# Investigation Work Plan

## Closed Industrial Waste Unit
## Austin Community Landfill

Prepared by:

ThermoRetec Consulting Corporation
1301 West 25th Street, Suite 406
Austin, Texas 78705

ThermoRetec Project No.: 3-4198-300

Prepared for:

Waste Management of Texas
9900 Giles Lane
Austin, Texas 78754

Prepared by:

James Greacen, Senior Hydrogeologist

Technically Reviewed by:

~~Andrew J. Nietupski~~, Project Manager
Steve Dischler

July 29, 1999

F:\PROJECT\4000-199\4198\WP\300\workplanrevised.wpd

# Table of Contents


Executive Summary ..... ES-1

1 Introduction ..... 1-1
- 1.1 Project Objectives ..... 1-1
- 1.2 Work Plan Organization ..... 1-2

2 Site Background and History ..... 2-1
- 2.1 Site Description ..... 2-1
- 2.2 Site History and Operations ..... 2-1
- 2.3 Past Investigations ..... 2-6

3 Site Characterization ..... 3-1
- 3.1 Topography ..... 3-1
  - 3.1.1 Original Site Topography ..... 3-1
  - 3.1.2 Current Topography ..... 3-1
- 3.2 Site Structures ..... 3-1
  - 3.2.1 Buildings and Aboveground Structures ..... 3-1
  - 3.2.2 Utilities and Underground Structures ..... 3-4
  - 3.2.3 Limits of Waste ..... 3-4
- 3.3 Stratigraphy ..... 3-4
  - 3.3.1 Vertical Limits of Waste ..... 3-10
  - 3.3.2 Vertical Limits of Weathered and Unweathered Clay Layers 3-10
- 3.4 Hydrology and Hydrogeology ..... 3-10
  - 3.4.1 Hydrology ..... 3-10
    - 3.4.1.1 Site Drainage Features ..... 3-10
    - 3.4.1.2 Surface Water Flow ..... 3-13
  - 3.4.2 Hydrogeology ..... 3-13
- 3.5 Constituents ..... 3-14
  - 3.5.1 Closed Industrial Waste Unit Soils and Buried Wastes .... 3-14
  - 3.5.2 Groundwater ..... 3-18
  - 3.5.3 Surface Water ..... 3-19

4 Field Investigation ..... 4-1
- 4.1 Investigation Objectives ..... 4-1
  - 4.1.1 Fluids Investigation ..... 4-1
  - 4.1.2 Soil and Waste Investigation ..... 4-4
  - 4.1.3 Surface Water and Sediment Investigation ..... 4-5
- 4.2 Fluids Investigation ..... 4-5
  - 4.2.1 Well Installation ..... 4-5

4.2.1.1 Well Installation Within the Closed Industrial Waste Unit . . . . . 4-5
4.2.1.2 Well Installation Outside the Closed Industrial Waste Unit . . . . . 4-6
~~4.2.1.3 Recovery Well Installation . . . . . 4-6~~
4.2.2 Fluids Monitoring . . . . . 4-7
4.2.2.1 Fluid Level Measurements . . . . . 4-7
4.2.2.2 Fluids Sampling . . . . . 4-7
4.2.3 Hydraulic Conductivity Testing . . . . . 4-7
~~4.2.3.2 Sustainable Yield Test . . . . . 4-7~~
4.3 Soil and Waste Sampling . . . . . 4-8
4.3.1 Boring Installation . . . . . 4-8
4.3.2 Waste Characterization . . . . . 4-10
4.3.3 Soil Sampling . . . . . 4-10
4.4 Surface Water and Sediments Sampling . . . . . 4-11

5 Data Reduction and Reporting . . . . . 5-1
5.1 Data Reduction . . . . . 5-1
5.2 Data Validation . . . . . 5-1
5.3 Reporting . . . . . 5-2

6 Site Conceptual Model . . . . . 6-1
6.1 Potential Sources and Migration Pathways . . . . . 6-1
6.1.1 Solid Waste Material and Associated Leachate . . . . . 6-5
6.1.2 On-Site Subsurface Soil . . . . . 6-5
6.1.3 Seeps and Impacted Surface Soil . . . . . 6-5
6.1.4 Impacted Surface Water and Sediments . . . . . 6-5
6.1.5 Groundwater . . . . . 6-5
6.2 Potential Human Receptors and Exposure Pathways . . . . . 6-6
6.2.1 Current Land Use Scenario . . . . . 6-6
6.2.2 Future Land Use Scenario . . . . . 6-7
6.2.2.1 Waste Excavation . . . . . 6-7
6.2.2.2 Leachate Collection . . . . . 6-8

7 References . . . . . 7-1

# Appendices

Appendix A Sampling and Analysis Plan
Appendix B Health and Safety Plan

# List of Tables


| | | |
|---|---|---|
| Table 2-1 | Site History Summary Austin Community Landfill | 2-2 |
| Table 2-2 | Site Investigation Summary Austin Community Landfill | 2-7 |
| Table 3-1 | Partial Closed Industrial Waste Unit Disposal List | 3-16 |
| Table 3-2 | Previous VOC Samples | 3-17 |
| Table 4-1 | Fluids Level Monitoring Locations | 4-8 |
| Table 5-1 | Quality Assurance Sampling Summary Austin Community Landfill | 5-3 |
| Table 5-2 | Proposed Investigation Report Outline | 5-4 |
| Table 6-1 | Exposure Assessment - Current Risk Scenarios | 6-2 |
| Table 6-2 | Exposure Assessment - Future Risk Scenarios | 6-3 |
| Table 6-2 | Exposure Assessment - Future Risk Scenarios (Continued) | 6-4 |

# List of Figures


Figure E-1 Summary Historical Features/Proposed Sampling Locations ..... ES-2
Figure 2-1 Site Location ..... 2-3
Figure 2-2 Historic Site Layout - Source April 28, 1969 Aerial Photograph ... 2-4
Figure 2-3 Historic Site Layout - Source February 15, 1972 Aerial Photograph 2-5
Figure 3-1 Historic Surface Water Drainage - Source January 16, 1951 Aerial Photograph ..... 3-2
Figure 3-~~1~~2 Current Site Features ..... 3-~~2~~3
Figure 3-~~2~~3 Historical Features ..... 3-5
Figure 3-~~3~~4 Historical Waste Management Features ..... 3-6
Figure 3-~~4~~5 Historical Waste Management Features ..... 3-7
Figure 3-~~5~~6 1998 Electromagnetic Survey ..... 3-8
Figure 3-~~6~~7 Cross Section ..... 3-9
Figure 3-~~7~~8 Prior Investigations ..... 3-11
Figure 3-~~8~~9 Top of Unweathered Clay Surface ..... 3-12
Figure 3-~~9~~10 Potentiometric Surface Map ..... 3-15
Figure 4-1 Summary Historical Features/Proposed Sampling Locations ..... 4-3

# Executive Summary

Waste Management of Texas (WM) is implementing a program to manage industrial waste placed in the closed industrial waste unit at the Austin Community Landfill (ACL). The closed industrial waste unit is a 10.36 ~~26~~-acre portion of the 290-acre ACL that received industrial waste during 1971 and 1972, and was closed in 1973. Since that time, several investigations have been performed to determine the extent of the industrial waste and whether it is impacting areas outside the closed industrial waste unit. The investigation described in this work plan is the most extensive investigation assessing the nature and extent of the materials placed in the closed industrial waste unit to date.

The scope of work presented in this work plan was developed by ThermoRetec with input from the community. Data collected during this investigation will be used by WM to evaluate possible human health risks posed by the materials in the closed industrial waste unit and to identify the most appropriate method for long term management of the industrial waste.

Figure E-1 shows the ACL and the closed industrial waste unit near the center of the ACL. The closed industrial waste unit is surrounded by cells of municipal waste. The closed Travis County Landfill abuts the ACL to the south, and the Browning Ferris Industries (BFI) landfill abuts the ACL to the north. Prior investigations show that the buried industrial waste is present from 5 to 16 feet below the ground surface. The closed industrial waste unit is overlain by a clay cap constructed in 1973. Beneath the closed industrial waste unit is a clay liner underlain by over 200 feet of unweathered clay.

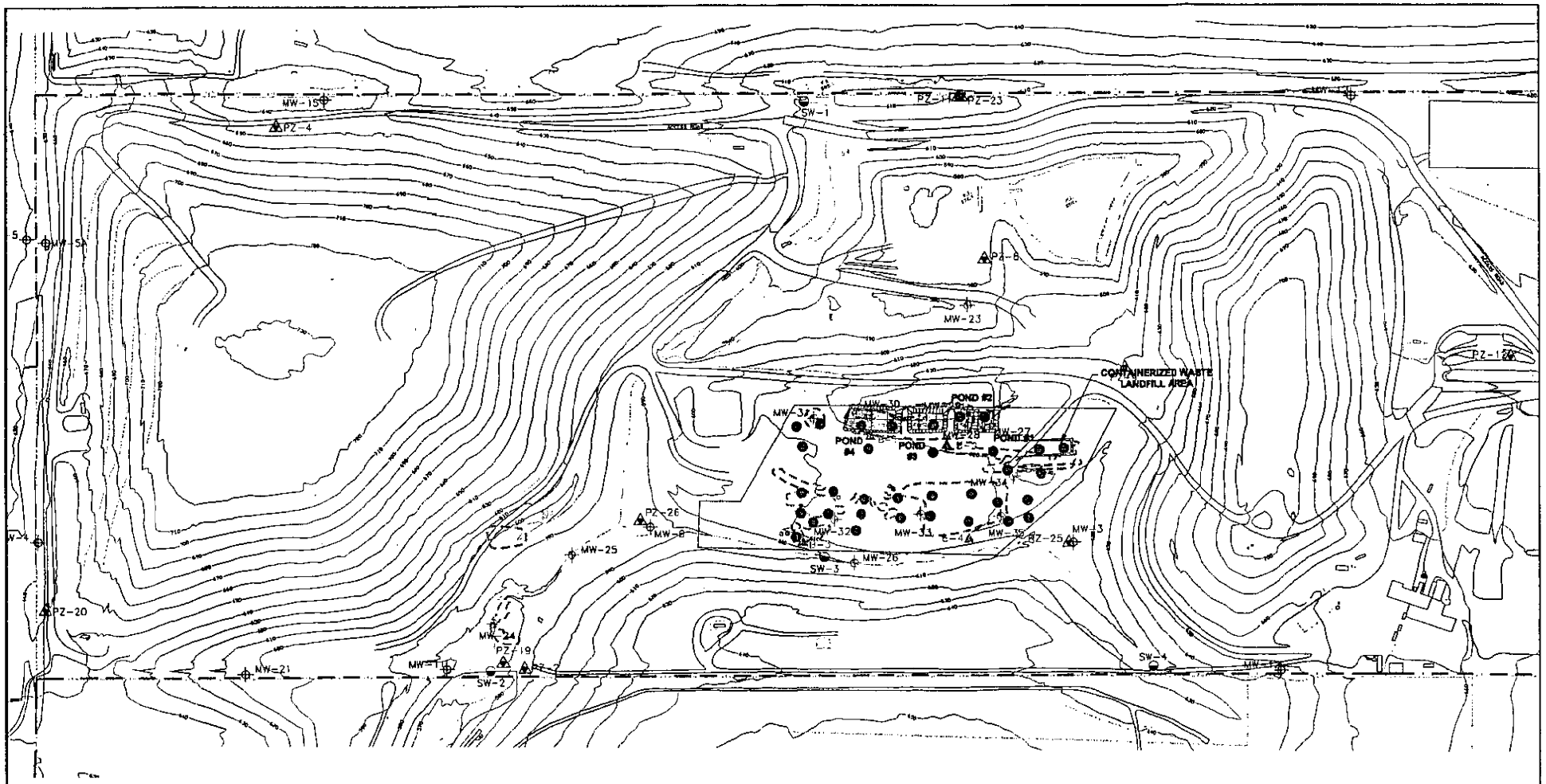
The field investigation described in this work plan consists of three components:

- a fluids investigation;
- a soil and waste investigation; and
- a surface water and sediments investigation.

A brief discussion of the three components of the field investigation, subsequent risk assessment, and remedial options evaluation is presented below.

### Fluids Investigation

The fluids investigation will determine if wastes contained within the closed industrial waste unit are or will affect fluids quality below and hydraulically downgradient of the closed industrial waste unit. The fluids investigation will




LEGEND

| | | | |
|---|---|---|---|
| ⊕ MW- | GW MONITORING WELL (EXISTNG) | ⊕ B- | DEEP BORINGS |
| ▲ PZ- | PIEZOMETER (EXISTNG) | ● | GEOPROBE BORING (FIRST ROUND) |
| ⊕ MW- | INVESTIGATION WELL (PROPOSED) | | WASTE MANAGEMENT FEATURE, FEBRUARY 4, 1972 |
| ◒ SW- | SURFACE WATER SAMPLING LOCATION (PROPOSED) | | 1998 TOPOGRAPHIC SURFACE |
| | | | 1998 SURFACE IMPROVEMENTS |
| | | | PROPERTY BOUNDARY |

APPROXIMATE BOUNDARY CLOSED INDUSTRIAL WASTE UNIT

AREA OF UNKNOWN OR SUSPECTED INDUSTRIAL WASTE MANAGEMENT, FEBRUARY 4, 1973

150 0 300

Scale 1" = 300'

ThermoRetec

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4198-300

CURRENT DATE 4/22/99 | CADD FILE | PROPOSED SL

**SUMMARY HISTORICAL FEATURES/ PROPOSED SAMPLING LOCATIONS**

**FIGURE E-1**

begin with the Geoprobe™ installation of 20 to 40 small diameter piezometers throughout the closed industrial waste unit. The exact number of Geoprobe™ borings required to determine the extent of the waste will be determined in the field. Data collected during installation of the piezometer will be used to identify the location of the waste and to determine whether the waste material is dry or wet. As shown in Figure E-1, nine investigation wells ~~and one pump test well~~ will be installed within the closed industrial waste unit. The investigation wells will be located in the former waste disposal areas and ponds identified through aerial photographs and other historical information. Samples collected from these wells will be analyzed for constituents specified in Appendix A ~~B~~, and will provide data to establish the fluids quality within the closed industrial waste unit. Hydraulic testing data collected from these wells will be used to evaluate the feasibility of draining the fluids out of the closed industrial waste unit. Four additional wells will be installed outside of the closed industrial waste unit to determine fluids quality and hydraulic properties downgradient of the closed industrial waste unit.

**Soil and Waste Investigation**

The soil and waste investigation will verify site stratigraphy, establish the limits of the industrial waste, characterize the waste, and determine whether constituents found within the closed industrial waste unit have migrated downward into the unweathered clay beneath the landfill. Soil samples will be collected during the installation of approximately 20 to 40 piezometers. This information~~, compiled with previously collected data,~~ will be used to establish the limits of industrial waste. Soil samples collected during the installation of the nine investigation wells within the closed industrial waste unit and the four investigation wells outside of the closed industrial waste unit will be analyzed for physical and chemical parameters as specified in Appendix A ~~B~~.

Within the closed industrial waste unit, four samples of the waste and five soil samples collected from former disposal areas and ponds will be analyzed so that the waste and surrounding soils can be characterized. Four soil samples will be collected at depth beneath the closed industrial waste unit and analyzed for any industrial waste constituent identified in fluids samples collected from the closed industrial waste unit. Soil samples collected from the clay cap overlying the industrial waste, the clay liner beneath the waste, and locations outside of the closed industrial waste unit will be analyzed for parameters used to determine the potential for migration of constituents away from the closed industrial waste unit.

