of contaminants and warrant an upgrade in the level of personal protection or the SHSO indicates that an upgrade in protection is required, the boundaries for the following work zones will be defined as follows:

- Work Zone - The area immediately around the work area, such as the drill rig boom radius.
- Hotline - The boundary between the Work Zone and the 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.

The 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 sign 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.

Unauthorized personnel will not be permitted in the work areas.

4.3.2 Level D/D+ Activities

Work Zones for activities conducted in Protection Level D or Level D+ will be monitored by the SHSO to restrict unauthorized personnel from entering the area during well installation and sampling events. In populated areas, work zones 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 equipment such as natural boundaries (e.g., buildings, structures, fences), signs/placards, boundary tapes, and barricades. In unpopulated areas, the aforementioned procedures may not be necessary due to the secluded nature of the site, the short duration of the activity, and the low risk to outside populations. The Senior Field Team Member or SHSO is responsible for making this determination.

4.4 Buddy System

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

4.5 Safe Work Practices

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.
- Adhering to applicable safety regulations in OSHA Standards 29 CFR 1910 and 1926.
- Setting up barriers to exclude unauthorized personnel from contaminated areas.
- Minimizing the number of personnel and equipment at each area under investigation.
- Establishing work zones within each area under investigation.
- Establishing control points for ingress to and egress from work zones.

4.5.1 Heavy Equipment

The following safe work practices will be adhered to if heavy equipment operations take place.

- 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, will not ride on equipment.
- A "spotter" will be used to help direct the heavy equipment operator.
- Personnel will 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.
- Hearing protection will be used.
- Backup alarms must operate properly on the heavy equipment.

4.5.2 Drilling Operations

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

- Hand signals will be prearranged between operator and personnel working around the drill rig.
- Personnel will 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.
- Personnel working near a drill rig will be aware of the location and operation of the emergency shut off devices.

- Utility clearances must be secured prior to digging (see Section 3.3.3).
- The drill rig boom will remain a minimum of 10 feet from power lines (see Section 3.3.3).
- During the HASP briefing, the supervisor of the drilling company will provide additional precautions to be observed when working around the drill rig.

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 will be provided.
- Single service disposal cups will be provided.
- Outlets for non-potable water, clearly marked, for fire fighting or other purposes will be provided. 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 will be provided. Two toilet facilities will be required for greater than 20 personnel.
- A place for food handling meeting applicable laws or suitable alternatives to such facilities will be provided (i.e., nearby restaurants, food wagons, etc.).
- Clean wash water will be available in the decontamination zone during Level C or B activities, each Baker Field Vehicle, and the Baker Field Trailer. Disposable towelettes and/or handwash stations also 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 also will 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, or 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 EXPOSURE MONITORING

Environmental monitoring will be performed at each 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 photo ionization device (PID), as specified in Section 5.1 below, are based on a "worst-case" contaminated 8-hour Time Weighted Allowance-Permissible Exposure Level (TWA-PEL) of 1 part per million (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). Monitoring equipment and frequency for each field Activity can be found in Table 5-1.

5.1 Breathing Zone

Personnel 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 the work party personnel. BZ monitoring will be performed each time a reading is taken at the point source (i.e., after a monitoring 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 meter unit (mu) above background for up to 1 continuous minute in the BZ = Stop work and consult the SHSO/PHSO
- >5mu above background for up to 15 continuous minutes in the BZ = Stop work and consult the SHSO/PHSO
- Instantaneous peak concentrations >10 mu in the BZ = Stop work and consult the SHSO/PHSO

(1) PID with 11.7 eV ultraviolet lamp set on the 1X Scale.

(2) Background is typically 1 to 2 mu.

The action level to upgrade from Level D/D+ to Level C will be an HNu PID reading in the breathing zone of greater than one ppm above the background for a period greater than or equal to 1 minute.

5.2 Point Source Monitoring

The HNu PID monitor will be used to monitor the point source during the soil intrusive activities. Point source monitoring is defined as monitoring performed at the source of the work activity. Instantaneous readings greater than 50 ppm will cause an immediate evacuation of the area until levels return to normal. If point source HNu PID readings are detected above background, breathing zone monitoring also will be conducted.

Furthermore, the oxygen/lower explosive limit (O_2/LEL) meter will be used during soil investigation activities conducted using a drill rig. The following action levels will be observed.

Oxygen Meter(1)

- 19.5% to 23.5% = Safe operating level
- <19.5% to >23.5% = Unsafe operating level; stop work and consult the SHSO/PHSO

LEL Meter(2)

- <20% of the LEL = Safe operating level
- >20% of the LEL = Unsafe operating level; stop work and consult the SHSO/PHSO

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

5.3 Perimeter Monitoring

A PID will be used to monitor the perimeter of the work area to determine safe areas during a work stoppage if concentrations meet the work stoppage criteria identified in Sections 5.1 and 5.2.

5.4 Equipment Calibration

Equipment calibration of the HNu PID and O_2/LEL meter under the direction of the SHSO will be completed daily before use. The calibration information will be logged on a field calibration form. These forms will be placed in the project files upon completion of the field activities.

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

5.5 Monitoring Documentation

As environmental monitoring is performed, documentation of the results will be entered into a field log book by the individual performing the monitoring or the SHSO. Documentation is to include date, time, instrument result, general location, weather conditions (temperature and humidity), and specific location, such as, background, point source, and breathing zone. This air monitoring documentation will be placed in the project files upon completion of the field activities.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The Level of Protection selected is based upon the following:

- Measured concentration of a chemical substance or substances in the ambient atmosphere
- Potential for exposure to substances in air, liquids, or direct contact with material because of work activities
- Knowledge of chemicals on-site along with properties such as toxicity, route of exposure, and contaminant matrix

6.1 Levels of Protection

Based on the information provided in Section 3.0, Site Characterization, the levels of protection and corresponding PPE have been designated for the following field activities. The SHSO will upgrade the level of protection based on realtime monitoring conducted at each investigation area, working conditions, or based on his or her professional judgement according to observations of site activities.

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.

The following table summarizes the level of protective clothing required for the field task to be performed at each site.

Job Task	Level of Protection				
	A	B	C	D+	D
General site activities (such as, Mobilization/Demobilization)					X
Soil boring and sampling				X	
Temporary monitoring well installation				X	
Monitoring well developing, purging and sampling				X	
Surface Water/Sediment sampling				X	
Equipment Decontamination				X	
Land Surveying					X

X - Level of protection for the task identified

Protective ensembles are described below:

Level D

- Normal work clothes*
- Steel toe boots
- Work gloves (as needed)
- Safety glasses (as needed)

* Long or short-sleeved shirt and long pants (made of a sturdy material)

Level D+

- Normal work clothes
- Gloves, chemical resistant (nitrile) (during sampling activities)
- Steel toe boots
- Safety glasses
- Hard Hat (during heavy equipment activities)
- Hearing protection (as needed)
- Snake chaps (as needed during surface water/sediment sampling)
- Chest/hip waders (as needed during surface water/sediment sampling)

Level C

- Air-purifying respirator, full-face, with organic vapor/HEPA cartridges
- Chemical-resistant clothing (such as polycoated tyvek)
- Gloves (outer), chemical resistant nitrile/rubber
- Gloves (inner), chemical resistant nitrile
- Steel toe boots
- Disposable boot covers (outer), chemical-resistant latex

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

6.2 Reassessment of Protection Program

The Level of Protection shall be upgraded or downgraded based on changes in site conditions or findings of investigations by the PHSO.

6.3 Care and Cleaning of Personal Protective Equipment

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

7.0 DECONTAMINATION PROCEDURES

The following presents the information for personnel and equipment decontamination requirements as well as handling of materials generated during decontamination.

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. All site personnel should minimize contact with contaminants in order to minimize the need for extensive decontamination.

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

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

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

- Two small tubs (one set of wash and rinse water)
- Scrub brush
- Towels*
- Hand and face wash capability (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 Field Sampling and Analysis Plan (FSAP).

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 techniques, inspection of PPE before and after decontamination, and the questioning of site personnel for signs and symptoms of exposure. Additional measures also may 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 OU No. 17 are found in the FSAP.

7.4 Decontamination Materials

The protocols outlined in the FSAP 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 Waste," 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 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, MSDSs for hazardous chemicals/materials brought on site (which are maintained at the Baker Field Trailer), 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 cardio pulmonary resuscitation (CPR).

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

8.4 Communications/Telephone Numbers

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

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

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

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

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

Hand gripping throat (typically Level C/B activities)	Can't breathe
Grip partner's wrist or both hands around waist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	OK, I am all right, I understand
Thumbs down	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, located in the "Tables" section at the end of this HASP.

8.5 Assembly Area

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

- Assembly for evacuated personnel
- First aid for injured personnel

- Decontamination material
- Communications

8.6 Emergency Hospital Route

An emergency hospital route map (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, North Carolina
On-Base Telephone No.	(*9) 577-2240
Off-Base Telephone No.	(910) 577-2240

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

Local ambulance service is available from the Naval Ambulance Service and the City of Jacksonville.

Name	Naval Hospital (On Base) or City of Jacksonville (Off Base)
On-Base Telephone No.	911
Off-Base Telephone No.	(910) 455-9119 or 911

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 also will be familiar with Baker's program for potential exposure to bloodborne pathogens as outlined in the Baker Safety SOPs in Attachment A. Subcontractors will be responsible for securing proper medical attention for their employees. Baker may assist the subcontractor as necessary.

8.8.1 Physical Injury

If an employee working in a contaminated area is physically injured, first aid procedures are to be followed. If the employee can be moved, he/she will be taken to the edge of the work area and decontaminated, if necessary (refer to Section 8.9). Depending on the severity of the injury, emergency medical response from the local ambulance service 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. The emergency eyewash unit meets ANSI Standard 2358.1-1990.

  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 1-800-672-1697. Do not induce vomiting in an unconscious person. Obtain medical attention as directed by the Poison Control Center.

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

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. Again, if possible, identification of the spider should be carried out.

8.8.5 Ticks and Insect Bites

If a tick is found embedded in the skin, do not squash or burn it. Grasp the tick with fine-tipped tweezers, as close to the skin as possible, and pull slowly. Once the tick is removed, wash the area immediately with soap and water. Apply an antiseptic or antibiotic ointment if available. Observe the bite area periodically for signs of a rash around the site. Also, keep alert for flu like symptoms; these may be symptoms of Lyme Disease.

Insect bites are characterized by localized pain, potential stinger, swelling, and a possible allergic reaction. Care for an insect bite by scrapping away stingers, wash wound, cover with sterile gauze, apply a cold pack, and watch for signals of allergic reactions.

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/D+	Level C
• 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
- Tyvek® suits, polyethylene coated and uncoated
- Nitrile gloves (inner and outer)
- Neoprene and nitrile gloves (outer)
- Face shields and goggles
- SCBAs

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

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

Fire Extinguisher:	Baker Field Trailer and Contractor Field Vehicle
First aid kit:	Baker Field Trailer and Baker Field Vehicle
Personal eye wash bottle:	Baker Field Trailer and Baker Field Vehicle
Air Horn:	With Personnel
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 Base Fire Department, the Activity Contact, the Project Manager, and the NTR as soon as possible. The notification report will include:

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

8.12 Hazard Assessment

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

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

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

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

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

8.13 Security

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

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

8.14 Emergency Alerting

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

Personnel Injury in the Work Zone:

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

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

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

Personnel Injury in the Support Zone:

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

Fire/Explosion:

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

Personal Protective Equipment Failure:

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

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

Other Equipment Failure:

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

8.15 Training

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

8.16 Spill Containment Procedures

In the event that a small (less than the reportable quantity), easily-controlled spill of hazardous substances (e.g., gasoline, oil, etc.) occurs during the implementation of field activities, spill containment will be utilized to prevent the additional migration of contaminants through the site area. Large, uncontrolled spills will be handled by qualified response organizations under the direction of qualified Base personnel and/or Navy On-Scene Commander. Any release to soil or surface water equaling or exceeding the reportable quantities under CERCLA or the USEPA Clean Water Act will be reported to the MCB Camp Lejeune 911 emergency number and the Environmental Management Department 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 AND HAZARD COMMUNICATION REQUIREMENTS

Training requirements for site personnel are outlined in the following subsections.

9.1 General Worker Training

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

In addition to the 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.

9.2 Supervisor Training

Baker 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 8 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 the use the various Health and Safety Programs and to implement the elements of the HASP. The SHSO will be qualified as a supervisor.

9.3 Site Specific Training

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

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

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

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

9.4 Hazard Communication

In order to comply with 29 CFR 1910.1200, Hazard Communication Standard, the Baker written Hazard Communication Program will be available to site personnel upon request.

All containers of hazardous materials received on site will be inspected to ensure the following: (1) all containers will be clearly labeled as to the contents; (2) the appropriate hazard warnings will be noted; (3) the name and address of the manufacturer will be listed.

All secondary containers will be labeled with either an extra copy of the original manufacturer's label or with generic labels which have a block for identity and blocks for the hazard warnings.

Copies of MSDSs for all hazardous chemicals known or suspected to be on site will be maintained in the work area. MSDSs will be available to all employees for review during each work shift.

9.5 Recordkeeping

Training records relevant to safe operation of the site will be maintained by the SHSO for all Baker employees at the site.

10.0 MEDICAL SURVEILLANCE REQUIREMENTS

10.1 General

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

All Baker employees that will be engaged in site activities covered by the 29 CFR 1910.120 standard receive a Group III physical examination by a occupational health physician who has provided information on the individual's site activities and exposure or anticipated exposure levels. This exam is received initially upon hire, then once every 12 months thereafter. More frequent medical examinations, consultations, and/or laboratory testing will be provided if the examining physician determines that an increased frequency of examination is required. A complete Group III medical exam includes parameters such as height, weight, vision, temperature, blood pressure, and a complete review of occupational and medical histories. Other tests in a Group III exam include chest x-rays, electrocardiogram, spirometry, urinalysis, and blood tests. Table 10-1, located in the "Tables" section at the back of this HASP, 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.

Procedures to follow in the event of an exposure to a hazardous material/chemical are provided in Attachment C.

11.0 HEALTH AND SAFETY PLAN APPROVAL

This Draft HASP for the RI/FS activities at MCB Camp Lejeune Sites 90, 91, and 92 has been reviewed by the following personnel prior to the start of field activities.

Mr. Ronald W. Krivan	PHSO	
Name (Print)	Title	Signature
Mr. Matthew D. Bartman	Project Manager	
Name (Print)	Title	Signature
Mr. Raymond P. Wattras	Senior Reviewer	
Name (Print)	Title	Signature
Ms. Heather A. DeBolt	Site Manager	
Name (Print)	Title	Signature

12.0 DECLARATION OF HEALTH AND SAFETY PLAN REVIEW*

All site personnel indicated below have reviewed and are familiar with this HASP developed for the RI/FS activities at MCB Camp Lejeune, Sites 90, 91, and 92.

(Name-Print)	(Company)
(Signature)	(Date/Time)
(Name-Print)	(Company)
(Signature)	(Date/Time)
(Name-Print)	(Company)
(Signature)	(Date/Time)
(Name-Print)	(Company)
(Signature)	(Date/Time)
(Name-Print)	(Company)
(Signature)	(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 until demobilization.

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TABLES

TABLE 3-1
PHYSICAL & TOXICOLOGICAL PROPERTIES OF CHEMICALS
SITES 90, 91, and 92
MCB CAMP LEJEUNE

CHEMICAL COMPOUND (a)	HAZARD RATING (b)			VOLATILITY(c)	SKIN ABSORP. (d)	CARC. (e)	TWA (f)	STEL (g)	IDLH (h)	IP (i)
	H	F	R							
VOLATILE:										
Benzene	2	3	0	75	No	Yes	1 ppm	5 ppm	500 ppm	9.24
Ethylbenzene	2	3	0	7	No	No	100 ppm	125 ppm	800 ppm	8.76
Fuel Oil No. 2	0	2	0	<1	No	No	5 mg/m^3 (mist)	10 mg/m^3 (mist)	-	<11.7
Toluene	2	3	0	22	No	No	100 ppm	150 ppm	2,000 ppm	8.82
Xylene	2	3	0	7	No	No	100 ppm	150 ppm	900 ppm	8.56
CHLORINATED:										
1,1-Dichloroethane	2	3	0	182	No	No	100 ppm	-	3,000 ppm	11.06
1,1,1-Trichloroethane	2	1	1	100	No	No	350 ppm	450 ppm	700 ppm	11.00
1,1,2,2-Tetrachloroethane	2	0	0	5	Yes	Yes	1 ppm	-	100 ppm	11.10
METALS:										
Cadmium	3	1	0	NA	No	Yes	0.05 mg/m^3	-	-	NA
Chromium	2	1	1	NA	No	Yes	0.5 mg/m^3	-	-	NA
Lead	3	1	0	NA	No	Yes	0.05 mg/m^3	-	700 mg/m^3	NA

Notes:

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

TABLE 5-1

MONITORING EQUIPMENT AND FREQUENCY FOR EACH FIELD ACTIVITY CONDUCTED AT OU NO. 17

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

TABLE 8-1

EMERGENCY TELEPHONE NUMBERS

Facility	Phone Number On-Base Phone(1)	Phone Number Off-Base Phone(2)	Contact*
Security	911 or 2555	911 or (910) 451-2555	Response Operator
Fire (Camp Geiger)	0538	(910) 451-0538	Response Operator
Fire (MCAS)	911 or 6620	911 or (910) 451-6620	Response Operator
Fire (Hot Work Permit)	3004	(910) 451-3004	Fire Alarm Operator
Ambulance (On-Base)	911	(910) 451-3004 or (910) 451-3005	Base Fire Dept. Dispatcher
Ambulance (Off Base)	(*9) 455-9119	(910) 455-9119 or 911	Response Operator
Hospital Emergency Room (On-Base)	911 or 4840, 4841, 4842	(910) 451-4840 (910) 451-4841 (910) 451-4842	Ms. Jeanne Sleiertin or charge nurse of the day
Onslow County Hospital (Off Base)	(*9) 577-2240	(910) 577-2240	Response Operator
Emergency (One Call)	911	911 or (910) 451-9111 (910) 451-3004 (910) 451-3005	Response Operator Base Fire Dept. Dispatcher
On-Scene Coordinator	911	(910) 451-5815	Fire Chief
Environmental Management Division (EMD)	5068	(910) 451-5068	Mr. Neal Paul Mr. Tom Morris Mr. Mick Senus
EMD (after hours)	▨	(910) 346-4316	Mr. Tom Morris (home)
Public Works Department (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	1-404-639-0700	1-404-639-0700	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

(2) When using the mobile phone, which is programmed for the Pittsburgh area, use the phone numbers (including area codes) for an off-base phone.

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 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 occupational health physician as being chronically exposed to organic compounds.