**Surface Water and Sediments Investigation**

Four surface water samples and four sediment samples will be collected from drainage areas surrounding the closed industrial waste unit. These samples will be analyzed for any industrial waste constituents detected within the closed

industrial waste unit. These samples will be used to evaluate surface water and sediment quality upstream and downstream of the closed industrial waste unit.

### Risk Assessment and Remedial Options

The data collected during the field investigation will be shared with the community and will be used to prepare a risk assessment for the closed industrial waste unit. The risk assessment will be prepared in accordance with guidelines developed by the Texas Natural Resource Conservation Commission and the United States Environmental Protection Agency (EPA). The risk assessment will identify exposure pathways and receptors under current and future use conditions. Following completion of the waste characterization and risk assessment, WM will evaluate potential remedial options and determine the most appropriate method for long term management of the waste in the closed industrial waste unit. It is anticipated that a combination of remedial options will be utilized given the several distinct waste disposal activities which took place within the industrial unit. The results of the risk assessment will be shared with the community and community input will be solicited prior to selection of remedial options.

# 1 Introduction

In late 1997 and early 1998, the former Waste Management developed a plan to characterize the waste present in the Closed Industrial Waste Unit ~~(Closed Industrial Waste Unit)~~ and to evaluate the feasibility of removing the waste. The Closed Industrial Waste Unit is a 10.36 ~~26~~ acre portion of the 290 acre ACL. The planned work was to be performed under the provisions and supervision of the Municipal Solid Waste Division of the Texas Natural Resource Conservation Commission (TNRCC). Field work required to perform the waste characterization was performed in January 1998.

Following completion of the waste characterization, the new management of WM decided to perform a more comprehensive evaluation of potential remedial options for the Closed Industrial Waste Unit. In order to evaluate a broader range of remedial technologies than those originally proposed, WM determined that additional site information relating to waste, soil, leachate, surface water characteristics, and potential air emissions would be required. This work plan describes a field investigation program to gather the additional information required to screen potential remedial options for the Closed Industrial Waste Unit and to assess potential current and future risk caused by the waste.

Preparation and revision of this work plan has taken place with the involvement of state and local government representatives and the surrounding community. This involvement has included the following elements:

- presentation of WM's plans for the site in ~~a~~ town meetings;
- meetings with state and local government representatives including the City of Austin, Travis County, and TNRCC; and
- review of project documents by an independent, third party environmental consultant.

WM will to continue to seek community input and will continue community briefings for the duration of this project.

## 1.1 Project Objectives

As discussed previously, WM decided that additional information is required to assess the risk and to evaluate potential remedial technologies for the Closed Industrial Waste Unit. Specific areas that require additional evaluation include:

- the hydraulics and fluids quality within the Closed Industrial Waste Unit;
- determination of the limits of the waste
- the potential for migration of contaminants away from the Closed Industrial Waste Unit;
- human health risks associated with the Closed Industrial Waste Unit; and
- potential remedial options for the unit.

The purpose of the proposed investigation described in this work plan is to gather the information required to complete the evaluations described above.

## 1.2 Work Plan Organization

Section 2 of this work plan describes the history of the ACL and lists past investigations performed at the site since 1970. Section 3 summarizes the results of past investigations and describes ThermoRetec's understanding of site conditions which will be relevant to the planning of future remedial actions and the proposed investigation. Section 4 describes the specific objectives and provides a scope of work for the proposed investigation. Section 5 describes data reduction and reporting that will be performed once the investigation is complete. Section 6 presents the proposed scope of the risk assessment for the Closed Industrial Waste Unit. Section 7 lists the references cited in this work plan.

Appendix A is the Sampling and Analysis Plan. Appendix B is the Site Specific Health and Safety Plan.

# 2 Site Background and History

This section presents a summary of the site's background and history relevant to the planned investigation and risk assessment.

## 2.1 Site Description

As shown on Figure 2-1, the ACL facility is located east of Austin in Travis County. The ACL facility is a 290 acre municipal solid waste landfill which has been in operation since 1970. Figure 2-2, an April 1969 aerial photograph, shows the ACL area prior to development. To date, disposal cells have been constructed on 216 acres of the facility and an additional 74 acres will be used to expand the disposal area in the future. Figure 2-1 also shows the layout of the facility and the surrounding area. Two other landfills, the closed Travis County landfill and a facility operated by Browning Ferris Industries, are located adjacent to the ACL.

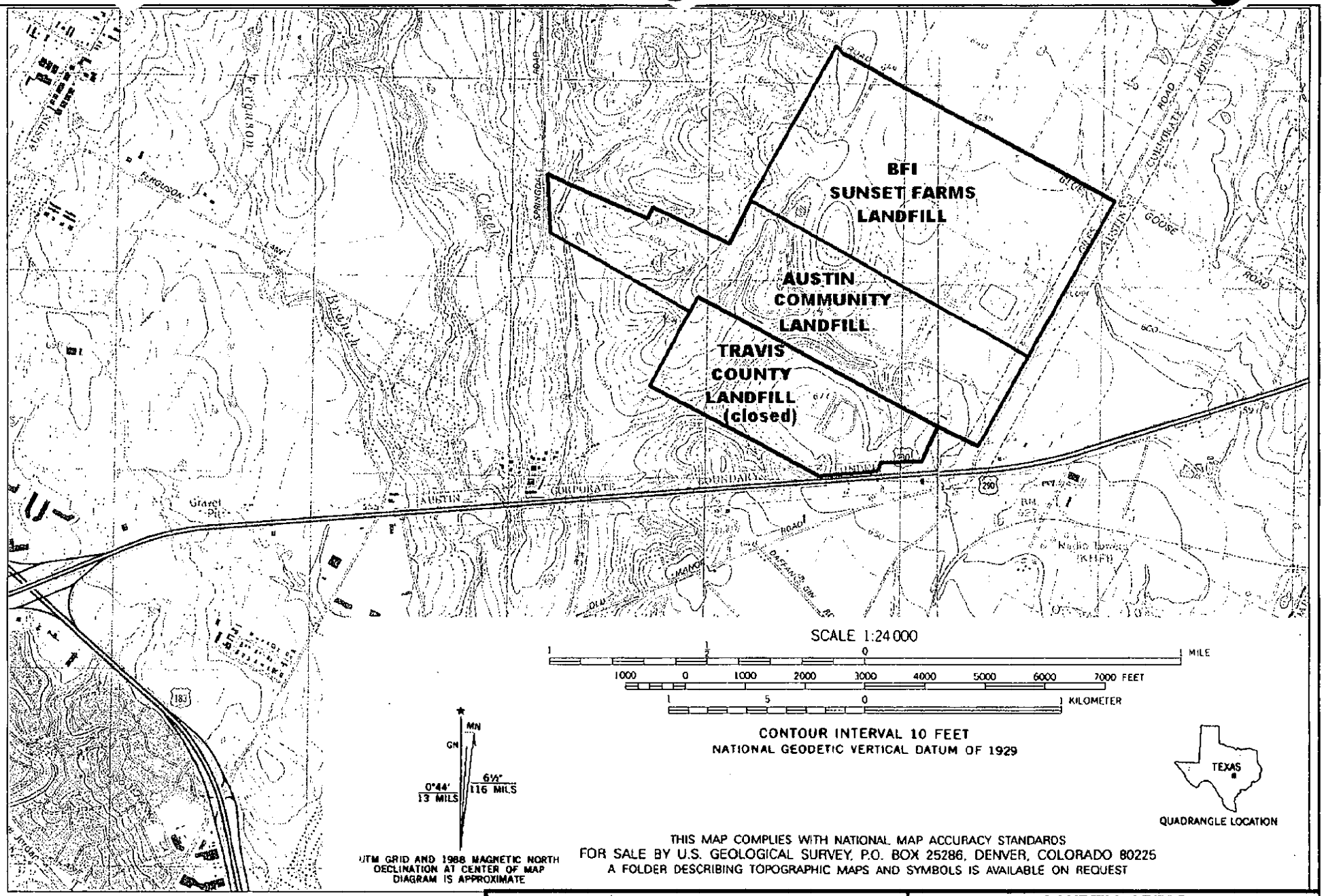
## 2.2 Site History and Operations

Table 2-1 presents a summary of some of the significant events in the history of the ACL. As shown on the table, a 108 acre portion of the ACL was first opened as a sanitary landfill by Universal Disposal starting in 1970.

Ownership of the landfill was transferred to Longhorn Disposal Service (LDS) from Universal Disposal in 1973. The state's approval to operate the landfill was transferred to LDS in 1974. LDS sold the ACL to Austin Community Disposal Company in 1978. Austin Community Disposal formed a new company, Longhorn Community Disposal (LCD), to operate the facility. LCD sold the landfill to Waste Management of America, currently known as Waste Management of Texas, in 1981. Starting early in 1971, the 10 36 ~~26~~ acre Closed Industrial Waste Unit, was used for the disposal of chemical wastes reported to include spent acids, spent caustics, spent solvents, paint residues, industrial process water, and waste hydrocarbons. Figure 2-3 depicts areas of known or suspected industrial waste management activities. Bulk liquids were disposed of in four, 10-foot deep, diked, *in situ* clay ponds. Pond No. 1, with a capacity of 206,000 gallons was used for the disposal of spent solvents and paint residues. Pond No. 2, with a capacity of 270,000 gallons, was used for the disposal of spent acids (principally sulfuric and hydrochloric acids) which were neutralized periodically with spent caustics or lime. Pond No. 3, with a capacity of 472,000 gallons, was the disposal site of industrial process wash water. Pond No. 4, the largest of the ponds with a capacity of 840,000 gallons, was used for the disposal of spent solvents and industrial process wash water. Bulk liquids that were disposed of in these ponds were allowed to evaporate (Wimberly, 1972).

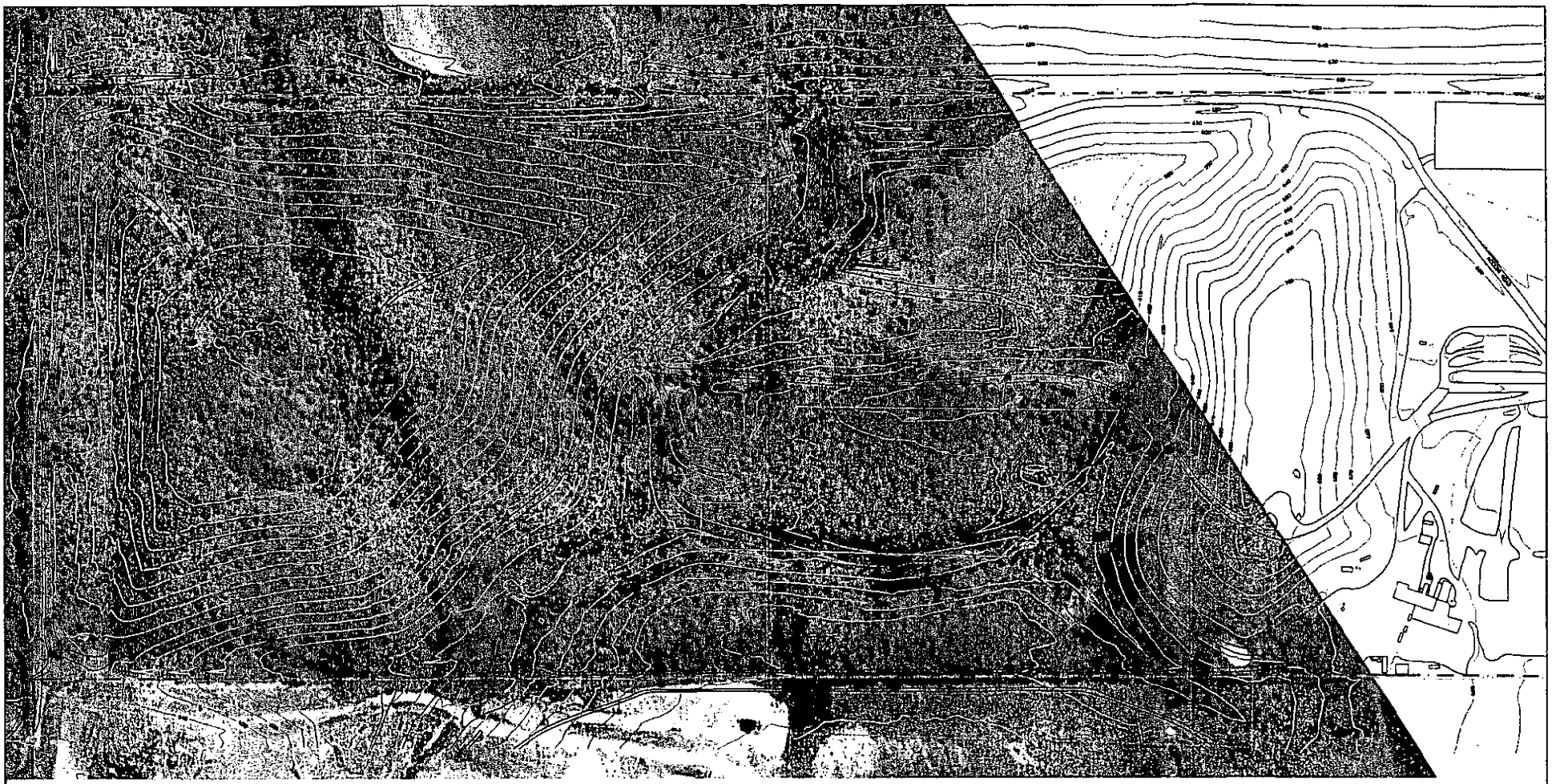
## Table 2-1 Site History Summary Austin Community Landfill

| Date | Event | Notes |
|---|---|---|
| Dec. 1970 | Sanitary landfill approval granted to Universal Disposal for 108 acre property | • Approval contingent on construction of rip rap dikes for drainage |
| May 1971 | Commercial industrial solid waste facility approval granted to Industrial Waste Materials Management ~~for 26 acre property~~ | |
| May 1972 | Texas Water Quality Board (TWQB) orders the end of chemical waste disposal at the Closed Industrial Waste Unit | |
| June 1972 | TWQB orders closure of the Closed Industrial Waste Unit | |
| Feb. 1973 | Implementation of TWQB closure requirements for Closed Industrial Waste Unit | • excavation of stained soil<br>• construction of a clay cutoff wall<br>• construction of a clay cap |
| July 1973 | Universal Disposal sold ACL to Longhorn Disposal Service, Inc. | |
| Oct. 1974 | Sanitary landfill approval transferred to Longhorn Disposal Service, Inc. | |
| March 1975 | Longhorn Disposal applies for a municipal solid waste landfill permit | |
| Sept. 1977 | Municipal solid waste landfill permit granted by Texas Department of Health (TDH) | |
| 1978 | Longhorn Disposal sold ACL to Austin Community Disposal Company, Inc. who formed Longhorn Community Disposal (LCD) | |
| 1979 | LCD applies for permit amendment to allow expansion of municipal solid waste landfill to 216 acres | |
| June 1980 | Seepage was observed in a landfill area south west of the Closed Industrial Waste Unit | |
| 1981 | LCD performs maintenance improvements in the Closed Industrial Waste Unit | • site grading and soil placement to promote drainage and prevent ponding<br>• placement of additional clay on the existing cap<br>• reseeding of portions of the existing cap |
| July 1981 | Permit amendment to allow landfill expansion granted by TDH | |
| Sept. 1981 | ACL sold to Waste Management of North America (presently, Waste Management of Texas) | |
| July 1988 | Permit amendment to allow installation of a gas collection system granted | |
| July 1991 | Permit amendment to allow additional 74 acre landfill expansion granted | |
| Dec. 1997 | Texas Natural Resource Conservation Commission (TNRCC) approves Waste Management of Texas' work plan to characterize materials stored in Closed Industrial Waste Unit | • Phase I study to characterize wastes for establishment of appropriate treatment and disposal options for Closed Industrial Waste Unit wastes |
| June 1998 | A sampling and analysis plan and a work plan for the removal of waste from the Closed Industrial Waste Unit were completed | |




ThermoRetec

| WASTE MANAGEMENT OF TEXAS, INC.<br>AUSTIN COMMUNITY LANDFILL<br>3-4198 | | | LANDFILL AREAS<br>USGS 7.5 MIN. QUADS<br>"AUSTIN EAST 1988 AND<br>MANOR 1988, TEXAS" |
|---|---|---|---|
| DATE: 4/99 | DRWN: BcV | FILE: 4198F001.prz | FIGURE: 2-1 |



| LEGEND | |
|---|---|
| | 1998 TOPOGRAPHIC SURFACE |
| | 1998 SURFACE IMPROVEMENTS |
| | PROPERTY BOUNDARY |
| | APPROXIMATE BOUNDARY INDUSTRIAL WASTE UNIT |

150 0 300

Scale 1" = 300'

N

ThermoRetec

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4166-300

| CURRENT DATE | 4/22/99 | CADD FILE | 022869 |
|---|---|---|---|

**HISTORIC SITE LAYOUT**
**SOURCE: APRIL 28, 1969**
**AERIAL PHOTOGRAPH**

**FIGURE 2-2**

~~used for the disposal of spent solvents and industrial process wash water. Bulk liquids that were disposed of in these ponds were allowed to evaporate (Wimberly, 1972).~~

Additionally, drummed wastes were buried at the site. Once a sufficient quantity of drums had accumulated, trenches were dug, drums were stacked inside them, and these drums were covered with three feet of soil (Wimberly, 1972). An estimated 21,000 drums of waste, the actual compositions of which are unknown, were buried at the Closed Industrial Waste Unit before operation ended in May 1972 (Carter & Burgess, 1999).

In 1975, the disposal of Type I municipal solid waste (MSW) began at the ACL site and the following year, the disposal of certain non-hazardous industrial wastes began. Additional landfill cells have been constructed by Waste Management since 1983 for disposal of MSW. The MSW disposal operations at the ACL site are presently active (Carter & Burgess, 1999).

Industrial waste disposal in the Closed Industrial Waste Unit ended in early 1972. The closure activities for the unit included removal of some stained soil identified in the area and installation of a clay cap overlying the area where industrial wastes were placed. In 1981, additional closure activities were performed to maintain the integrity of the containment of industrial wastes including site grading and soil placement to promote drainage and prevent ponding, placement of additional clay on the existing cap, and reseeding of portions of the existing cap.

## 2.3 Past Investigations

Table 2-2 presents a listing of past environmental and geotechnical investigations that have taken place at the ACL and a brief summary of their scopes. The findings of these investigations are summarized in Section 3.

## Table 2-2 Site Investigation Summary Austin Community Landfill

| Date | Investigation | Scope |
|---|---|---|
| 1970 | Proposed landfill subsurface Investigation, Trinity Engineering Testing Corporation (TETCO) | • four soil borings in proposed sanitary landfill area,<br>• collection of soil samples,<br>• analysis for geotechnical properties; |
| April 1972 | Texas Water Quality Board (TWQB) Inspection | • inspection of Closed Industrial Waste Unit; |
| April 1972 | Closed Industrial Waste Unit subsurface investigation, TETCO | • two soil borings in industrial waste landfill; |
| June 1974 | Landfill expansion investigation | • one soil boring in area of proposed landfill extension; |
| 1977 | Environmental investigation at the Closed Industrial Waste Unit , TWQB | • three test borings in drum disposal Site No. 1,<br>• collection of soil samples analysis of three soil samples for metals;<br>• analysis of soil samples for hydraulic conductivity; |
| 1979 | Engineering investigation, TETCO | • one boring in "Old Wet Weather Area,"<br>• collection of soil samples,<br>• laboratory analysis for geotechnical properties; |
| May 1980 | Geotechnical Investigation and Laboratory Analysis, Jack H. Holt, PhD. & Associates, Inc. (Holt) | • 17 soil borings in area of proposed landfill expansion,<br>• collection of soil samples;<br>• laboratory analysis for geotechnical properties and hydraulic conductivity; |
| July - August 1980 | Unknown investigation, Holt | • installation of 14 soil borings. |
| 1980 | Environmental investigation at the closed Closed Industrial Waste Unit, Texas Department of Water Resources (TDWR) | • collection of soil and groundwater samples,<br>• laboratory analysis for metals and organic compounds; |
| 1981 | Quarterly surface water monitoring | • collection of soil and surface water samples,<br>• laboratory analysis for water quality parameters; |
| 1982 | Unknown investigation, Underground Resource Management, Inc. | • installation of monitoring wells MW-1 and MW-2; |
| Unknown | Abandonment of three monitoring wells in Site No. 1 | |

| Date | Investigation | Scope |
|---|---|---|
| July 1986 | Geotechnical evaluation of Closed Industrial Waste Unit area, July 1986, McBride-Ratcliff & Associates (McBride) | • cone penetrometer testing at 20 locations |
| 1990 - 1992 | Comprehensive Hydrogeologic Assessment - Austin Community Type I Municipal Landfill - October, 1992, McBride | • installation of five piezometers,<br>• field permeability tests on weathered clay,<br>• hydraulic conductivity of unweathered clay measured. |
| 1994 | Unknown investigation, Holt | • installation of 21 piezometers. |
| 1995 | Engineering evaluation of Phase I area: | • installation of 30 soil borings,<br>• installation of 5 piezometers; |
| 1996 | Groundwater monitoring system installation expanded | • installation or conversion of 11 monitoring wells throughout the landfill,<br>• quarterly groundwater monitoring; |
| 1998 | Closed Industrial Waste Unit waste characterization, OHM Corporation (OHM) | • 20 soil borings,<br>• collection of soil and waste samples,<br>• laboratory analysis for metals, organic compounds, and pH; |
| Sept. 1998 | Closed Industrial Waste Unit geophysical investigation, RUST Environmental & Infrastruture, Inc. (RUST) | • low-frequency electromagnetic induction survey. |

# 3 Site Characterization

## 3.1 Topography

### 3.1.1 Original Site Topography

A 1951 aerial photograph of this area of Travis County shows that prior to the construction of the ACL, including the Closed Industrial Waste Unit, the topography consisted of a series of gently rolling hills separated by erosional valleys. Figure 3-2 ~~3-1~~ shows the t~~T~~hree prominent drainages that crossed this area and converged near, what would in later years be, the southern side of the ACL. United States Geological Survey (U.S.G.S.) 7.5 minute topographic quadrangle maps for Austin East Quadrangle (1966)~~(1996)~~, and Manor Quadrangle (1968) also show the three main drainages depicted on the 1951 aerial photograph. These topographic quadrangle maps show surface elevations across the pre-landfill area to range from 570 to 670 feet above mean sea level (msl).

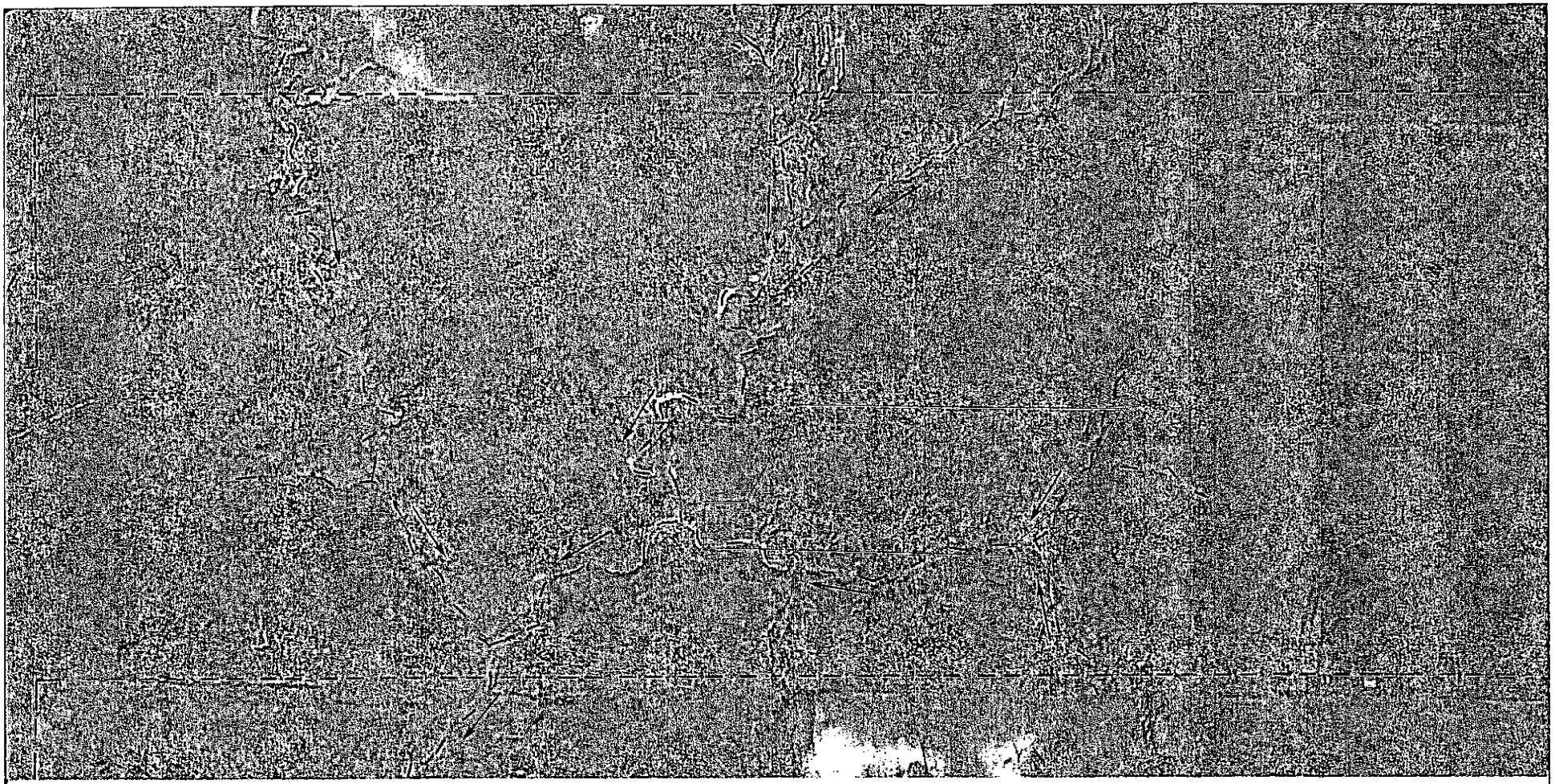
### 3.1.2 Current Topography

Figure 3-1 shows the topographic layout of the ACL in the vicinity of the Closed Industrial Waste Unit, as surveyed in 1998. In general, the topography of the ACL consists of man-made topographic highs along with certain areas that have been leveled (McBride, 1992). Typically, the slopes leading down to natural erosional valleys are more steeply sloped than they were originally. The current ground surface within the Closed Industrial Waste Unit ranges from an elevation of 598 feet msl in the southwest to 634 feet msl in the north-central portion of the area. The northern half of the Closed Industrial Waste Unit is typically between 621 and 634 feet msl (highest in the center) and the southern half has an elevation ranging from 598 to 618 feet msl. To the south and west of the Closed Industrial Waste Unit are small, intermittent streams located in erosional valleys, ranging in elevation from about 610 feet msl in the east to about 576 feet msl in the west.

## 3.2 Site Structures

### 3.2.1 Buildings and Aboveground Structures

At the present time no structures are located within the Closed Industrial Waste Unit. South of the Closed Industrial Waste Unit in the Phase I Area, are located (from west to east) a small gas condensate tank, a small gas flare station (about 25 x 20 feet), and a small condensate pump station. No other aboveground structures are located within 300 feet of the Closed Industrial Waste Unit.



LEGEND

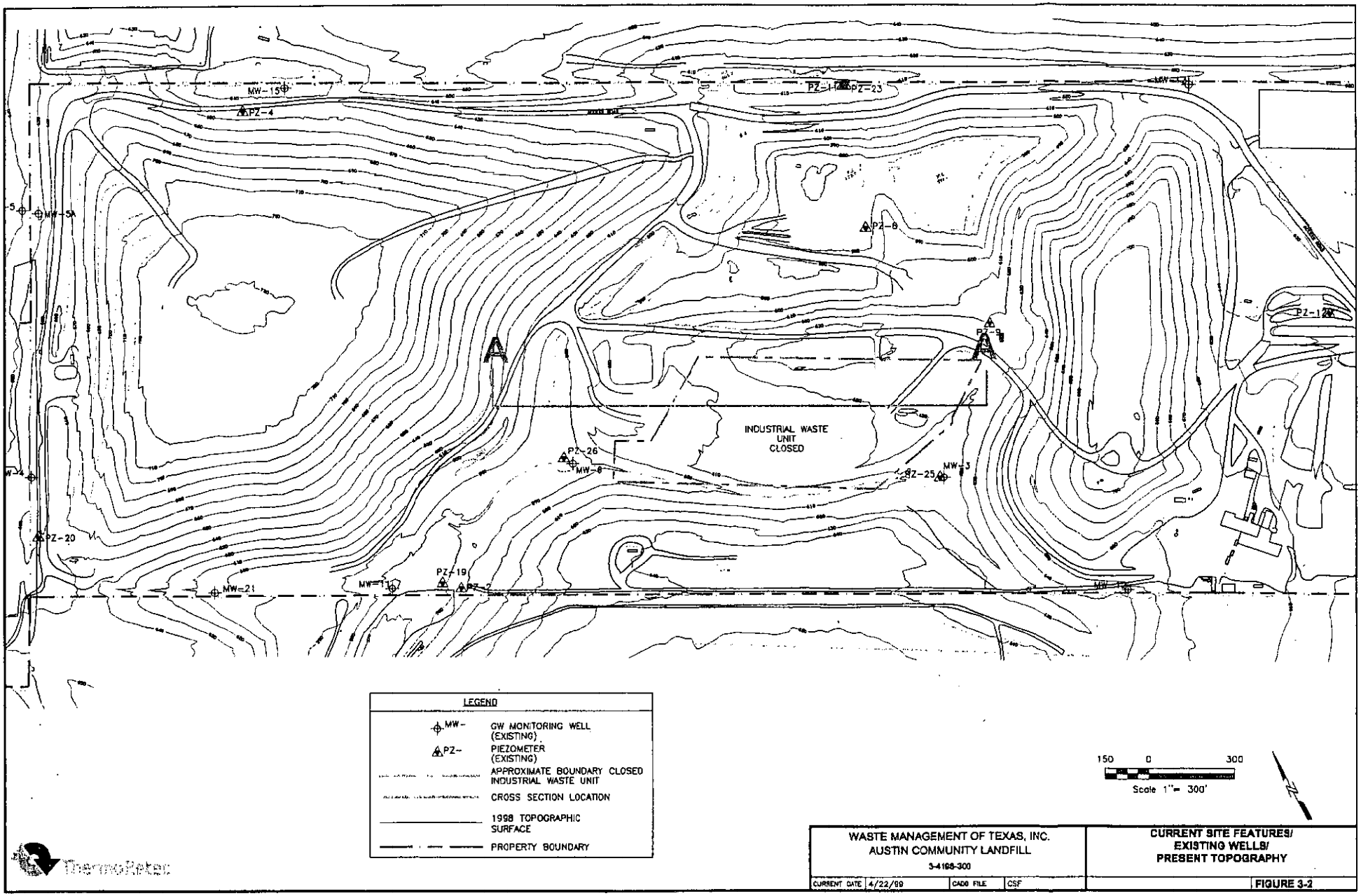
- CLOSED INDUSTRIAL WASTE UNIT
- HISTORIC SURFACE WATER DRAINAGE
- PROPERTY BOUNDARY
- DIRECTION OF FLOW

150 0 300

Scale 1" = 300'

Thermoretec

| | | | |
|---|---|---|---|
| WASTE MANAGEMENT OF TEXAS, INC.<br>AUSTIN COMMUNITY LANDFILL<br>3-4198-300 | | | HISTORIC SURFACE WATER DRAINAGE<br>SOURCE: JANUARY 16, 1951<br>AERIAL PHOTOGRAPH |
| CURRENT DATE 7/22/99 | CADD FILE 51 FLOW | | FIGURE 3-1 |


MW-15
PZ-4
PZ-23
MW-5A
PZ-8
PZ-9
PZ-12
INDUSTRIAL WASTE
UNIT
CLOSED
PZ-26
MW-6
PZ-25
MW-3
PZ-20
MW-21
PZ-19
PZ-7
LEGEND
MW- GW MONITORING WELL (EXISTING)
PZ- PIEZOMETER (EXISTING)
APPROXIMATE BOUNDARY CLOSED INDUSTRIAL WASTE UNIT
CROSS SECTION LOCATION
1998 TOPOGRAPHIC SURFACE
PROPERTY BOUNDARY
150 0 300
Scale 1"= 300'
N
ThermoRetec
WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4168-300
CURRENT DATE 4/22/99
CADD FILE CSF
CURRENT SITE FEATURES/
EXISTING WELLS/
PRESENT TOPOGRAPHY
FIGURE 3-2

### 3.2.2 Utilities and Underground Structures

The documentation ThermoRetec has reviewed does not show any utilities within the limits of the Closed Industrial Waste Unit. Existing monitoring wells in the vicinity of the Closed Industrial Waste Unit are shown in Figure 3-2 ~~3-1~~.