FIGURES

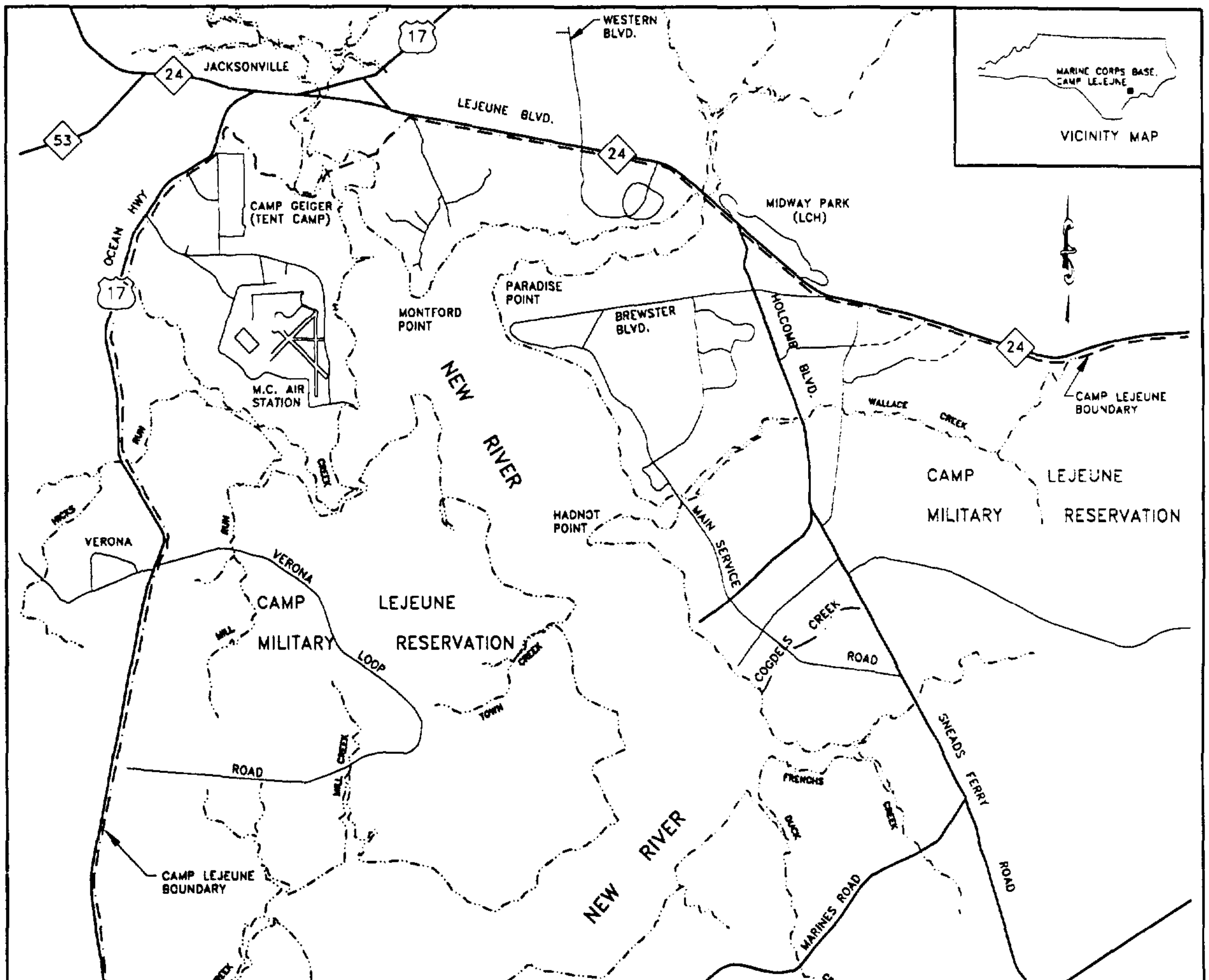

FIGURE 4-1
LOCATION MAP
SITES 90, 91, AND 92

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

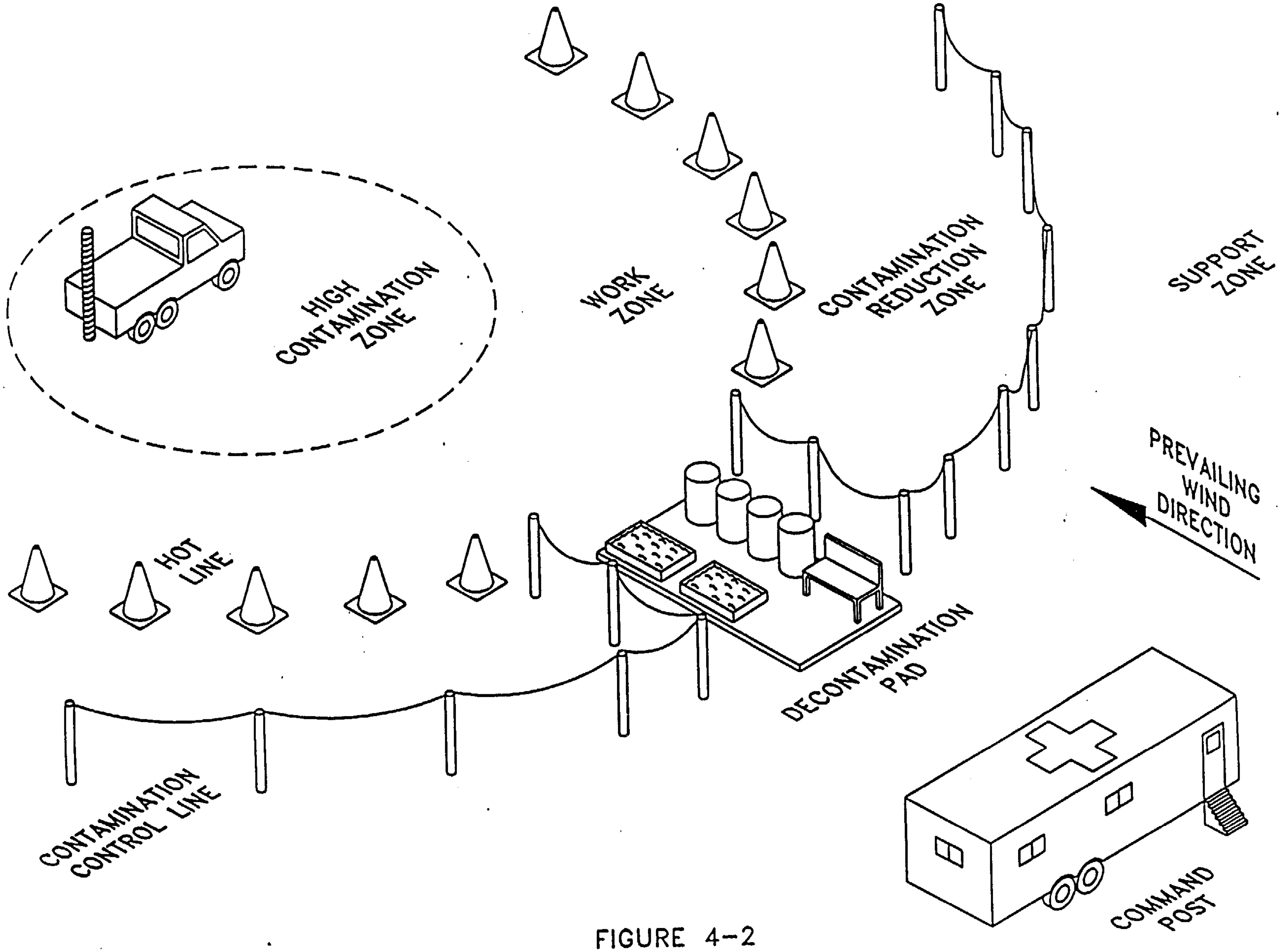

FIGURE 4-2
SCHEMATIC DIAGRAM
GENERAL CONTAMINATION
REDUCTION ZONE LAYOUT

Baker
Baker Environmental, Inc.