### 3.2.3 Limits of Waste

Figure 3-3 ~~3-2~~ shows the approximate limits of suspected industrial waste management areas in the vicinity of the Closed Industrial Waste Unit. These areas include:

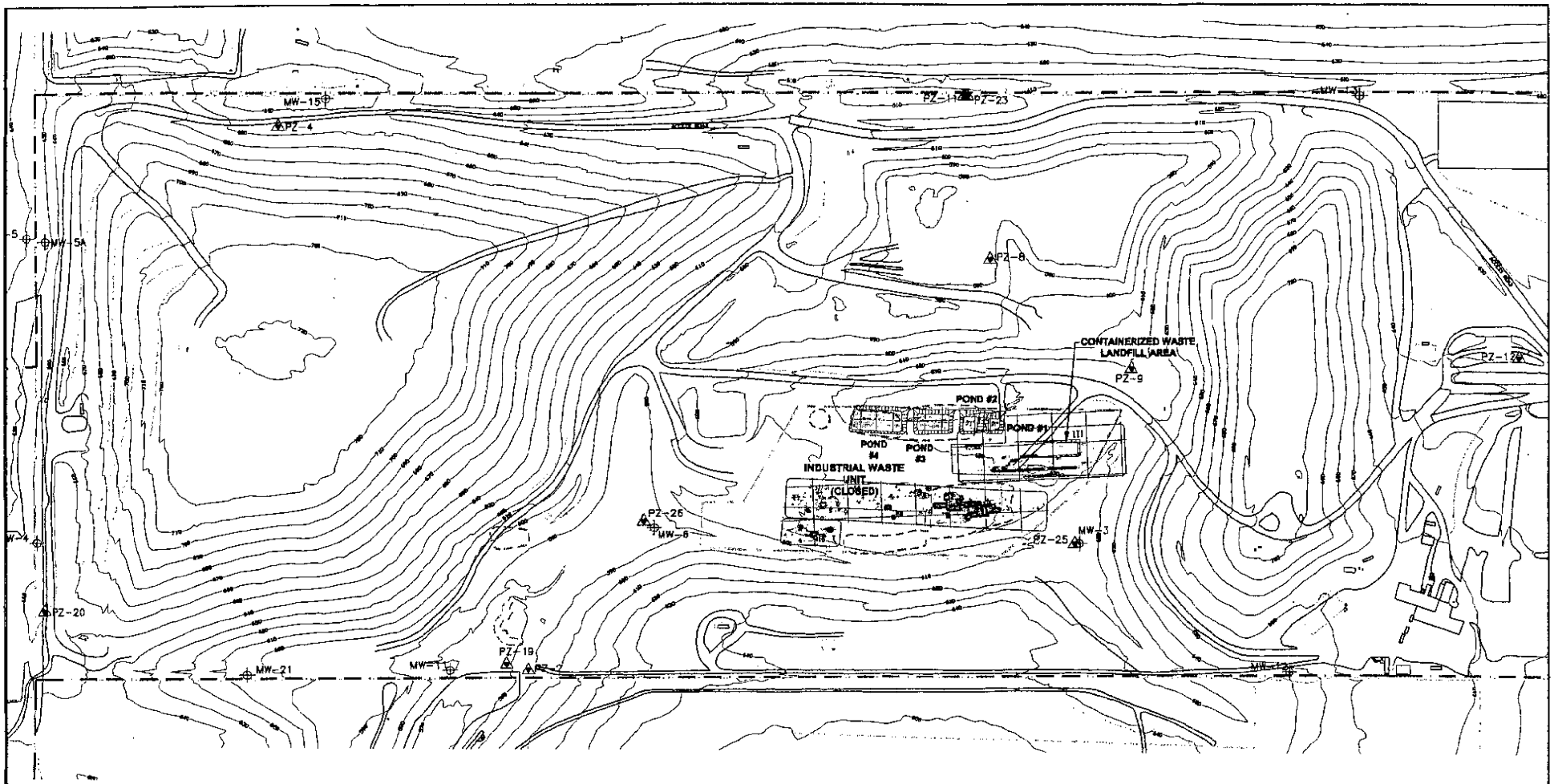
- four ponds identified in a 1972 engineering report (Figure 3-4 ~~3-3~~);
- four ponds described in Section 2.2, and identified in a February 4, 1973 aerial photograph of the ACL (Figure 3-5 ~~3-4~~).

Three additional areas where management of industrial waste may have taken place are also identified in the February 4, 1973 aerial photograph. Four suspected drum disposal areas identified from a review of historical records; and results of an electromagnetic (EM) survey conducted by RUST Environmental and Infrastructure (RUST) in September, 1998 (Figure 3-6 ~~3-5~~).

Each area was located on Figure 3-3 ~~3-2~~ by superimposing the 1972 engineering report, the February 4, 1973 aerial photograph and the results of the EM survey onto the ACL base map.

## 3.3 Stratigraphy

Figure 3-7 ~~3-6~~ shows a cross-section drawn through the southern portion of the Closed Industrial Waste Unit. The location of this cross section is shown on Figure 3-2 ~~3-1~~. Currently, the stratigraphy within the Closed Industrial Waste Unit consists of five stratigraphic units. An engineered clay cap (topped with topsoil) covers the entire area. Below the cap lies buried waste and naturally occurring or engineered clay. Below this clay/waste unit lies a natural, weathered clay layer. This clay, the upper part of the Taylor group, is described as a low permeability, tan-brown, heavily weathered clay, containing fractures, and some iron staining, gypsum, and pyrite. Below the weathered clay is an unweathered, hard, gray, very plastic clay with high calcium mineral content and very low permeability. The Taylor Clay at the ACL extends approximately 200 - 400 feet bgs. Beneath the unweathered clay lies bedrock, described as the Austin Chalk, a chalk and limestone, often with imbedded, fossilized shells (Carter & Burgess, 1999; McBride, 1992).







LEGEND

- MW- GW MONITORING WELL (EXISTING)
- PZ- PIEZOMETER (EXISTING)
- WASTE MANAGEMENT FEATURE, FEBRUARY 4, 1972
- 1998 TOPOGRAPHIC SURFACE
- 1998 SURFACE IMPROVEMENTS
- ELECTROMAGNETIC SURVEY RESULTS, SEPTEMBER 1998
- AREA OF UNKNOWN OR SUSPECTED INDUSTRIAL WASTE MANAGEMENT, FEBRUARY 4, 1973
- APPROXIMATE BOUNDARY CLOSED INDUSTRIAL WASTE UNIT
- PROPERTY BOUNDARY

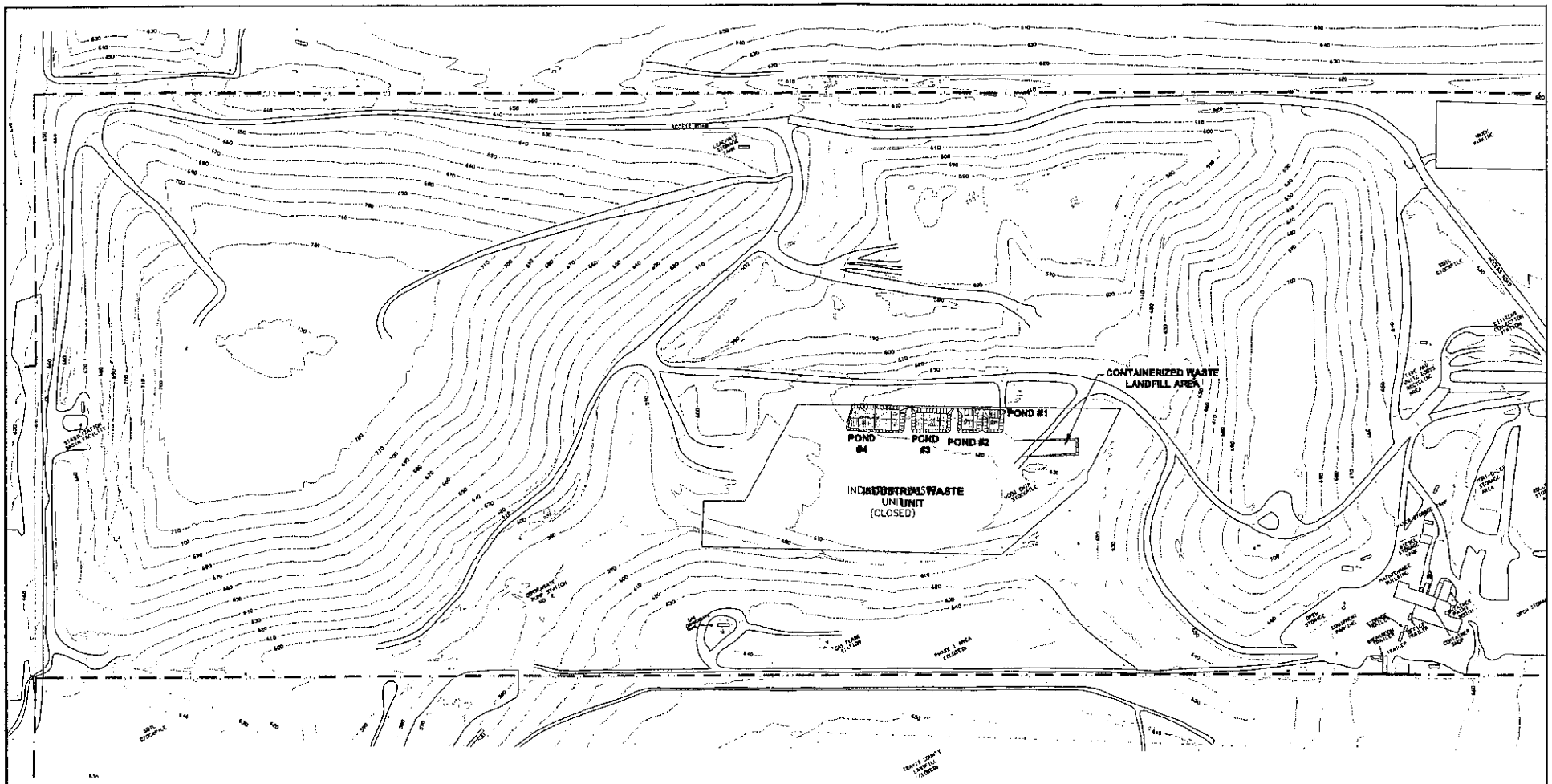
Thermoretec

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4136-300

CURRENT DATE 4/22/99 | CADD FILE | HISTORIC

**SUMMARY HISTORICAL FEATURES/ EXISTING WELLS**

**FIGURE 3-3**




LEGEND

- WASTE MANAGEMENT FEATURE
- 1998 TOPOGRAPHIC SURFACE
- 1998 SURFACE IMPROVEMENTS
- PROPERTY BOUNDARY
- APPROXIMATE BOUNDARY INDUSTRIAL WASTE UNIT

150 0 300

Scale 1" = 300'

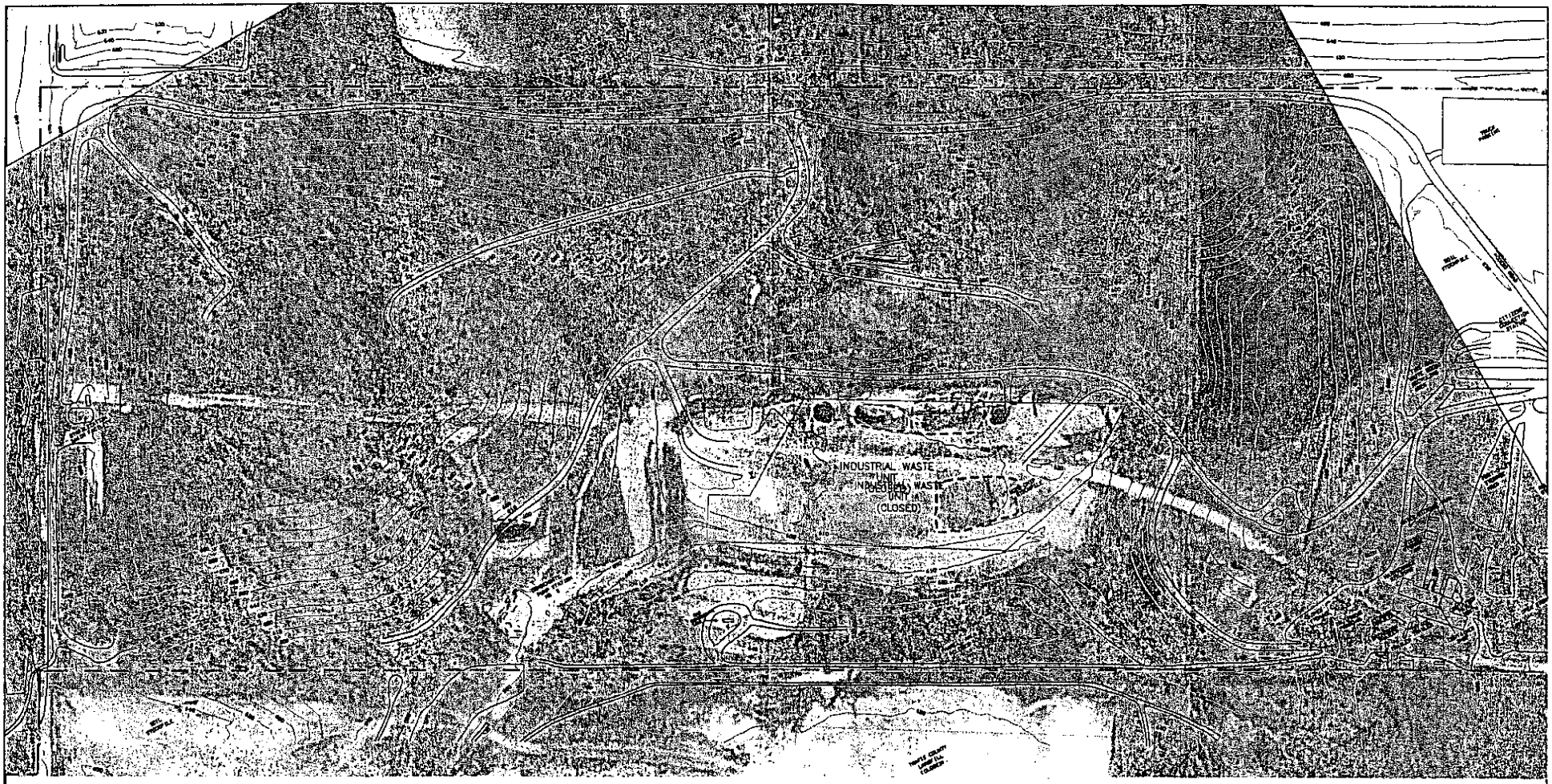
ThermoRetec

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4198-300

CURRENT DATE 4/12/99 | CADD FILE SURFACE PONDS

**HISTORICAL WASTE MANAGEMENT FEATURES**
**SOURCE: CONCEPTUAL ENGINEERING REPORT, PROPOSED WASTE TREATMENT FACILITY, TRAVIS COUNTY, TEXAS FEBRUARY 4, 1972**

**FIGURE 3-4**




LEGEND

- AREA OF KNOWN OR SUSPECTED INDUSTRIAL WASTE MANAGEMENT
- 1998 TOPOGRAPHIC SURFACE
- 1998 SURFACE IMPROVEMENTS
- PROPERTY BOUNDARY
- APPROXIMATE BOUNDARY CLOSED INDUSTRIAL WASTE UNIT

55 0 110

Scale 1" = 110'

N

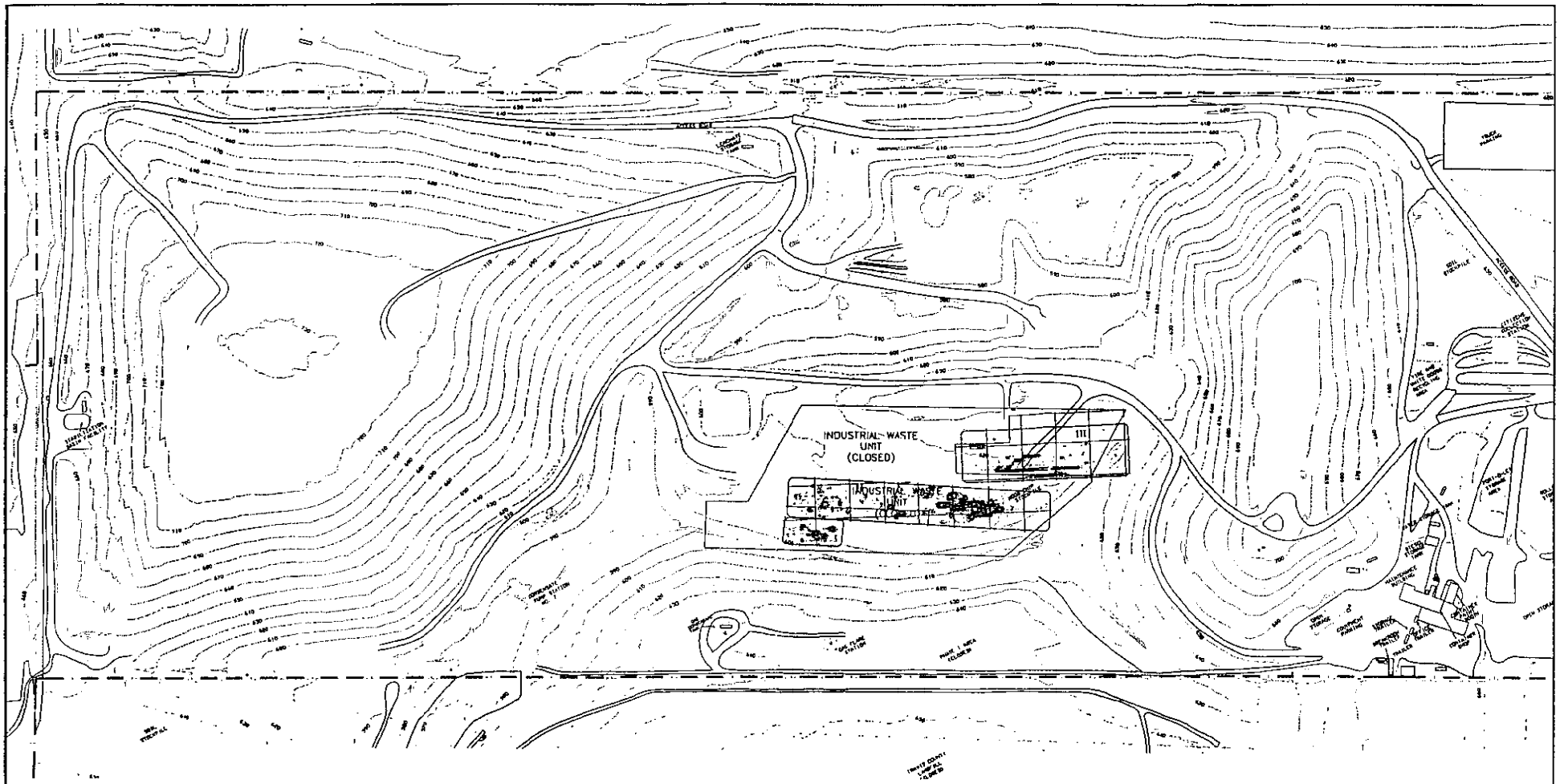
TRC Environmental

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4198-300

| CURRENT DATE | 4/12/98 | CADD FILE | 020473 |
|---|---|---|---|

**HISTORICAL WASTE MANAGEMENT FEATURES SOURCE: FEBRUARY 4, 1973 AERIAL PHOTOGRAPH**

FIGURE 3-5




LEGEND

- ELECTROMAGNETIC SURVEY RESULTS
- 1998 TOPOGRAPHIC SURFACE
- 1998 SURFACE IMPROVEMENTS
- PROPERTY BOUNDARY
- APPROXIMATE BOUNDARY INDUSTRIAL WASTE UNIT

150 0 300

Scale 1" = 300'

N

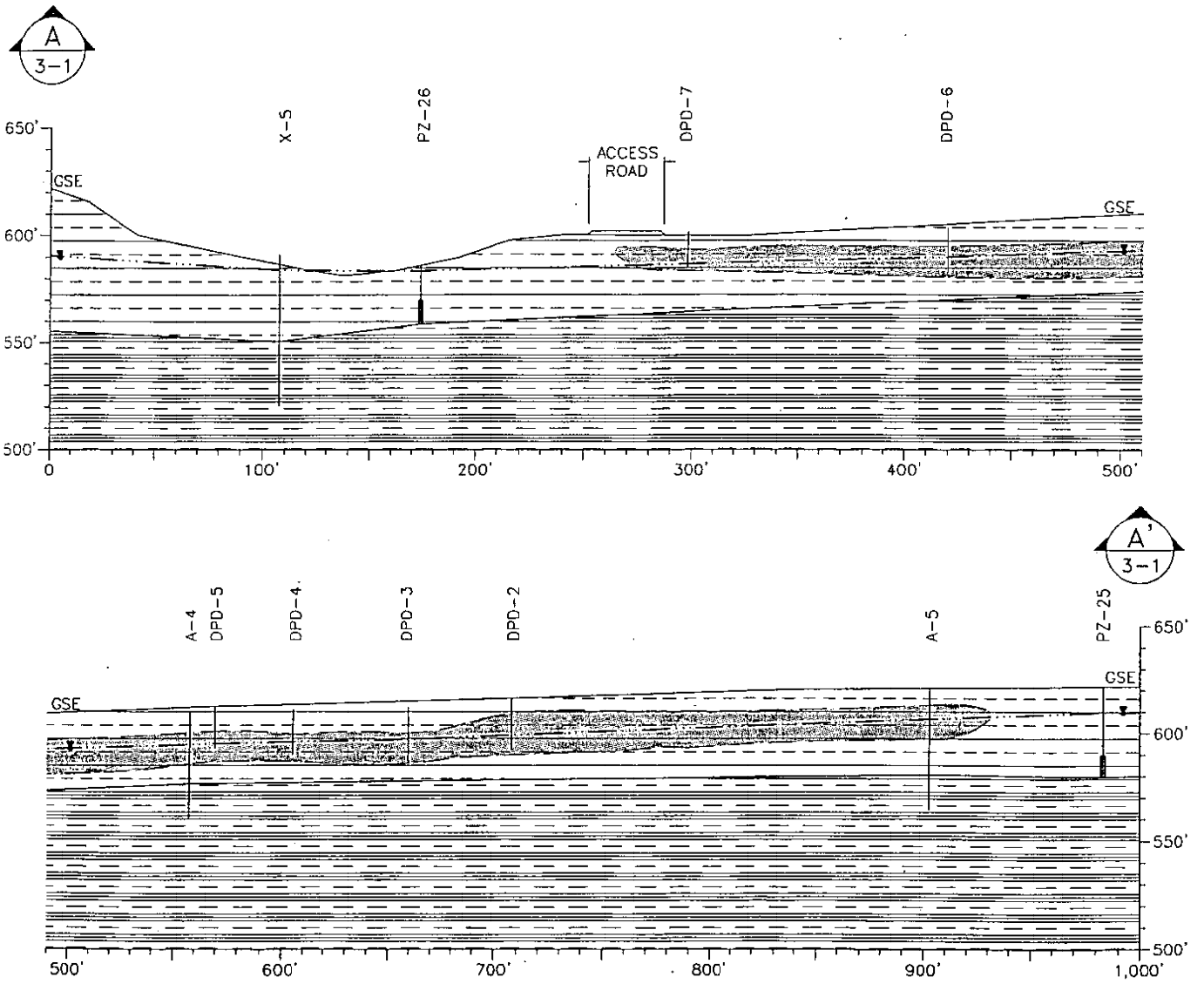
ThermoRetec

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4198-300

CURRENT DATE | 4/12/99 | CADD FILE | CONDUCTIVITY

**1998 ELECTROMAGNETIC SURVEY RESULTS SOURCE: GEOPHYSICAL SURVEY AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY, SEPTEMBER 1998**

**FIGURE 3-6**




## LEGEND

- WEATHERED CLAY
- UNWEATHERED CLAY
- APPROXIMATE LIMITS OF OF INDUSTRIAL WASTE
- GROUNDWATER ELEVATION
- WELL OR BORING W/SCREENED INTERVAL
- GSE — GROUND SURFACE ELEVATION

ThermoRetec

| | |
|---|---|
| WASTE MANAGEMENT OF TEXAS, INC.<br>AUSTIN COMMUNITY LANDFILL<br>3-4198 | CROSS SECTION OF INVESTIGATION AREA |
| DATE: 4/99 \| Drwn: BcV-J.M. \| FILE: 4198X001 | FIGURE: 3-7 |

### 3.3.1 Vertical Limits of Waste

The vertical limits of waste are based on a Geoprobe™ exploration conducted by OHM Remediation Services (OHM) in June 1998, and cone penetrometer tests (CPT) performed by McBride-Ratcliff and Associates, Inc. (McBride) in 1986. Results of these investigations showed that waste was encountered in the Closed Industrial Waste Unit at depths ranging from 5 ft to 16 ft below the ground surface (elevations approximately 605 ft msl to 595 ft msl). The locations of these borings are shown in Figure 3-8 ~~3-7~~.

### 3.3.2 Vertical Limits of Weathered and Unweathered Clay Layers

Figure 3-9 3-8 shows elevation contours of the weathered/unweathered clay contact based on a review of the available boring logs for the site. The top of the unweathered clay surface within the ACL ranges from over 610 feet msl in the southwest to nearly 550 feet msl near the southern border in the vicinity of the surface drainage channel. Within the Closed Industrial Waste Unit, the elevation of the weathered/unweathered clay contact ranges from over 580 feet msl in the northeast to below 570 feet msl in the southwest.

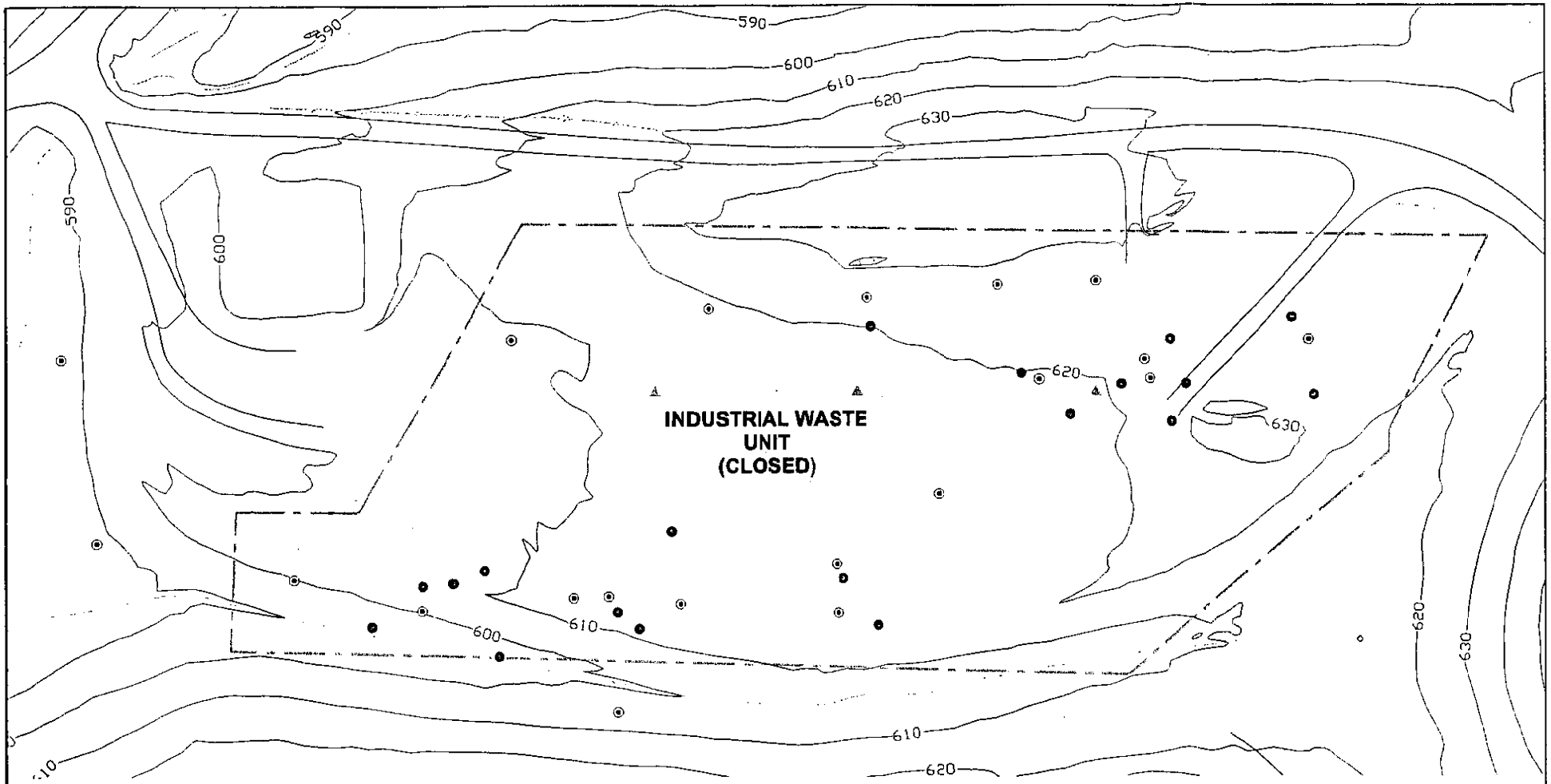
Based on the available data, the thickness of the weathered clay unit at the Closed Industrial Waste Unit ranges from about 20 feet to more than 40 feet. No site specific boring information was available to determine the thickness of the unweathered clay unit and the depth to bedrock.