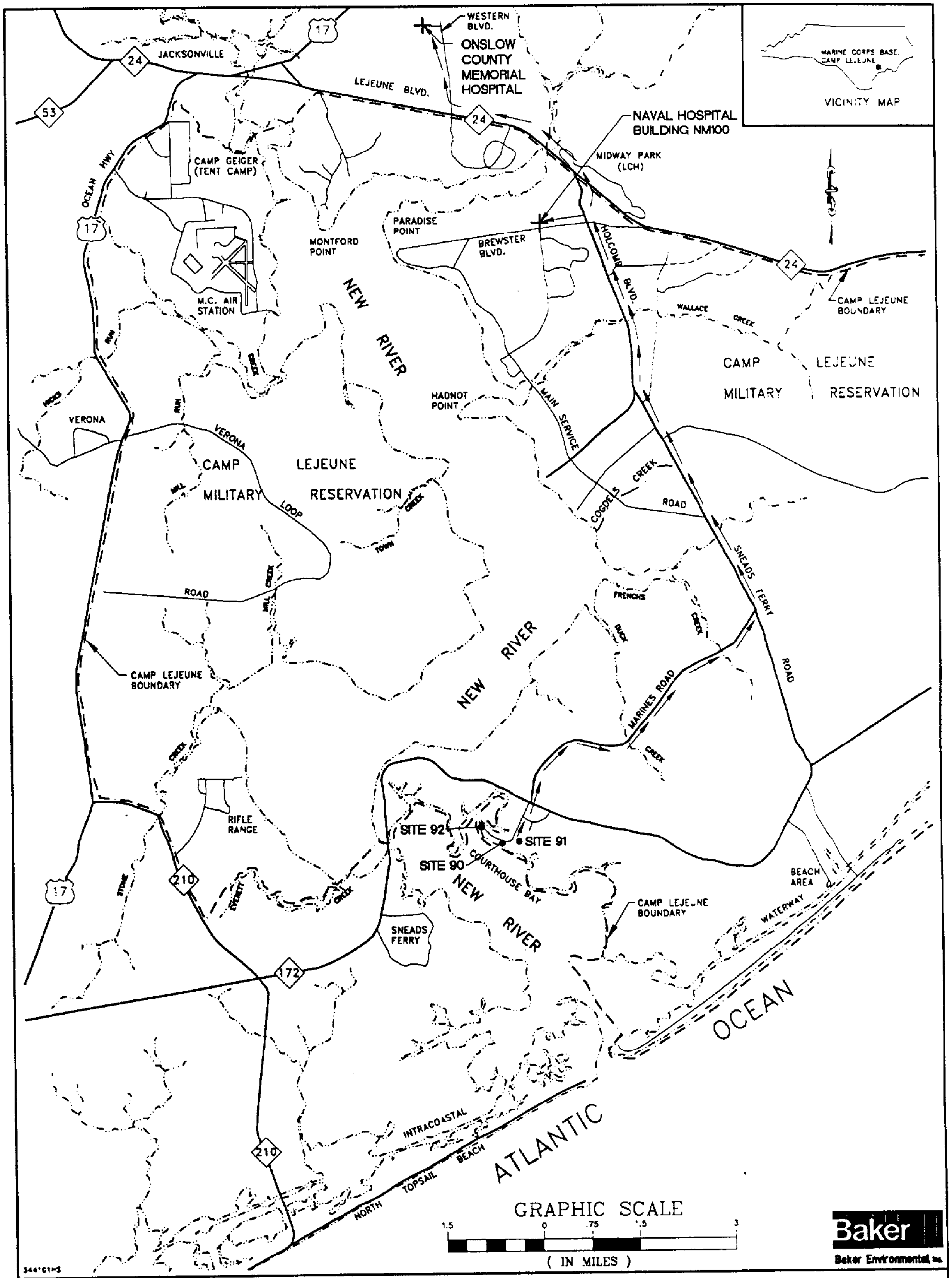

FIGURE 8-1
EMERGENCY HOSPITAL ROUTE
SITES 90, 91, AND 92

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

FIGURE 8-2

DIRECTIONS TO HOSPITAL FROM SITES 90, 91, and 92

Directions to Naval Hospital Building NM100 are as follows:

1a. From Site 90, proceed west on Clinton Street and turn right (north) onto Marines Road.
1b. From Site 91, proceed west on Poe Road and turn right (north) onto Marines Road.
1c. From Site 92, proceed east on Front Street and turn left (north) onto Marines Road.

2. Travel northeast on Marines Road for approximately 5-1/4 miles until intersecting with Sneads Ferry Road.

3. Turn left onto Sneads Ferry Road and travel for approximately 5 miles (at this point Sneads Ferry Road becomes Holcomb Boulevard).

4. Proceed on Holcomb Boulevard to Brewster Boulevard.

5. Turn left onto Brewster Boulevard and proceed approximately 3/4 of a mile.

6. Turn right, following directions to the emergency room entrance.

Directions to Onslow County Memorial Hospital are as follows:

1a. From Site 90, proceed west on Clinton Street and turn right (north) onto Marines Road.
1b. From Site 91, proceed west on Poe Road and turn right (north) onto Marines Road.
1c. From Site 92, proceed east on Front Street and turn left (north) onto Marines Road.

2. Travel northeast on Marines Road for approximately 5-1/4 miles until intersecting with Sneads Ferry Road.

3. Turn left onto Sneads Ferry Road and travel for approximately 5 miles (at this point Sneads Ferry Road becomes Holcomb Boulevard).

4. Proceed north on Holcomb Boulevard off base and onto Route 24 West.

5. Travel west on Route 24 for approximately 2-1/4 miles until intersecting with Western Boulevard.

6. Turn right onto Western Boulevard and proceed north until the fifth stoplight (approximately 1.5 miles).

7. Look for hospital on left.

8. Follow directions to emergency room entrance.

ATTACHMENT A
BAKER SAFETY STANDARD OPERATING PROCEDURES

ATTACHMENT A

BAKER ENVIRONMENTAL, INC.
SAFETY STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

*Not Applicable

Baker
Baker Environmental, Inc

2.0 - RESPIRATORY PROTECTION PROGRAM

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

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

2.1 PURPOSE

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

2.2 SCOPE

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

2.3 RESPONSIBILITY

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

2.4 HAZARD ASSESSMENT

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

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

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

2.5 TRAINING

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

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

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

2.6 TYPES OF RESPIRATORS

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

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

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

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

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

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

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

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

2.7 AIR QUALITY

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

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

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

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

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

2.8 CLEANING AND MAINTENANCE

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

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

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

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

2.9 INSPECTIONS

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

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

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

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

2.10 FIT-TESTING

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

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

2.11 MEDICAL SURVEILLANCE

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

2.12 LIMITATIONS

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

2.13 SUBCONTRACTOR REQUIREMENTS

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

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

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

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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: ____________________ Signed: ____________________
(Test Subject) (Technician/Instructor)

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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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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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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.

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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. <u>Introduction</u>

- 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. <u>Bloodborne Diseases</u>

- A. Types
- B. Modes of Transmission

III. <u>Baker Exposure Control Plan</u>

- 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.

7.0 - SAFE BOAT OPERATIONS

This Safe Boating Operations Program presents the Baker Environmental, Inc. (Baker) safe boat operating procedures. The elements addressed in this procedure include purpose, scope, responsibilities, equipment, terms, and general safe practices.

7.1 PURPOSE

The intent of the Baker Safe Boating Operations Program is to establish requirements for safe boat operating procedures to protect personnel from potential hazardous situations. This program is also designed to address elements of the United States (U.S.) Department of Transportation, U.S. Coast Guard Federal Requirements for Recreational Boats.

7.2 SCOPE

This program applies to Baker SRN projects in which Baker personnel may be involved with sampling activities from boats as part of their job duties. This program contains requirements for practices and procedures to protect these employees from the hazards of boating operations.

7.3 RESPONSIBILITY

The Baker SRN Project Health and Safety Officer (PHSO) and Project Manager are responsible for implementing and administering this Safe Boat Operations Program at project sites. The Baker Site Health and Safety Officer (SHSO), Site Manager, and field personnel are responsible to adhere to these procedures.

7.4 TERMS

Bailer - manual device (portable bilge pump, bucket scoop, etc.) for bailing water.

Bow - The forward part of a boat.

Port - The left side of a vessel as one faces the front or bow.

Starboard - The right hand side of a vessel as one faces the front or bow.

Stern - The rear or aft part of a boat.

Type I PFD - personal flotation device rating; it is effective for all waters, especially open, rough or remote waters where rescue may be delayed. It is designed to turn most unconscious wearers in the water to a faceup position.

Type II PFD - personal flotation device rating; intended for calm, inland water or where there is a good chance of quick rescue.

Type III PFD - personal flotation device rating, good for calm, inland water, or where there is a good chance of quick rescue. It is designed so wearers can place themselves in a face-up position in the water.

Type IV PFD - personal flotation device rating; throwable device intended for inland water with heavy boat traffic, where help is always present. It is designed to be thrown to a person in the water and grasped and held by the user until rescued. Type IV devices include buoyant cushions, ring buoys, and horseshoe buoys.

7.5 GENERAL SAFE PRACTICES

The following list consists of general safe practices during sampling activities from a boat. These safe practices are intended as a guideline for field personnel to recognize.

1. Safe boat operation training can be conducted during the site health and safety plan (HASP) pre-entry briefing. Training procedures for personal who will use a boat to conduct sampling at a minimum consist of the following dot listed items.

    - Fire safety - including fire extinguisher use
    - Distribution of weight and movement of personal inside the boat
    - Sounding distress or warning signals
    - Engine operation and mixing of fuel
    - Heat exposure
    - Rescue techniques
    - Sampling procedures

2. Personnel must be cognizant of current weather conditions by checking weather reports before leaving shore and watchful for signs of bad weather. Sampling from boats should not be conducted during inclement weather conditions, such as, heavy rains, electrical storms or flooding.

3. A minimum of two people should comprise the sampling crew, however, the maximum capacity rating for the boat should not be exceeded. Only one person should move on the boat at any one time.

4. The motor should be turned off during sampling, anchoring, or when entry or exit from the boat takes place.

5. Each Baker boat should be inspected annually by a qualified individual. These inspections should be documented and any safety concerns addressed before the boat is used on any other projects.

6. Equipment listed in Section 7.6 of this program should be maintained of the boat and inspected to assure good operating conditions.

7. PFDs must be Coast Guard-approved, in good and serviceable condition, and of appropriate size for the intended user. Wearable PFDs must be readily accessible, meaning the crew must be able to put them on in a reasonable amount of time in an emergency (boat sinking, on-board fire, etc.). The PFDs should not be stowed in

plastic bags, in locked or closed compartments or have other gear stowed on top of them.

8. All boating accidents must be reported to the Baker PHSO and Project Manager as soon as possible.

7.6 EQUIPMENT

The following equipment is required to be available on each boat.