## 3.4 Hydrology and Hydrogeology

### 3.4.1 Hydrology

#### 3.4.1.1 Site Drainage Features

As Figure 3-2 ~~3-1~~ shows, storm water around the area of the Closed Industrial Waste Unit drains through small streams, some of which are intermittent, located to the south and to the west of the Closed Industrial Waste Unit. An unnamed tributary of Walnut Creek flows into the ACL from the south at a location southeast of the Closed Industrial Waste Unit. The ditch then flows westward between the Closed Industrial Waste Unit and the Travis County Landfill before turning southwest and flowing back onto the Travis County Landfill to the south. Additional drainage from the northern part of the ACL enters this unnamed tributary at a point southwest of the Closed Industrial Waste Unit as it turns back toward the Travis County Landfill (Carter & Burgess, 1999; McBride, 1992).




LEGEND

- TEXAS WATER QUALITY BOARD BORING LOCATIONS (8/22/77)
- CONDUCTIVITY CONE PENETROMETER TEST McBRIDE-RATCLIFF AND ASSOC., INC. (07/86)
- GEOPROBE SAMPLING LOCATIONS OHM REMEDIATION SERVICES CORP. (04/98)
- 1998 TOPOGRAPHIC SURFACE
- 1998 SURFACE IMPROVEMENTS
- APPROXIMATE BOUNDARY CLOSED INDUSTRIAL WASTE UNIT

50 0 100

Scale 1" = 100'

N

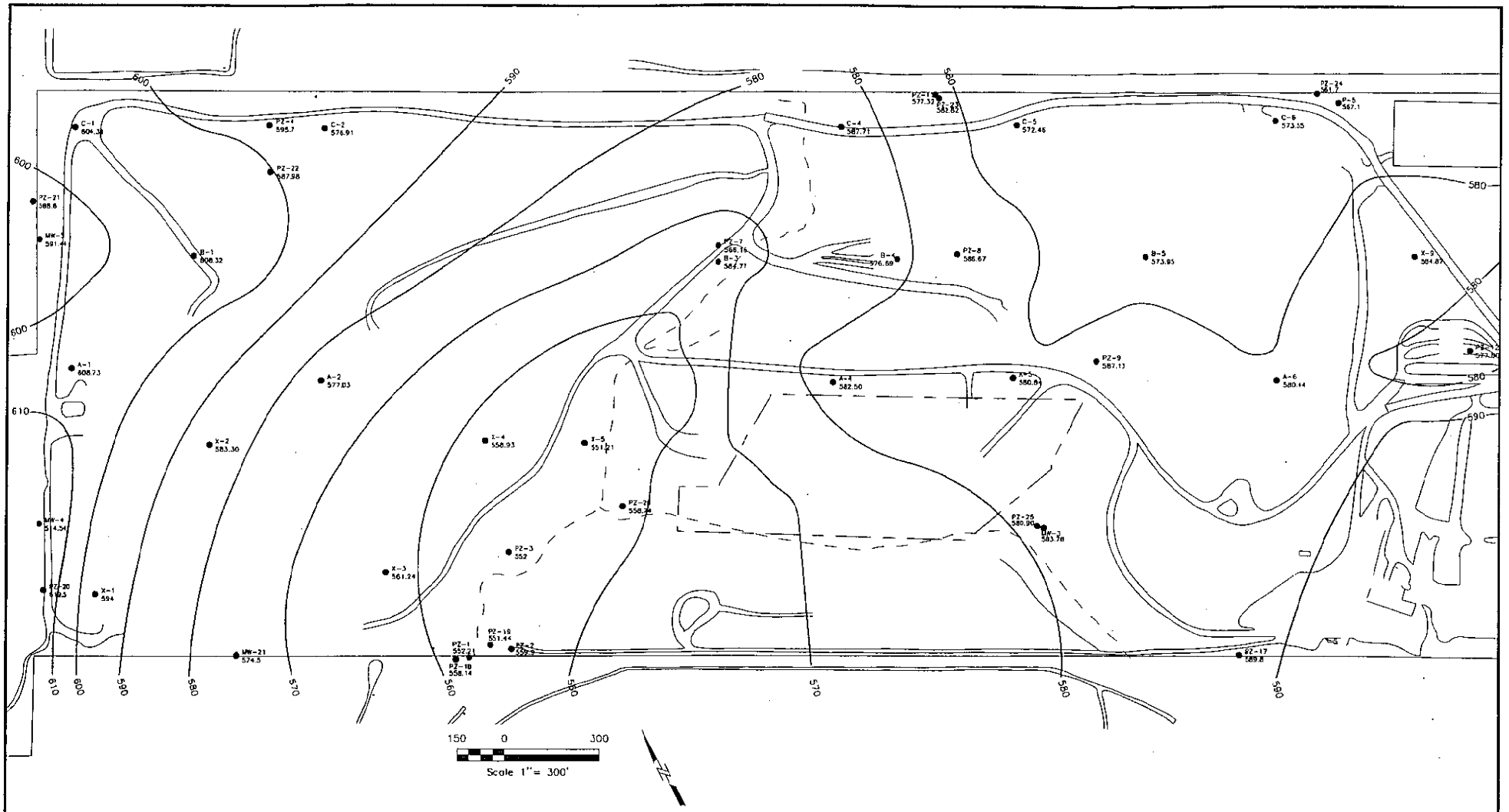
ThermoRetec

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4188-300

CURRENT DATE 4/22/99 | CADD FILE | PRIOR INVEST

PRIOR INVESTIGATIONS IN THE INDUSTRIAL WASTE DISPOSAL AREA

FIGURE 3-3




ThermoRetec

| | | | |
|---|---|---|---|
| WASTE MANAGEMENT OF TEXAS, INC.<br>AUSTIN COMMUNITY LANDFILL<br>3-4198 | | | TOP OF UNWEATHERED CLAY SURFACE |
| CURRENT DATE 4/99 | CADD FILE 41985001 | | FIGURE: 3-9 |

Seeps have been observed at about the midpoint between the east and west ends of the drainage ditch on the ACL property (south of the Closed Industrial Waste Unit). These seeps did not exhibit iron staining or other visible indication of leachate. At the west end of the Phase I Area and also continuing south of the ACL property line a number of seeps were identified which contained water which was reported to be "milky" in appearance with iron staining. These seeps may be leachate seeps. These seeps do not appear to be connected with the Closed Industrial Waste Unit portion of the ACL (Carter & Burgess, 1999).

#### 3.4.1.2 Surface Water Flow

Surface water runoff during storm events over the western three-quarters of the ACL is directed toward the southwest to an unnamed tributary which drains to Walnut Creek. A surface water divide is present in the eastern portion of the ACL. Runoff flow in the ACL to the east of this divide drains toward Gilleland Creek to the east. In the vicinity of the Closed Industrial Waste Unit, surface water flow is directed to drainage ditches located south and west of the Closed Industrial Waste Unit (Carter & Burgess, 1999).

### 3.4.2 Hydrogeology

A hydrogeologic assessment of the ACL was performed by McBride in 1992. In this assessment, five piezometers were installed (designated PZ-1 through PZ-5). Groundwater was found within the weathered clay layer screened by wells, probably traveling through secondary porosity fractures or slickensided planes (McBride, 1992).

Field permeability tests of the weathered clay gave permeability (horizontal hydraulic conductivity) values ranging from $1 \times 10^{-3}$ to $1 \times 10^{-6}$ cm/s, and a geometric average of $2.17 \times 10^{-5}$ cm/s ~~averaging $1 \times 10^{-5}$ cm/s~~ (McBride, 1992). Samples taken by the Texas Water Quality Board (TWQB) during boring installations in 1977 showed field permeability values of about $1 \times 10^{-7}$ cm/s (TWQB, 1977). By comparison, a sample of unweathered clay had a vertical hydraulic conductivity of $1 \times 10^{-9}$ cm/s (Rust, 1998).

The water column thickness (the elevation difference between the static groundwater level in the well and the weathered clay/unweathered clay contact) was measured in several wells and piezometers in the ACL. MW-3, just east of the Closed Industrial Waste Unit had a water column thickness of 12.4 feet. PZ-1 through PZ-3, all southwest of the Closed Industrial Waste Unit, had water column thicknesses in the 13 to 19 foot range (McBride, 1992). Therefore it is estimated that the water column thickness within the Closed Industrial Waste Unit is between 10 and 20 feet. The horizontal hydraulic ~~Hydraulic~~ gradient is

estimated to be about 0.01 ft/ft based on groundwater elevation measurements (McBride, 1992). Figure 3-10 ~~3-9~~, a potentiometric surface map (Rust, 1995), shows historic water table contours and groundwater flow directions at the ACL. Two distinct groundwater flow directions are shown. In the western portion of the site groundwater flows toward the southeast, and from the eastern portion of the site groundwater flows to the north-northwest. These two groundwater flows meet in a potentiometric low located in the west central part of the site. These groundwater flow directions are consistent with the historic surface topography prior to construction of the ACL.

## 3.5 Constituents

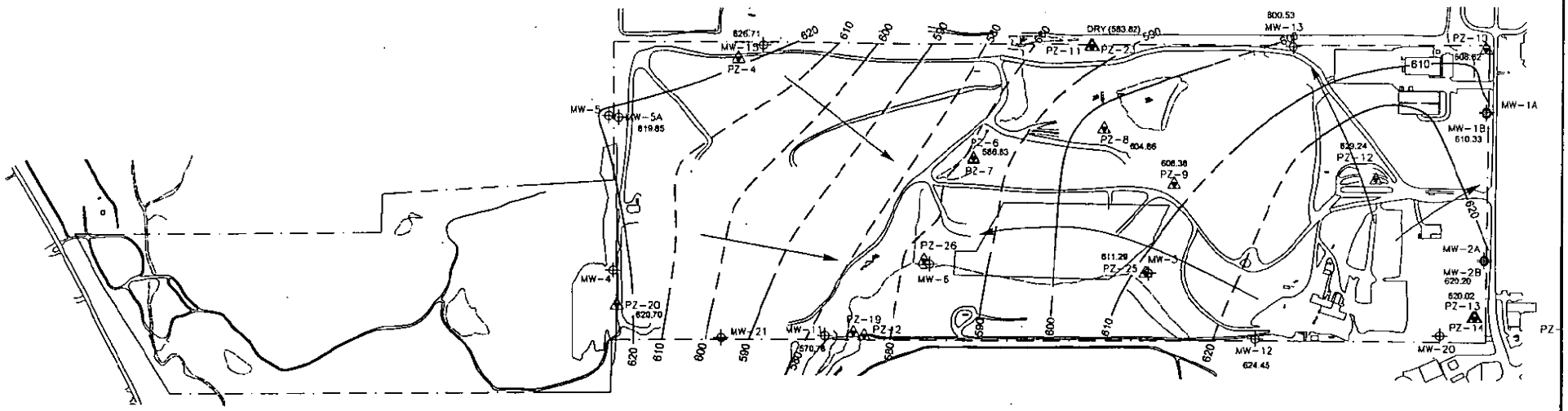
### 3.5.1 Closed Industrial Waste Unit Soils and Buried Wastes

The wastes disposed of in the Closed Industrial Waste Unit are reported to include: Type I MSW, spent acids, spent caustics, spent solvents, waste hydrocarbons, and industrial process washwater. Table 3-1 shows a partial listing of compounds known to have been disposed of at the Closed Industrial Waste Unit (TWQB, 1977).

OHM installed 20 Geoprobe borings and collected several samples for waste analysis and characterization during January 1998. Five perimeter soil samples, designated as P1 through P5 were taken in addition to three 5-gallon composite samples from the probings collected from former drum disposal areas and the acid and solvent ponds area (designated as TS-1 through TS-3) (OHM, 1998). Samples P1 through P5 were collected within the weathered clay surrounding the Closed Industrial Waste Unit, and contained few of the constituents known to have been placed into the Closed Industrial Waste Unit.

Samples P-2 through P-4 contained detectable concentrations of six volatile organic compounds (VOC). However, all concentrations of VOC's detected in these samples were below the TNRCC Risk Reduction Standard No. 2 (RRS No. 2) soil meduim-specific concentrations (MSC) for Groundwater Protection Industrial Use (GWP - Ind.), and the MSC for Inhalation, Ingestion, and Dermal Contact Industrial Use (SAI-Ind.). Table 3-2 compares the highest VOC concentrations detected in these samples with the TNRCC RRS No. 2, MSC for GWP-Ind., and SAI-Ind.

Sample TS-1 consisted of soil mixed with municipal solid waste. The only constituent of concern that was detected in this sample was total lead at 119 mg/Kg which is above the RRS No. 2 MSC for GWP-Ind. (1.5 mg/Kg) but below the MSC fro SAI-Ind. (1,000 mg/Kg). Sample TS-2 consisted of soil that




| LEGEND | |
|---|---|
| MW- | MONITOR WELL LOCATION |
| P- | PIEZOMETER LOCATION |
| | 1998 SURFACE IMPROVEMENTS |
| | PROPERTY BOUNDARY |
| | GROUND WATER CONTOURS (DASHED WHERE INFERRED) |

300 0 600

Scale 1" = 600'

ThermoRetec

| | | |
|---|---|---|
| WASTE MANAGEMENT OF TEXAS, INC.<br>AUSTIN COMMUNITY LANDFILL<br>3-4198-300 | | POTENTIOMETRIC SURFACE OF WEATHERED CLAY<br>APRIL 1995<br>(RUST, 1995) |
| CURRENT DATE 5/17/99 | CADD FILE CLAY 1995 | FIGURE 3-10 |

## Table 3-1 Partial Disposal List-Closed Industrial Waste Unit ~~Disposal List~~

| |
|---|
| Aldehyde |
| Olefin |
| Toluene |
| Acetone |
| Heptane |
| Xylene Washwater |
| Amine Washwater |
| Spent Caustic |
| Sulfuric Acid |
| Resins - Polyester |
| Phosphates |
| Anti-foaming Agents |
| Oxygen Scavengers |
| Sulfuric Acid with Nitric Acid & 0.4% to 0.6% Nitrated, Chlorinated Benzoic Acid |
| Grease Trap Fluids |
| Solvents |
| Acids |
| Butyl Isocyanate with Chlorobenzene |
| Phenyl Isocyanate with Chlorobenzene |
| Turbine Grade Lube Oil with HCl, Phosgene, Phenyl Isocyanates, Methyl Diphenyl Isocyanates, Urea |
| Polymethylene Polyphenyl Isocyanates |
| Polymethylene Polyphenyl Amine |

Texas Water Quality Board, 1977, Investigation of an Abandoned Industrial Waste Disposal Site, Travis County, Texas.

## Table 3-2 Previous VOC Samples

| Sample | VOC | mg/Kg | RRS No. 2 GWP-Ind. (mg/Kg) | RRS No. 2 SAI-Ind. (mg/Kg) |
|---|---|---|---|---|
| P-4 | Acetone | 0.39 | 1,000 | 79,000 |
| P-2 | Benzene | 0.013 | 0.50 | 1.5 |
| P-2 | Carbon Disulfide | 0.015 | 1,000 | 1,500 |
| P-2 | Chlorobenzene | 0.047 | 10 | 41,000 |
| P-2 | Ethylbenzene | 0.032 | 70 | 6,900 |
| P-2 | Xylenes | 0.011 | 1,000 | 3,600 |

Texas Water Quality Board, 1977, Investigation of an Abandoned Industrial Waste Disposal Site, Travis County, Texas.

contained solvents and other organic constituents. Benzene was present in this sample at 100 mg/Kg, which is above the RRS No. 2 MSC for GWP-Ind. (0.5 mg/Kg) and the MSC for SAI-Ind. (1.5 mg/Kg). The detection of certain constituents of concentrations greater than Risk Reduction standard No. 2 indicates that additional work must be done to characterize the potential risk to human health and the environment. The determination will be made under risk reduction standard No. 3.

Sample TS-3 showed constituents indicative of neutralized, acidic material. The TCLP analysis did not detect concentrations of any compounds above the regulatory limits (OHM, 1998), indicating the materials would not be considered a hazardous waste.

### 3.5.2 Groundwater

Groundwater monitoring from a network of six wells (designated as MW-1 through MW-6) began in 1982. None of these wells are located within the Closed Industrial Waste Unit, although MW-3 is located about 150 feet east and MW-6 about 150 feet west of the Closed Industrial Waste Unit. In 1996, a site-wide groundwater monitoring system was upgraded in the ACL with the installation of new monitoring wells in accordance with Subtitle D requirements. The system currently consists of eight monitoring wells (designated as MW-2B, MW-5A (which replaced the old MW-5), MW-11, MW-12, MW-13, MW-15, MW-20, and MW-21). Quarterly monitoring began at these wells in 1997 to establish "background" conditions for the municipal ACL (Carter & Burgess, 1999).

While some groundwater sampling reportedly occurred in the 1970s, few data have been found for that period. In 1980, the Texas Department of Water Resources sampled two historic wells within the Closed Industrial Waste Unit and found evidence of hydrocarbons in Well No. 1 (location unknown). Sampling at several wells within the ACL has occurred since the early 1980s. Analytes measured included metals and groundwater quality parameters (total organic carbon (TOC), potassium, chloride, nitrate, and sulfate).

MW-3 and MW-6 were sampled for VOCs during 1988 to determine if migration of constituents from the Closed Industrial Waste Unit was occurring. No VOCs were detected in either well. In more recent sampling since 1991, total organic halogens, vinyl chloride, cis-1,2-dichloroethylene and trichloroethane have been detected one or more times at concentrations only slightly above detection limits (6 $\mu$g/L or less) at other wells outside of the Closed Industrial Waste Unit. Cis-1,2 dichloroethylene has been detected in MW-21 at concentrations below the RRS No. 2, MSC for GWP-Ind. of 70 $\mu$g/L. Organic compounds consisting of

dissolved chlorinated hydrocarbon have also been detected in MW-5. However, only trichloroethene at 6 µg/L has been above the RRS No. 2, MSC for GWP-Ind. of 5 µg/L. These concentrations are not considered significant and are detected only sporadically in different wells at different times; they do not appear to be indicative of migration of constituents outside of the Closed Industrial Waste Unit (Carter & Burgess, 1999).

### 3.5.3 Surface Water

Surface water analytical data is available from samples collected from four locations on-site between April 1993 and October 1997. Forty nine samples were collected and analyzed for chemical constituents including VOCs, pesticides, PCBs, SVOCs, and metals. None of the constituents was ever measured above detection limits except for zinc, measured at a maximum concentration of 56.5 µg/L, and lead, measured at a maximum concentration of 5.1 µg/L. The surface water samples were also analyzed for water quality parameters. Both of these concentrations are below their respective RRS No. 2, MSC for GWP-Ind. of 31,000 µg/L (Zinc) and 15 µg/L (Lead).

A sample was collected in December 1998 of the reported "leachate" seeps to the west of the Closed Travis County Landfill (southwest of the Closed Industrial Waste Unit). This sample, which was described as "milky" in appearance with iron staining, had a total organic carbon (TOC) concentration of 89.5 mg/L and a chemical oxygen demand of 240 mg/L (Carter & Burgess, 1999).

# 4 Field Investigation

The field investigation will consist of three components including; a subsurface fluids investigation, a soil and waste investigation, and a surface water and sediments investigation. Specific activities conducted during the field investigation include:

- fluid monitoring, sampling and analysis;
- hydraulic conductivity testing;
- soil borings for delineation of waste;
- soil boring\investigation well installation;
- soil\waste material sampling and analysis; and
- surface water and sediment sampling and analysis.

This section presents objectives for each component of the field investigation, and describes each of the specific activities conducted during the investigation. Additional detail regarding investigation methodologies and quality assurance procedures are included as Appendix A.

## 4.1 Investigation Objectives

The purpose of the field investigation is to obtain the data needed to complete a risk assessment and evaluation of remedial alternatives for materials contained in the Closed Industrial Waste Unit. The investigation data will provide a detailed understanding of the hydraulics and fluids quality within the Closed Industrial Waste Unit, evaluate the potential for migration of constituents away from the Closed Industrial Waste Unit, and provide data to evaluate risk to human health and potential remedial options for the waste. Objectives for each component of the field investigation are presented below.

### 4.1.1 Fluids Investigation

The fluids investigation will determine if materials contained in the Closed Industrial Waste Unit are affecting fluids quality below and hydraulically downgradient from the Closed Industrial Waste Unit, and provide data needed to evaluate remedial alternatives for the material contained in the Closed Industrial Waste Unit. To accomplish this, investigation wells and a recovery well will be installed within the Closed Industrial Waste Unit, investigation wells will be installed downgradient of the Closed Industrial Waste Unit, and monitoring will be performed as described in Section 4.2.

Approximately 20 to 40 piezometers will be installed in the Closed Industrial Waste Unit with a ~~G~~geoprobe™ rig prior to installation of investigation wells. The piezometers will be used to determine the location of the materials within the Closed Industrial Unit and to determine whether the material is saturated. Saturated conditions will be defined as an accumulation of more than 1.0 foot ~~0.2 feet~~ of fluid within a piezometer in a 24 hour period. Nine investigations wells will be installed following Geoprobe™ ~~geoprobe~~ piezometer installation. ~~A recovery well will also be installed within the Closed Industrial Waste Unit.~~ The locations of all of the proposed borings and investigation wells shown are on Figure 4-1. These locations may be modified, if necessary, based upon the results of the piezometer installation. These modifications, if any, would be reviewed by TNRCC prior to implementing any modifications. The wells will be screened in the waste if the waste is saturated. If the waste is unsaturated, the boring will be abandoned by grouting back to the surface and a location outside of the waste area will be selected for the installation of a well screened in the weathered clay. ~~the wells will be double-cased through the waste material and screened in the underlying weathered clay.~~ Sampling, fluid level monitoring~~,~~, and hydraulic testing will be conducted in the wells and piezometers as described in Section 4.2. The data collected from the wells will be used to:

- determine if free phase fluids (water, and/or non-aqueous phase fluids) are present in the void spaces of the waste material contained in the Closed Industrial Waste Unit;

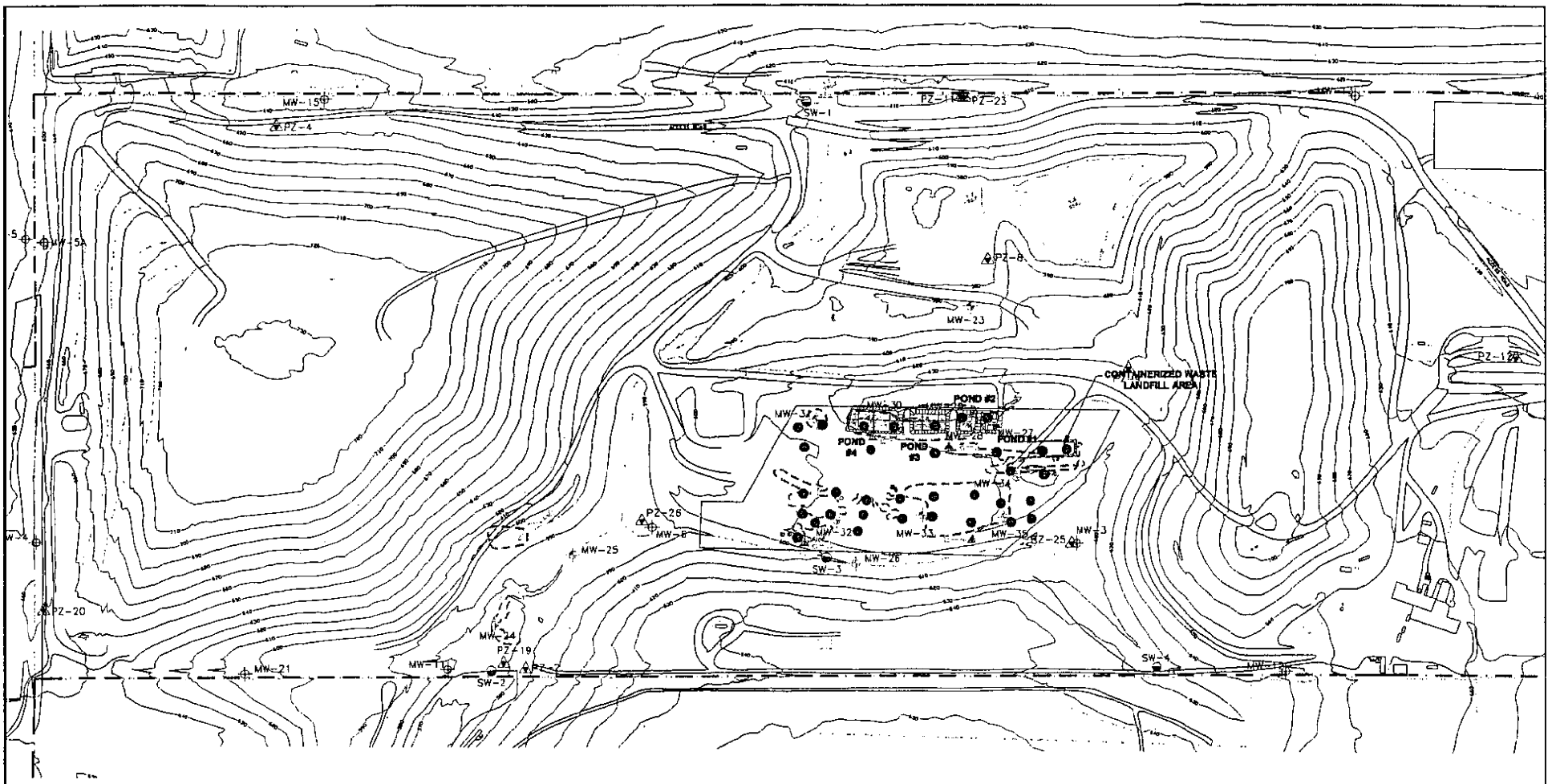
- establish fluids quality in the weathered clay beneath the Closed Industrial Waste Unit;

- establish the physical and chemical properties of any free phase fluids found in the Closed Industrial Waste Unit wells;

- establish the hydraulic properties (i.e., hydraulic conductivity, and hydraulic gradient) of the ~~unweathered and~~ weathered clay liners and the waste~~; and~~.

- ~~determine if pumping/recovery of any free fluids found in the Closed Industrial Waste Unit is feasible.~~

Four investigation wells will be installed outside the Closed Industrial Waste Unit as shown in Figure 4-1. The wells will be screened at the bottom of the weathered clay. Sampling, water level monitoring, and hydraulic testing will be conducted in these wells, and other existing wells found in the vicinity of the Closed







ThermoRetec

**LEGEND**

- MW- GW MONITORING WELL (EXISTING)
- PZ- PIEZOMETER (EXISTING)
- MW- INVESTIGATION WELL (PROPOSED)
- SW- SURFACE WATER SAMPLING LOCATION (PROPOSED)
- B- DEEP BORINGS
- GEOPROBE BORING (FIRST ROUND)
- WASTE MANAGEMENT FEATURE, FEBRUARY 4, 1972
- 1998 TOPOGRAPHIC SURFACE
- 1998 SURFACE IMPROVEMENTS
- PROPERTY BOUNDARY
- APPROXIMATE BOUNDARY CLOSED INDUSTRIAL WASTE UNIT
- AREA OF UNKNOWN OR SUSPECTED INDUSTRIAL WASTE MANAGEMENT, FEBRUARY 4, 1972

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4198-300

| CURRENT DATE | 4/22/99 | CADD FILE | PROPOSED SL |
|---|---|---|---|

**SUMMARY HISTORICAL FEATURES/ PROPOSED SAMPLING LOCATIONS**

**FIGURE 4-1**

Industrial Waste Unit, as described in Section 4.2. The data collected from the wells will be used to:

- refine estimates of water table elevation and hydraulic gradients in the vicinity of the Closed Industrial Waste Unit.
- estimate the hydraulic conductivity of the weathered clay material; and
- determine if chemical constituents found within the Closed Industrial Waste Unit have reached the weathered clay water bearing zone beneath the surface water drainage pathways within the ACL.

The combined data set collected during the fluids investigation will be used in the risk assessment to establish and analyze migration pathways for potential ~~any~~ fluids found in the Closed Industrial Waste Unit. The data will also be used to evaluate the effectiveness of remedial alternatives such as hydraulic containment and natural attenuation.

### 4.1.2 Soil and Waste Investigation

The soil and waste investigation will consist of soil sampling from the geoprobe borings and the 13 borings installed as part the investigation well installation described above. In addition, four soil borings not completed as monitoring wells may be installed in the unweathered clay beneath the Closed Industrial Waste Unit. A sample of the unweathered clay would be collected from each of four borings. Details of the soil and waste investigation are provided in Section 4.3. The objectives of the soil and waste investigation are to:

- verify site stratigraphy including the limits of weathered clay, and the limits of waste material found in the Closed Industrial Waste Unit;
- characterize waste to evaluate potential disposal and treatment options;
- determine if chemical constituents found in the Closed Industrial Waste Unit have migrated vertically into the unweathered clay; and
- evaluate the integrity of the weathered and unweathered clay underlying the waste.

### 4.1.3 Surface Water and Sediment Investigation

Surface water and sediment samples will be collected from the surface water drainages running through the ACL that contain water as shown in Figure 4-1. The sampling is described in detail in Section 4.4. The purpose of the investigation is to determine if chemical constituents found in the Closed Industrial Waste Unit are affecting surface water and sediments found in the drainages running through the ACL.

## 4.2 Fluids Investigation

Piezometer installation, well installation, monitoring, sampling, and testing activities conducted as part of the fluids investigation are summarized below. Detailed procedures for completion of these activities are presented in Appendix A (Sampling and Analysis Plan). Waste and soil sampling conducted during well installation are described in Section 4.3.

### 4.2.1 Well Installation

All investigation wells will be installed using conventional drilling techniques. The wells will be constructed with PVC screen and riser pipe as described in Appendix A. A discussion of the number and location of the monitoring wells is presented below.

#### 4.2.1.1 Well Installation Within the Closed Industrial Waste Unit

Nine investigation wells will be installed within the Closed Industrial Waste Unit as shown in Figure 4-1. The well locations were selected to coincide with specific areas where materials were handled within the Closed Industrial Waste Unit. These areas include the evaporation ponds and drum placement areas shown in Figure 4-1. The locations of these areas were generated from a review investigation documents, aerial photographs, and geophysical investigations (RUST, 1995).