- 2-pound ABC type fire extinguisher
- First aid kit
- Minimum of two oars
- Knife
- Type I, Type II, or Type III PFD for each crew member
- Bailer
- One Type IV throw flotation device with 50 feet of line
- Anchor with 75 feet of line
- Waste containers
- Safety kill switch connected to driver
- Air horn, flashlight and orange flag
- Poly-coated tyvek or rainsuit
- Towels

7.7 HYPOTHERMIA

The effects of cold water can cause hypothermia to the body within minutes. Signs and symptoms of hypothermia are:

- Shivering
- Loss of coordination
- Lethargy
- Coma

A poly-coated tyvek or rainsuit can be used to help maintain body temperatures while transporting back to shore any individual who had fallen overboard.

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.

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

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 677

1,1,2,2-TETRACHLOROETHANE

Issued: November 1988

SECTION 1. MATERIAL IDENTIFICATION 27

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

0
2 0
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Genium

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

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

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

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

R 1
I 4
S --
K --

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
1,1,2,2-Tetrachloroethane, CAS No. 0079-34-5 *This material can be absorbed through intact skin, which contributes to overall exposure. **See NIOSH, *RTECS* (KI8575000), for additional data with references to reproductive, tumorigenic, and irritative effects.	Ca 100	**OSHA PEL (Skin*)** 8-Hr TWA: 1 ppm, 7 mg/m^3 **ACGIH TLV (Skin*), 1988-89** TLV-TWA: 1 ppm, 7 mg/m^3 **Toxicity Data**** Human, Oral, TD_{Lo}: 30 mg/kg Human, Inhalation, TC_{Lo}: 1000 mg/m^3 (30 Mins) Rat, Oral, LD_{50}: 800 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point: 295°F (146°C)
Melting Point: -47°F (-44°C)
% Volatile by Volume: Ca 100
Vapor Pressure: 6 Torrs at 77°F (25°C)*

Molecular Weight: 168 Grams/Mole
Solubility in Water (%): Insoluble
Specific Gravity (H_2O = 1): 1.58658 at 77°F (25°C)

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

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

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature*	LEL*	UEL*

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

SECTION 5. REACTIVITY DATA

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

SECTION 6. HEALTH HAZARD INFORMATION

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

SECTION 6. HEALTH HAZARD INFORMATION, cont.

tremors, sensation of deafness, numbness in hands and feet, a decrease in reflexes, headache, and nausea. FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. Skin. Rinse the affected areas with flooding amounts of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Keep the exposed person warm and at rest until medical help is available. **Ingestion.** Unlikely. Should this type of exposure occur, give the exposed person 3 glasses of water to drink and induce vomiting, then repeat this procedure. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Workers exposed to this liquid should be evaluated with a full battery of tests for the liver, kidneys, and CNS systems, as well as the blood.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, and provide adequate ventilation. Cleanup personnel must be properly clothed and equipped to protect the skin and eyes against any contact with the liquid as well as inhalation of its vapor (see sect. 8). Vacuum the spilled 1,1,2,2-tetrachloroethane and pump it into suitable containers for disposal. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
RCRA Waste, No. U209
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per the Clean Water Act (CWA), § 307 (a); and the Resource Conservation and Recovery Act (RCRA), § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of this liquid is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent skin contact with this liquid. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale 1,1,2,2-tetrachloroethane vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

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

Transportation Data (49 CFR 172.101-2)

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

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

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

Prepared by: PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: W Silverman, MD

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Sheet No. 316
Benzene

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

Section 1. Material Identification 32

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

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

NFPA

HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

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

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

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

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

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

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

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

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

Section 3. Physical Data

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

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

Section 4. Fire and Explosion Data

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

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

Section 5. Reactivity Data

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

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).
Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.
Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.
Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).
Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

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

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

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

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

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

Transportation Data (49 CFR 172.101, .102)

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

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

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

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

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

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Sheet No. 23
Cadmium Metal/Powder
Issued: 9/77 Revision: D, 5/93

Section 1. Material Identification

41

Cadmium Metal/Powder (Cd) Description: Occurs naturally in the mineral greenockite (cadmium sulfide). This form is rare and most cadmium is obtained by extraction from other ores containing it as a mineral (lead, copper, and zinc). Zinc sulfide ores are the main source; by direct distillation or recovery from the electrolytic process. Used in electroplating other metals, fire protection systems, nickel-cadmium storage batteries, power transmission wire, TV phosphors, pigments for ceramic glazes, machinery enamels, baking enamels, photography and lithography, selenium rectifiers, electrodes for cadmium-vapor lamps, and photoelectric cells; as a fungicide and a Weston standard cell control of atomic fission in nuclear reactors.

Other Designations: CAS No. 7440-43-9, colloidal cadmium.

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

Cautions: Cadmium is a highly toxic metal. Symptoms may be delayed several hours and include pulmonary edema (fluid in lungs) which can be fatal. Chronic effects include kidney damage. Cd is considered a carcinogen by several government agencies. The powder is pyrophoric and presents a significant fire/explosion hazard.

Powder

HMIS				
H	3*	R	3	1
F	1	I	4	3 3
R	3	S	2	–
		K	3	

Genium

Solid

HMIS				
H	3*	R	1	0
F	0	I	4	3 0
R	0	S	2	–
		K	1	

*Chronic effects PPE-Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Cadmium, ca 100%

1992 OSHA PEL
8-hr TWA: 5 μg/m^3

1992 OSHA SECAL*
TWA: 15 or 50 μg/m^3

1990 IDLH Level
50 mg/m^3

1993-94 ACGIH TLVs
TWA: 0.01 mg/m^3 (total dust), Class A2 carcinogen
TWA: 0.002 mg/m^3 (respirable fraction)

1991 DFG (Germany) MAK
None established

1992 NIOSH REL
Carcinogen, keep as low as possible

1992 Toxicity Data†
Human, inhalation, LC$_{Lo}$: 39 mg/m^3/20 min caused cardiac changes, thrombosis, and respiratory depression.
Rat, oral, LD$_{50}$: 225 mg/kg; details not reported.
Woman, inhalation, LC$_{Lo}$: 129 μg/m^3 for 20 continuous years produced lung tumors.
Man, TC$_{Lo}$: 88 μg/m^3/8.6 years caused kidney and ureter toxicity with protein in the urine.

* Separate engineering control limit: to be achieved in processes and work places where it is not possible to achieve the PEL through engineering and work practices alone. The SECAL for Cd is 15 or 50 μg/m^3 depending on the processes involved. See Federal Register 57 (178): 42222, Table VIII-B1, 9/14/92.
†See NIOSH, *RTECS* (EU9800000), for additional mutation, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 1409 °F (765 °C)
Melting Point: 610 °F (321 °C)
Vapor Pressure: 0.095 mm Hg at 609.6 °F (320.9 °C)
Refraction Index: 1.13
Mohs Hardness: 2.0
Molecular Weight: 112.4

Density: 8.642
Water Solubility: Insoluble
Other Solubilities: Soluble in nitric (rapidly), hydrochloric (slowly), and other acids. The solid is soluble in ammonium nitrate solution, but the powdered form undergoes an explosive reaction.

Appearance and Odor: Silver-white, blue-tinged, lustrous, odorless, soft metal that is easily cut with a knife. The powder is grayish-white.

Section 4. Fire and Explosion Data

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

Extinguishing Media: The solid metal is not flammable, but the finely divided powder is pyrophoric. As a rule, the more finely divided the powder is, the greater the potential for explosion. Use carbon dioxide, dry chemical, or sand. **Unusual Fire or Explosion Hazards:** Processes that create cadmium dust such as cutting, grinding, or welding present a serious explosion hazard in presence of ignition sources. Avoid creation of cadmium dust clouds. **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. Do not release runoff from fire control methods to sewers or waterways; dike for proper disposal.

Section 5. Reactivity Data

Stability/Polymerization: Cadmium easily tarnishes in moist air as it is oxidized to cadmium oxide. The solid is stable in dry air. The powder is pyrophoric. Cd becomes brittle at 176 °F (80 °C). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include ammonium nitrate (powdered Cd), hydrazoic acid, tellurium, zinc, ammonia, sulfur, selenium, nitryl fluoride, and oxidizing agents. **Conditions to Avoid:** Creation of Cd dust clouds, exposure to heat and ignition sources, and contact with incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of Cd can produce toxic cadmium oxide (CdO) fumes.

Section 6. Health Hazard Data

Carcinogenicity: The following agencies list Cd as a carcinogen: IARC Class 2A (probably carcinogenic in humans),(183) NTP Class 2 (reasonably anticipated to be a carcinogen),(169) and NIOSH Class X (carcinogen defined without further categorization),(183) ACGIH TLV-A2 (suspected human carcinogen),(183) EPA-B1 (Probable human carcinogen) and DFG MAK-A2 (unmistakably carcinogenic in animal experimentation only).(183)

Summary of Risks: Dust or fume inhalation generally results in acute symptoms delayed up to 24 hr. Effects include a flu-like syndrome similar to metal fume fever with chills, fever, and muscle pain in the back and limbs. Pulmonary edema (fluid in lungs) can develop after severe exposure and may result in death. If victim recovers, residual changes may include lung fibrosis (thickening) and vascular changes. Long-term exposure to Cd damages the liver and kidneys (accumulates, half-life = 7 to 30 yr). Proteinuria (protein in urine) of low molecular weight is the first sign of tubular dysfunction. Excess urinary glucose is also seen. Bone demineralization similar to osteoporosis (decreased bone density)...

Continue on next page

Section 6. Health Hazard Data, *continued*

occurs *not* as a direct effect of Cd exposure, but indirectly by altering kidney regulation of calcium and phosphorus which are needed for strong, healthy bones. Some studies show a correlation between anemia (low hemoglobin in blood) and high Cd levels. Selenium (Se) and zinc (Zn) appear to suppress Cd toxicity; Se binds up Cd, preventing it from entering body tissue and Zn may compete for the same metabolic site. **Medical Conditions Aggravated by Long-Term Exposure:** Kidney, blood, or respiratory disorders. **Target Organs:** Blood, kidney, liver, respiratory system. **imary Entry Routes:** Inhalation, ingestion. **Acute Effects:** Inhalation may cause irritation of the eyes, nose, and throat, nausea and vomiting, abdominal colic, diarrhea, chest tightness, cough, headache, and weakness. Pulmonary edema could develop up to 24 hr post exposure. Kidney damage may occur after acute exposures, but is more likely with chronic exposure. **Chronic Effects:** Symptoms may be delayed several years after last exposure and include perforation of the nasal septum (tissue between the nostrils), loss of smell, chronic bronchitis, severe progressive emphysema, anorexia, insomnia, fatigue, pallor, anemia, kidney damage, bone demineralization, lung fibrosis and possible cancer of the respiratory tract.

FIRST AID

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

Skin: *Quickly* remove contaminated clothing. Wash exposed area with soap and water.

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

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of cadmium's irritating nature.

Note to Physicians: ß-2 microglobulin excretion of > 200 μg/g creatinine indicates kidney dysfunction as does a renal cortex [Cd] of 180 to 220 μg/g of wet kidney cortex. Blood Cd levels are *not* indicative of exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against inhalation. Carefully scoop up small spills and place in sealed impermeable containers. *Do not* disperse dust by sweeping. Remember that Cd powder can be pyrophoric and must be handled carefully. Prevent entry into sewers, drains, and 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

Listed as a RCRA Hazardous Waste (40 CFR 261.24): D006, Characteristic of Toxicity; regulatory level = 1.0 mg/L
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 10 lb (4.54 kg)† [* per CWA, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1027)

† No reporting of releases of this substance is required if the diameter of the pieces of the solid metal is equal to or exceeds 100 μm (0.004 in.)

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 any detectable concentration, use a SCBA or supplied air respirator (with auxiliary SCBA) with a full facepiece operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear gloves, boots, aprons, and gauntlets to prevent Cd dust from contacting skin. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL or SECAL (Sec. 2). Lunchroom facilities should not have concentrations above 2.5 $\mu g/m^3$ at any time. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes; launder before reuse. Remove Cd from shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using Cd, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage/Handling Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles. Do not allow cadmium dust to build up in storage area.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level.

Administrative Controls: Prohibit workers from removing Cd from protective clothing and equipment by blowing, shaking, or any other means that disperses Cd into the air. Employees must not enter eating facilities while wearing PPE unless it is vacuumed with a HEPA. Consider preplacement and periodic medical exams of exposed workers emphasizing the blood, kidneys, liver, and respiratory system. Educate workers on Cadmium's carcinogenicity.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Poisonous solids, n.o.s.*, Pyrophoric metals, n.o.s.†
DOT Hazard Class: 6.1*, 4.2†
ID No.: UN2811*, UN1383†
DOT Packing Group: III*, I†
OT Label: Keep away from food*, Spontaneously Combustible†
Special Provisions (172.102): — *, B11†

* Solid metal, † Powder

Packaging Authorizations
a) Exceptions: 173.153*, None†
b) Non-bulk Packaging: 173.213*, .187†
c) Bulk Packaging: 173.240*, .242†

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

Vessel Stowage Requirements
a) Vessel Stowage: A*, D†
b) Other: –

***MSDS Collection* References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 148, 159, 167, 169, 183, 185, 186
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** TW Thoburn, MPH, MD

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Sheet No. 83
Chromium Metal/Powder

Issued: 3/81 Revision: A, 11/89

Section 1. Material Identification 30

Chromium Metal/Powder Description: Obtained from chrome ore, chromite ($FeCr_2O_4$), by electrolysis of chromium solutions, by direct reduction (ferrochrome), and by reducing the oxide with finely divided carbon or aluminum. Used for chromeplating other metals; for greatly increasing metal resistance and durability; in manufacturing chrome-steel or chrome-nickel-steel alloys (stainless steel); as a constituent of inorganic pigments; as protective coating for automotive and equipment accessories; and in nuclear and high-temperature research.
Other Designations: Chrome; Cr; CAS No. 7440-47-3.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.

R 1
I 4
S 1
K 1

Genium
1
2 1
-

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

Section 2. Ingredients and Occupational Exposure Limits

Chromium metal/powder, ca 100%

OSHA PEL	ACGIH TLV, 1988-89*	NIOSH REL, 1987†	Toxicity Data‡
8-hr TWA: 1 mg/m³	TLV-TWA: 0.5 mg/m³	8-hr TWA (for chromium metal and insoluble salts): 1 mg Cr/m³	Rat, implant, TD_{Lo}: 1200 µg/kg body weight administered intermittently over six weeks

* This TLV is applicable to Cr^{+2} and Cr^{+3} compounds. For water soluble and water-insoluble Cr^{+6}, the 8-hr TWA is 0.05 mg Cr^{+6}/m^3. Certain water-insoluble Cr^{+6} compounds (zinc chromate, calcium chromate, lead chromate, barium chromate, strontium chromate, and sintered chromium trioxide) are designated as A1a (human carcinogen).
† The NIOSH REL (10-hr TWA) for carcinogen Cr^{+6} compounds is 1 µg/m³; for noncarcinogenic Cr^{+6} compounds (including chromic acid), the RELs (10-hr TWAs) are 25 µg/m³ and 50 µg/m³ (15-min ceiling). The noncarcinogenic compounds include mono- and dichromates of hydrogen, cesium, sodium, lithium, potassium, rubidium, ammonia, and Cr^{+6} (chromic acid anhydride). Any and all Cr^{+6} materials excluded from the noncarcinogenic group above are carcinogenic Cr^{+6} compounds.
‡ See NIOSH, *RTECS* (GB4200000), for additional data with references to tumorigenic effects.

Section 3. Physical Data

Boiling Point: 4788 °F (2642 °C)
Melting Point: 3452 °F (1900 °C)
Vapor Pressure: 1 mm Hg at 2941 °F (1616 °C)
Vapor Density (Air = 1): 1.79

Atomic Weight: 51.996 g/mol
Specific Gravity (H_2O = 1 at 39 °F (4 °C)): 7.2 at 68 °F (20 °C)
Water Solubility: Insoluble

Appearance and Odor: Steel-gray, lustrous metal; no odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** Cloud, 1076 °F (580 °C); dust layer, 752 °F (400 °C)	**LEL:** Dust cloud explosion, 0.230 oz/ft³	**UEL:** None reported

Extinguishing Media: Use dry chemical or sand.
Unusual Fire or Explosion Hazards: Particle size and dispersion in air determine reactivity. Chromium powder explodes spontaneously in air, while chromium dust suspended in CO_2 is ignitable and explosive when heated.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

*One hundred percent of dust goes through a 74-µm sieve. A 140-mJ spark can ignite a dust cloud.

Section 5. Reactivity Data

Stability/Polymerization: Chromium is stable when properly handled and stored. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Chromium reacts readily with dilute, not nitric, acids to form chromous salts. It is soluble in acids (not nitric) and strong alkalis. Its powder is incompatible with strong oxidizing agents, including high O_2 concentration. Evaporation of mercury (Hg) from Cr amalgam leaves pyrophoric chromium. Finely divided Cr attains incandescence with nitrogen oxide, potassium chlorate, and sulfur dioxide. Molten lithium at 18 °C severely attacks Cr. Fused ammonium nitrate below 200 °C reacts explosively and may ignite or react violently with bromine pentafluoride.
Hazardous Products of Decomposition: Thermal oxidative decomposition of Cr can produce toxic chromium oxide fumes.

Section 6. Health Hazard Data

Carcinogenicity: The NTP and OSHA list chromium as a human carcinogen.

Summary of Risks: When ingested chromium is a human poison, with gastrointestinal (GI) effects. Chromium 3 (Cr^{+3}) compounds show little or no toxicity. Less soluble chromium 6 (Cr^{+6}) compounds are suspected carcinogens and severe irritants of the larynx, nasopharynx, lungs, and skin (Sec. 2). Chromic acid or chromate salts cause irritation of the skin and respiratory passage. Ingestion leads to severe irritation of the gastrointestinal tract, renal damage, and circulatory shock. Chromium metal (when heated to high temperatures) and insoluble salts are said to be involved in histological fibrosis of the lungs, which may progress to clinically evident pneumoconiosis. Exposure to chromate dust and powder can cause skin (dermatitis) and eye irritation (conjunctivitis).

Medical Conditions Aggravated by Long-Term Exposure: An incresed incidence of bronchogenic carcinoma occurs in workers exposed to chromate dust.

Target Organs: Respiratory system.

Primary Entry: Inhalation, percutaneous absorption, and ingestion.

Acute Effects: Acute exposures to dust may cause headache, coughing, shortness of breath, pneumoconiosis, fever, weight loss, nasal irritation, inflammation of the conjunctiva, and dermatitis.

Chronic Effects: Asthmatic bronchitis.

FIRST AID

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

Skin: Brush off chromium dust. After rinsing affected area with flooding amounts of water, wash it with soap and water.

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

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that conscious person slowly drink 1 to 2 glasses of water to dilute. Do not induce vomoting. A physician should evaluate all ingestion cases.

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

Physician's Note: Acute toxicity causes a two-phase insult: 1) multisystem shock due to gastrointestinal corrosivity and 2) hepatic, renal, hematopoetic insult. Treatment should use ascorbic acid as a neutralizer with gastric lavage. If the ingestion is substantial, exchange transfusions and/or consider hemodialysis. Treat allergic dermatitis with local cortisone or 10% ascorbic acid to reduce Cr^{+6} to Cr^{+3}. Ten percent EDTA in a lanolin base applied every 24 hr helps heal skin ulcers.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of large spills. Cleanup personnel should wear protective clothing and approved respirators. Remove heat and ignition sources. Provide adequate ventilation. Keep airborne dust at a minimum. Remove spills quickly and place in appropriate containers for disposal or reuse.

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

OSHA Designations

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

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

Section 8. Special Protection Data

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

Respirator: Wear a NIOSH-approved respirator if necessary. Wear an SCBA with a full facepiece when the particle concentration's upper limit is 50 mg/m^3.

Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.

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

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA standard (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by eliminating it at its source (Genium ref. 103).

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

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

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

Section 9. Special Precautions and Comments

Storage Requirements: Store material in cool, dry, well-ventilated area separate from acids and oxidizing agents. Seal and protect containers from physical damage. Keep away from heat or ignition sources.

Engineering Controls: Avoid dust inhalation. Practice good housekeeping (vacuuming and wet sweeping) to minimize airborne particulates and to prevent dust accumulation. Use nonsparking tools and ground electrical equipment and machinery.

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

MSDS Collection References: 1, 2, 26, 38, 80, 87, 88, 89, 100, 109, 124, 126

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD

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Sheet No. 830
1,1-Dichloroethane

Issued: 6/92

Section 1. Material Identification

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1,1-Dichloroethane (CH_3CHCl_2) Description: Derived by various methods; by direct chlorination of ethane, as a side product of chloral manufacture, by treating ethylene and chlorine with calcium chloride, by action of phosphorus chloride on acetaldehyde, and the reaction of hydrogen chloride and vinyl chloride at 20 to 55 °C in the presence of an aluminum, ferric, or zinc chloride catalyst. Found as an air contaminant in submarines and space craft. Its largest industrial use is in the production of 1,1,1-trichloroethane. Also used as a cleansing agent, degreaser, solvent for plastics, oils, and fats, grain fumigant, chemical intermediate; in insecticide sprays, rubber cementing, fabric spreading, paint and varnish removers, in ore flotation, vinyl chloride production, and as a coupling agent in anti-knock gasoline. Formerly used as an anesthetic.

Other Designations: CAS No. 75-34-3; assymetrical dichloroethane; chlorinated hydrochloric ether; ethylidene chloride; ethylidene dichloride.

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

Cautions: 1,1-Dichloroethane is volatile and highly flammable. It is irritating to the eyes and respiratory tract and inhalation of high concentrations causes an anesthetic effect.

R 1
I 3
S 2
K 4

NFPA
3
2 0
–

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

Section 2. Ingredients and Occupational Exposure Limits

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

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

1990 IDLH Level
4000 ppm

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

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

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

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

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

Section 3. Physical Data

Boiling Point: 135 °F (57.3 °C)
Melting Point: -143 °F (-96.98 °C)
Vapor Pressure: 230 mm Hg at 77 °F (25 °C)
Saturated Vapor Density (air = 1.2 kg/m^3 or 0.075 lbs/ft^3): 2.076 kg/m^3 or 0.129 lbs/ft^3
Refraction Index: 1.4166 at 68 °F (20 °C)
Surface Tension: 24.75 dyne/cm at 68 °F (20 °C)
Molecular Weight: 98.97
Specific Gravity: 1.174 at 68 °F (20/4 °C)
Water Solubility: Slightly, 0.5%
Other Solubilities: Very soluble in alcohol and ether, soluble in acetone, benzene, and fixed and volatile oils.
Relative Evaporation Rate (BuAc=1): 11.6
Odor Threshold: 49 to 1359 ppm; odor is not sufficient to warn against overexposure

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

Section 4. Fire and Explosion Data

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

Extinguishing Media: A Class 1B Flammable Liquid. For small fires, use dry chemical, carbon dioxide (CO_2), or "alcohol-resistant" foam. For large fires, use fog or "alcohol-resistant" foam. Water may be ineffective unless used as a "blanket".

Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Container may explode in heat of fire.

Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide only limited protection. If possible without risk, move container from fire area. Apply cooling water to sides of containers until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if this is impossible, withdraw from area and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers (explosion) or waterways.

* 22 °F (-5.5 °C), OC(148)

Section 5. Reactivity Data

Stability/Polymerization: 1,1-Dichloroethane is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Incompatible with strong oxidizers and forms acetaldehyde in contact with caustics. 1,1-Dichloroethane will attack some forms of plastics, rubber, and coatings.

Conditions to Avoid: Exposure to heat and ignition sources and contact with incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition of 1,1-dichloroethane can produce carbon dioxide (CO_2), irritating hydrogen chloride (HCl) and toxic phosgene ($COCl_2$) fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list 1,1-dichloroethane as a carcinogen. However, the National Cancer Institute has recommended caution due to analogy to other chloroethanes such as 1,2-dichlorothane which are shown to cause cancer in animals.

Summary of Risks: 1,1-Dichloroethane is irritating to the eyes and respiratory system. It causes varying degrees of central nervous system (CNS) disturbance depending on the concentration and duration of exposure. Liver and kidney toxicity is controversial.

Continue on next page

Section 6. Health Hazard Data, *continued*

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

FIRST AID *Emergency personnel should protect against contamination.*

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do *not* allow victim to rub or keep eyes tightly shut. Immediately consult an ophthamlologist. **Skin:** 1,1-Dichloroethane vaporizes easily and poses an inhalation hazard as well. *Quickly and carefully* remove contaminated clothing; *1,1-dichloroethane is flammable!* Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. After vomiting, give 2 tbsp activated charcoal in 8 oz water to drink.

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

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

Section 7. Spill, Leak, and Disposal Procedures

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

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

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

EPA Designations
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U076
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001 & CWA, Sec. 307(a)]

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

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH/MSHA-approved respirator. For < 1000 ppm, use any supplied-air respirator or SCBA. For < 2500 ppm, use any supplied-air respirator operated in a continuous flow mode. For < 4000 ppm, use any supplied-air respirator or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent repeated or prolonged skin contact. Polyvinyl alcohol is recommended as suitable material for PPG. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Thoroughly decontaminate personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles (Sec. 5). Label containers to indicate the contents' high flammability. Periodically inspect containers for cracks and leaks. To prevent static sparks, electrically ground and bond all equipment used in 1,1-dichloroethane manufacture, use, storage, transfer, and shipping.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level.

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

Transportation Data (49 CFR 172.102)

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

MSDS Collection **References:** 73, 89, 101, 103, 126, 127, 131, 132, 133, 136, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD

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Material Safety Data Sheets Collection:

Sheet No. 385
Ethylbenzene

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

Section 1. Material Identification 39

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

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

NFPA

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

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

Section 2. Ingredients and Occupational Exposure Limits

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

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

1990 IDLH Level
2000 ppm

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

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

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

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

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

Section 3. Physical Data

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

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

Section 4. Fire and Explosion Data

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

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

Section 5. Reactivity Data

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

Section 6. Health Hazard Data

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

Continue on next page

Section 6. Health Hazard Data

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

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface tension will cause it to spread over a large area of the lung tissue.

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

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

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** Shrimp (*Mysidopsis bahia*), LC_{50} = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC_{50} = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 1508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (450 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

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

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

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

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

Transportation Data (49 CFR 172.101)

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

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

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

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

***MSDS Collection* References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179

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

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Sheet No. 469
Fuel Oil No. 2

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

Section 1. Material Identification

Fuel Oil No. 2 Description: A mixture of petroleum hydrocarbons; a distillate of low sulfur content. Fuel oil no. 2 resembles kerosine. Used as a general-purpose domestic or commercial fuel in atomizing-type burners; as a fuel for trucks, ships and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.
Other Designations: CAS No. 68476-30-2, diesel oil.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

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S 2
K 2

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2
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-

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

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

Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 2*

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

* A complex mixture (<95%) of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons; sulfur content (<0.5%); and benzene (<100 ppm). [A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)].
† Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point Range: 363 to 634 °F (184 to 334 °C)
Viscosity: 268 centistoke at 100 °F (37.8 °C)
Specific Gravity: 0.8654 at 59 °F (15 °C)
Appearance and Odor: Brown, slightly viscous liquid.
Water Solubility: Insoluble
Pour Point:* <21 °F (-6 °C)

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

Section 4. Fire and Explosion Data

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

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

Section 5. Reactivity Data

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

Section 6. Health Hazard Data

Carcinogenicity: Although it has not assigned an overall evaluation to fuel oil No. 2, the IARC has evaluated distillate (light) fuel oils as not classifiable as human carcinogen (Group 3; animal evidence limited).

Summary of Risks: Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and time of exposure. Since intestinal absorption of longer chain hydrocarbons is lower than absorption from lighter fuels, a lesser degree of systemic effects and more diarrhea may result. When removed from exposed area, affected persons usually experience complete recovery. Hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result if oil is aspirated into the lungs. These results are more likely when vomiting after ingestion rather than upon ingestion, as is often the case with lower viscosity fuels. A comparative ratio of oral-to-aspirated lethal doses may be 1 pt vs. 5 ml. Prolonged or repeated skin contact may cause irritation of the hair follicles and may block the sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.

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

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

Primary Entry Routes: Inhalation, ingestion.

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

Chronic Effects: Repeated contact with the skin causes dermatitis.

FIRST AID

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

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

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

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

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

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

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Fuel oil no. 2 is an environmental hazard. Report large spills.

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

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.21): Ignitable waste
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

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

Section 8. Special Protection Data

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

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

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

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

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

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

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

Section 9. Special Precautions and Comments

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

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

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Fuel oil
DOT Hazard Class: Combustible liquid
ID No.: NA1993
DOT Label: None
DOT Packaging Exceptions: 173.118a
DOT Packaging Requirements: None

MSDS Collection **References:** 1, 6, 7, 12, 73, 84, 103, 126, 127, 132, 133, 136, 143

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

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Sheet No. 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.

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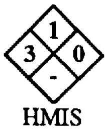

HMIS

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R	0
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* Sec. 8

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.

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
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Sheet No. 311
Methyl Chloroform

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

Section 1. Material Identification

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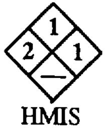
Methyl Chloroform ($C_2H_3Cl_3$) Description: Derived by catalytic addition of hydrogen chloride to 1,1-dichloroethylene or by re-fluxing chlorine monoxide with carbon tetrachloride and chloroethane. Available in technical and solvent grades which differ only in the amount of stabilizer added to prevent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

R	1
I	2
S	2*
K	1

Genium



HMIS

H	2
F	1
R	1
PPG*	

* Sec. 8

Other Designations: CAS No. 71-55-6, α-trichloroethane; Inhibisol; 1,1,1-trichloroethane; Strobane.

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

Cautions: Methyl chloroform is a skin, eye, and respiratory tract irritant and can become narcotic with an anesthetic effect at high concentrations.

* Data on skin absorption via methyl chloroform is conflicting.(133) Some studies show definite absorption where others don't.

Section 2. Ingredients and Occupational Exposure Limits

Methyl chloroform, ca 92 to 97%*

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

1990 IDLH Level
1000 ppm

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

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

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

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

* Methyl chloroform usually contains inhibitors (3 to 8%) to prevent corrosion of aluminum and some other metals. Typical inhibitors are nitromethane, butylene oxide, secondary butyl alcohols, ketones, and glycol diesters.

† See NIOSH, *RTECS* (KJ2975000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

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

Appearance and Odor: Colorless liquid with a sweetish, chloroform-like odor. The odor threshold is 44 ppm.

Section 4. Fire and Explosion Data

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

Extinguishing Media: *Noncombustible liquid* whose ***vapor*** burns in the presence of excess oxygen or a strong ignition source. For small fires, use dry chemical or carbon dioxide (CO_2). For large fires use fog or regular foam. If these materials are unavailable, a water spray may be used but be aware that water reacts slowly with methyl chloroform to release hydrochloric acid.

Unusual Fire or Explosion Hazards: Vapors are heavier than air and may travel to a strong ignition source and flash back. Air/vapor mixtures may explode when heated. Container may explode in heat of fire. Exposure to open flames or arc welding can produce hydrogen chloride and phosgene.

Special Fire-fighting Procedures: Methyl chloroform's burning rate is 2.9 mm/min. Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides limited protection. Wear clothing specifically recommended by the manufacturer for use in fires involving methyl chloroform. Apply cooling water to container sides until after fire is extinguished. Stay away from ends of tanks. Isolate area for 1/2 mile if fire involves tank, truck, or rail car. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Methyl chloroform is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can occur in contact with aluminum trichloride.

Chemical Incompatibilities: Methyl chloroform is incompatible with sodium hydroxide, nitrogen tetroxide, oxygen (liquid or gas), strong oxidizers, and chemically active metals like aluminum, zinc, and magnesium powders; reacts violently with caustics to form dichloroacetylene; reacts slowly with water to form hydrochloric acid; forms shock sensitive mixtures with potassium; and polymerizes in contact with aluminum trichloride.

Conditions to Avoid: Exposure to moisture, strong ignition sources, and arc-welding units, and contact with incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition (temperatures >500 °F, contact with hot metals, or under UV rays) of methyl chloroform can produce carbon dioxide (CO_2) and toxic dichloroacetylene, hydrogen chloride, and phosgene gases.

Section 6. Health Hazard Data

Carcinogenicity: The IARC (Class 3, inadequate evidence),(164) NTP,(142) and OSHA(164) do not list methyl chloroform as a carcinogen.

Summary of Risks: Methyl chloroform is considered one of the least toxic of the liquid chlorinated hydrocarbons. It is irritating to eyes, skin, and respiratory tract. Although low in systemic toxicity, methyl chloroform is an anesthetic capable of causing death at high concentrations (>15,000 ppm), generally in poorly ventilated, enclosed areas. Quick and complete recovery is observed after prompt removal of unconscious persons from area of exposure. Like many other solvents, methyl chloroform sensitizes the heart to epinephrine (blood pressure-raising hormone) and may induce cardiac arrhythmias and arrest.

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

Target Organs: Skin, eyes, central nervous (CNS) and cardiovascular (CVS) systems.

Continue on next page

Section 6. Health Hazard Data, *continued*

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

FIRST AID

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to rub or keep eyes tightly shut. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Inhalation: Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center, and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. When deciding whether to induce vomiting, carefully consider amount ingested, time since ingestion, and availability of medical help. If large amounts are recently ingested (absorption into the body is not yet likely to have occurred), and medical help or transportation to a medical facility is not readily available, induce vomiting. Otherwise, vomiting is not recommended since aspiration of vomitus can produce chemical pneumonitis.

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

Section 7. Spill, Leak, and Disposal Procedures

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

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

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

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

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U226

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

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

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

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

Section 8. Special Protection Data

Goggles: Wear splash-proof, protective chemical safety goggles or faceshields, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent repeated or prolonged skin contact. Viton and butyl rubber [with breakthrough times (BTs) of >8 hr and 4 to 7.9 hr, respectively] are recommended materials for protective gear. *Do not use* neoprene, polyvinyl chloride (PVC), natural rubber, or polyethylene because these materials have a BT of <1 hr.

Ventilation: Provide general and local exhaust (in some cases, explosion-proof) ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into work area by controlling it at its source.(103)

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

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

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

Section 9. Special Precautions and Comments

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

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. To prevent static sparks, electrically ground and bond all equipment used in methyl chloroform manufacturing, use, storage, transfer, and shipping.

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

Transportation Data (49 CFR 172.101, .102)

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

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

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

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Sheet No. 317
Toluene
Issued: 8/79 Revision: E, 9/92 Errata: 2/94

Section 1. Material Identification

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

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

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

NFPA

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

Section 2. Ingredients and Occupational Exposure Limits

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

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

1990 IDLH Level
2000 ppm

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

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

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

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

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

Section 3. Physical Data

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

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

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

Section 4. Fire and Explosion Data

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

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

Section 5. Reactivity Data

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

Section 6. Health Hazard Data

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

Continue on next page

Section 6. Health Hazard Data

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

Section 7. Spill, Leak, and Disposal Procedures

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

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

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

ection 8. Special Protection Data

Goggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 2000 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

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

Transportation Data (49 CFR 172.101)

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

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

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

Vessel Stowage Requirements
Vessel Stowage: B
Other: --

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
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Sheet No. 318
Xylene *(Mixed Isomers)*

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

Section 1. Material Identification

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

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

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

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

R 1
I 2
S 2
K 3

NFPA
3
2 0
–

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

Section 2. Ingredients and Occupational Exposure Limits

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

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

1990 IDLH Level
1000 ppm

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

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

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

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

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

Section 3. Physical Data

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

Appearance and Odor: Clear, sweet-smelling liquid.

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

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

Section 4. Fire and Explosion Data

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

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

Section 5. Reactivity Data

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

Section 6. Health Hazard Data

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

Continue on next page

Section 6. Health Hazard Data, *continued*

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

FIRST AID *Emergency personnel should protect against exposure.* **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing as it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. Monitor exposed person for respiratory distress. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, *do not induce vomiting!* If spontaneous vomiting should occur, keep exposed person's head below the hips to prevent aspiration (breathing liquid xylene into the lungs). *Aspiration of a few millimeters of xylene can cause chemical pneumonitis, pulmonary edema, and hemorrhage.* **Note to Physicians:** Hippuric acid or the ether glucuronide of *ortho*-toluic acid may be useful in diagnosis of *meta-*, *para-* and *ortho*-xylene exposure, respectively. Consider gastric lavage if a large quantity of xylene was ingested. Proceed gastric lavage with protection of the airway from aspiration; consider endotracheal intubation with inflated cuff.

Section 7. Spill, Leak, and Disposal Procedures

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

EPA Designations

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

OSHA Designations

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

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations >1000 ppm, use any chemical cartridge respirator with organic vapor cartridges; any powered, air-purifying respirator with organic vapor cartridges; any supplied-air respirator; or any self-contained breathing apparatus. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. With breakthrough times > 8 hr, consider polyvinyl alcohol and fluorocarbon rubber (Viton) as materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

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

Transportation Data (49 CFR 172.101)

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

***MSDS Collection* References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 176, 180.

Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

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 Teresa Nelson at (412) 269-4655. 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

Page 1 of 2

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)

Immediately with Exposure:

☐ Burning of eyes, nose, or throat
☐ Tearing
☐ Headache
☐ Cough
☐ Shortness of breath
☐ Delirium
☐ Chest tightness/pressure
☐ Nausea/vomiting
☐ Dizziness
☐ Weakness
☐ Heat flashes
☐ Other ______________

Delayed Symptoms:

☐ Weakness
☐ Nausea/vomiting
☐ Shortness of breath
☐ Cough
☐ Loss of appetite
☐ Abdominal pain
☐ Headache
☐ Numbness/tingling
☐ Other ______________

POTENTIAL EXPOSURE REPORT

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.