Prior to installing the investigation wells, approximately 20 to 40 piezometers will be installed in the Closed Industrial Waste Unit with a Geoprobe™ ~~geoprobe~~ rig. The piezometers will be gauged 24 hours ~~one week~~ after they are installed to determine if fluids are present in the waste material. The results of the piezometer gauging will be used to establish the exact locations and screened intervals of the investigation wells. The gauging results and proposed well locations will be discussed with the TNRCC prior to installing the investigation wells.

If the placed material is saturated, investigation wells within the Closed Industrial Waste Unit will be advanced through the waste material to the top of the weathered clay surface. A ten-foot well screen (see Appendix A) will be placed at the bottom of the material. If the placed material is not saturated, the boring will be abandoned by grouting back to the surface and a location outside of the waste area will be selected for the installation of a well screened in the weathered clay. ~~the wells will be advanced through the material to the weathered/unweathered clay contact.~~ These wells will be screened in the weathered clay down to the top of the weathered/unweathered clay contact. ~~The wells screened beneath the buried material will be double cased, as described in Appendix A to ensure that placed material is contained in the Closed Industrial Waste Unit.~~ Following installation, the wells will be developed and surveyed in accordance with the methods described in Appendix A. If piezometers screened in the placed material contain fluids, they will be surveyed to provide additional data on the fluids elevation within the Closed Industrial Waste Unit.

### 4.2.1.2 Well Installation Outside the Closed Industrial Waste Unit

Four investigation wells will be installed outside the Closed Industrial Waste Unit. The well locations were selected to provide water quality data hydraulically upgradient and downgradient from the Closed Industrial Waste Unit, and to refine the direction of groundwater flow in the vicinity of the Closed Industrial Waste Unit. The existing data indicate that groundwater flow at the ACL is toward ~~follows~~ the historic ~~path of the~~ surface water drainages shown in Figure 3-1 ~~4-1~~. Therefore, wells will be installed along the surface water drainage pathway.

The four wells will be screened in the bottom 10 feet of the weathered clay. If the soil boring is dry during installation the well location may be moved to a more appropriate location. Following installation, the wells will be developed and surveyed according to the methods described in Appendix A.

### ~~4.2.1.3 Recovery Well Installation~~

~~A fluids recovery well will be installed within the Closed Industrial Waste Unit. The well will be used to determine whether fluids extraction is a viable remedial alternative. The recovery well will be located near the Closed Industrial Waste Unit investigation well screened in the material that has the greatest likelihood of producing significant quantities of fluids based on field observations. As shown on Figure 4-1, the proposed recovery well RW-1 is located adjacent to investigation well MW-33. If field observations indicate that a different location is more appropriate, the TNRCC will be consulted prior to installing the well.~~

~~The recovery well will be screened from the bottom of the placed material to above the fluid level observed in the adjacent investigation well. Installation and construction details are presented in Appendix A.~~

## 4.2.2 Fluids Monitoring

Fluids monitoring will be conducted in all the new investigation wells, existing monitoring wells MW-11, MW-6 and MW-3 as shown in Figure 4-1, and other accessible wells at the ACL. Detail procedures for groundwater monitoring are presented in Appendix A.

### 4.2.2.1 Fluid Level Measurements

Fluid level measurements will be taken in all the piezometers and wells shown on Figure 4-1 and on Table 4-1. All measurements will be collected in a single day. The depth to water will be measured from the inner casing of the well or the top of the piezometer.

### 4.2.2.2 Fluids Sampling

Fluids samples will be collected from each of the proposed investigation wells shown on Table 4-1 as well as existing wells MW-3, MW-6, and MW-4 using low flow sampling techniques described in Appendix A. The samples will be placed in containers (prescribed in the various analytical methods) and shipped to an analytical laboratory.

The wells inside the Closed Industrial Waste Unit will be sampled first and analyzed for Appendix IX constituents listed in Table 2-2, page 2-6 of Appendix A, and natural attenuation parameters listed in Table 3-3, page 3-7 of Appendix A. Wells located outside the Closed Industrial Waste Unit will be subsequently sampled and analyzed for natural attenuation parameters and those constituents of interest (COI) detected in the Closed Industrial Waste Unit wells.

## 4.2.3 Hydraulic Conductivity Testing

Slug testing as described in Appendix A will be completed in all newly installed investigation wells. The test results will be used to estimate the hydraulic conductivity of the waste material within the Closed Industrial Waste Unit and the weathered clay.

### ~~4.2.3.2 Sustainable Yield Test~~

~~A sustainable yield test will be conducted in the recovery well screened in the Closed Industrial Waste Unit. The test will be conducted with a submersible pump. After initial drawdown, the pumping rate will be adjusted until the~~

~~maximum sustainable yield of the waste material is established. Pumping will continue at a constant drawdown for 72 hours. If flow rates are unsustainable, the pumping test may be discontinued prior to 72 hours.~~

## 4.3 Soil and Waste Sampling

A total of 13 soil borings will be installed at investigation well locations as shown in Figure 4-1. An additional 20 to 40 soil borings will be installed with a Geoprobe™ rig inside the Closed Industrial Waste Unit. Four additional borings may be advanced into the unweathered clay beneath the Closed Industrial Waste Unit to determine if constituents from the placed materials have migrated vertically. All borings will be installed and sampled in accordance with the procedures outlined in Appendix A. Samples collected from the borings will be used for waste characterization, geotechnical analysis, and natural attenuation analysis.

### 4.3.1 Boring Installation

Soil borings will be advanced with a hollow-stem auger drilling rig or a Geoprobe™ ~~geo-probe~~ rig. Continuous split spoon samples (ASTM D1586) will be collected from the drilling rig borings in the Closed Industrial Waste Unit. The contents of the split spoons will be logged for moisture, color, and other physical characteristics. The representative samples from ~~contents of~~ the spoons will then be placed in jars for possible laboratory analysis. Photo ionization detector (PID) head space readings will be collected from each sample. The borings within the Closed Industrial Waste Unit will be advanced to the bottom of the placed material as ~~which can be~~ confirmed by the presence of natural weathered clay soil in the split spoon sample. When the clay is encountered an additional split spoon will be driven to confirm its presence. Undisturbed Shelby tube samples (ASTM D 1587) of the overlying clay cap and underlying weathered clay will also be collected from borings installed in the Closed Industrial Waste Unit. The undisturbed samples will be used for geotechnical testing.

Geoprobe™ samples will be collected continuously throughout the waste material as described in Appendix A. The samples will be logged for moisture, color and other physical characteristics.

## Table 4-1 Fluids Level Monitoring Locations

| Existing Wells | Existing Piezometers | Proposed Investigation Wells |
|---|---|---|
| MW-1A | PZ-2 | MW-23 |
| MW-1B | PZ-5 | MW-24 |
| MW-2A | PZ-12 | MW-25 |
| MW-2B | PZ-15 | MW-26 |
| MW-3 | PZ-16 | MW-27 |
| MW-4 | PZ-17 | MW-28 |
| MW-5A | PZ-18 | MW-29 |
| MW-6 | PZ-20 | MW-30 |
| MW-11 | PZ-21 | MW-31 |
| MW-12 | PZ-22 | MW-32 |
| MW-13 | PZ-24 | MW-33 |
| MW-15 | PZ-25 | MW-34 |
| MW-20 | PZ-26 | MW-35 |
| MW-21 | | |

The four soil borings completed as monitoring wells outside the Closed Industrial Waste Unit, MW-23, MW-24, MW-25, and MW-26, will be advanced to the weathered/unweathered clay contact. Continuous split spoon or Shelby tube soil samples will be collected in the borings from the ground surface to the weathered/unweathered clay contact. The samples will be logged, and stored in jars or bags. When the weathered/unweathered clay contact is encountered an additional split spoon will be collected to confirm the contact has been reached.

If Appendix IX analysis of fluids beneath Closed Industrial Waste Unit contains detectable concentrations of COI, then four additional borings will be advanced through the Closed Industrial Waste Unit 30 feet into the unweathered clay. The borings will be advanced using telescoping casing methods, as described in Appendix A, to ensure migration pathways for COI are not created. Continuous split spoon soil samples will be collected above the anticipated elevation of the weathered/unweathered clay contact. Once the contact is confirmed, the boring will be advanced 30 feet into the unweathered clay and samples will be collected continuously and field screened. The actual depth of the boring may be greater based on field screening results. A sample of unweathered clay at the bottom of the boring will be submitted for analytical laboratory analyses ~~analysis~~. The decision to install the borings into the unweathered clay will be discussed with the TNRCC after fluids analytical results are available.

Questioned by Christina on 7/1/99, not addressed by WM, no IF mentioned on 5/15 - it was definite @ th Andy W.

## 4.3.2 Waste Characterization

A sample of waste material from nine of the borings advanced into the Closed Industrial Waste Unit waste will be analyzed for Appendix IX constituents, Toxicity Characteristics Leaching Procedure, and other parameters to evaluate appropriate disposal options for the waste. A complete list of parameters is presented in Appendix A.

## 4.3.3 Soil Sampling

Undisturbed soils samples of the clay cap and the *in situ* clay liner within the Closed Industrial Waste Unit will be analyzed for hydraulic conductivity (falling head ASTM D5084) and Atterberg limits (ASTM D2487). At nine locations beneath the waste within the Closed Industrial Waste Unit, soil samples will be collected and analyzed for bulk density and total organic carbon (TOC)~~;, that~~ These data will be used to evaluated the potential for constituents to migrate away from the Closed Industrial Waste Unit. Soil samples of the unweathered clay will be analyzed for the COI identified in the fluids investigation. A complete list of parameters is presented in the Sampling and Analysis Plan (Appendix A).

## 4.4 Surface Water and Sediments Sampling

Surface water and sediment samples will be collected where the surface water drainage enters the ACL, where it leaves the ACL, and in the drainage south of the Closed Industrial Waste Unit as shown in Figure 4-1. The samples will be collected in accordance with Appendix A, analyzed for the COI list developed from fluid samples within the Closed Industrial Waste Unit. Staff gauges will be installed and surveyed at each sampling location, so a surface water elevation can be determined if present.

Analytical results from the surface water and sediment samples will be compared to results the investigation wells to determine if surface water is being affected by fluids found in the Closed Industrial Waste Unit.

# 5 Data Reduction and Reporting

## 5.1 Data Reduction

Following completion of each data gathering activity, the collected data will be evaluated and presented in tables, figures and charts. Specific data presentations to be produced include the following:

- Fluids:
  - well drilling and construction logs,
  - a table of fluids elevations and a piezometric contour map,
  - a table of fluids sample analytical results,
  - maps summarizing fluids concentrations of constituents of concern,
  - calculations and a table of fluids flow parameters from slug and pump testing;
- Soil and Waste:
  - soil boring logs,
  - tables of soil and waste analytical results,
  - updated cross-section drawings showing site stratigraphy and the vertical limits of waste placement,
  - updated site plans showing contours of the weathered/unweathered clay contact and the limits of waste placement;
- Surface Water and Sediments:
  - table of surface water and sediments analytical results, and
  - cross-section drawings showing the interaction between surface water and groundwater.

## 5.2 Data Validation

Analytical data obtained from the laboratory analysis of soil, waste, fluids, surface water, and sediments samples will be validated by reviewing the referenced quality

control procedures contained in each of the applicable methods used. Quality control practices reviewed as part of the data validation program will include the following:

- sample holding times;
- surrogate recoveries;
- field sample duplicates;
- trip and field blank results;
- analytical method blank results;
- continuing calibration verifications; and
- laboratory control samples (matrix spike and matrix spike duplicate samples).

Maximum holding times, prior to chemical analyses, are assigned to prevent oxidation, evaporation, chemical reaction, or biodegradation of constituents due to storage time. Surrogate recoveries are used to evaluate the efficiency of the analytical method. Field duplicates measure the precision of the field sampling program. Trip blanks detect possible contamination entering the samples during container shipment. Field blanks measure contamination caused by improperly decontaminated sampling equipment. Method blanks are analyzed in the laboratory to ensure that positive values in the field samples are not the result of laboratory contamination. Continuing calibrations are used to verify the initial calibration. A laboratory control sample is used to measure the accuracy of the analytical method. Table 5-1 summarizes the quality assurance sampling.

Data that are found to be out of quality control limits, for the referenced practices, will be qualified following the procedures detailed in the Sampling and Analysis Plan (Appendix A) and the *National Functional Guidelines for Organic and Inorganic Analysis* (USEPA CLP June 1991). As part of the validation process, data will be qualified using letter codes, which have specific meanings notifying the data user that some data have additional uncertainties.

## 5.3 Reporting

Following completion of the activities described above, an Investigation Report will be prepared to present the results of data gathering. Table 5-2 shows a proposed outline for the report.

Results of the risk assessment will be included in a Risk Assessment Report. The report will document the procedures used to identified the risks, if any, posed by the closed industrial waste unit. Once the risk assessment is completed, potential remedial options for the industrial waste will be evaluated and the most appropriate options will be selected for implementation.

## Table 5-1 Quality Assurance Sampling Summary Austin Community Landfill

| Sample | Frequency | Sample Requirements |
|---|---|---|
| **Field QA Samples** | | |
| Field Duplicate | 1 per 10 samples | Bottles provided by lab. Sample collected in field. |
| Field Blank | 1 per 20 samples | Bottles and deionized water provided by lab. Samples prepared in field. |
| Trip Blank | 1 per cooler with groundwater VOC samples. | Prepared samples provided by lab. Samples should be kept in cooler and shipped with samples. |
| Equipment Rinseate Blank | 1 per 10 samples | Bottles and deionized water provided by lab. Samples prepared in field. |
| Laboratory QA Samples | | |
| Blank Spike | 1 per 20 samples | Laboratory specific requirement |
| MS/MSD | 1 per 20 samples | Laboratory specific requirement |
| Surrogate Analysis | every sample | Laboratory specific requirement |
| Method Blank | 1 per 20 samples | Laboratory specific requirement |

## Table 5-2 Proposed Investigation Report Outline

1.0 Introduction
- 1.1 Site Background and History
- 1.2 Investigation Objectives
- 1.3 Report Organization

2.0 Investigation Activities
- 2.1 Fluids Investigation
  - 2.1.1 Well Installation
  - 2.1.2 Fluids Monitoring
  - 2.1.3 Hydraulic Conductivity Testing
- 2.2 Soil and Waste Investigation
  - 2.2.1 Boring Installation
  - 2.2.2 Waste Characterization
  - 2.2.3 Soil Sampling and Analysis
- 2.3 Surface Water and Sediment Investigation

3.0 Investigation Results
- 3.1 Fluids Investigation
  - 3.1.1 Fluids Flow Characteristics
  - 3.1.2 Constituents in Fluids
- 3.2 Soil and Waste Investigation
  - 3.2.1 Site Stratigraphy
  - 3.2.2 Waste Characterization
  - 3.2.3 Constituents in Soil
- 3.3 Surface Water Investigation

4.0 Conclusions
- 4.1 Fluids
  - 4.1.1 Distribution of Chemical Constituents in Fluids
  - 4.1.2 Potential for Off-site Migration of Constituents
  - 4.1.3 Potential Effectiveness of Natural Attenuation
- 4.2 Soil and Waste
  - 4.2.1 Distribution of Chemical Constituents in Soil
  - 4.2.2 Waste Treatment and Disposal Options
- 4.3 Surface Water
  - 4.3.1 Distribution of Chemical Constituents in Surface Water
  - 4.3.2 Interaction between Groundwater and Surface Water

5.0 References

# 6 Site Conceptual Model

This section presents a conceptual exposure assessment model for the site. The site assessment model presents the relationship between the media of concern and the persons and things potentially exposed, both now and in the future, to the constituents of interest (COI). The conceptual exposure model was developed to identify the ~~insure all~~ potential pathways, current and future, from the Closed Industrial Waste Unit will be evaluated by the site investigation. The results of the site investigation will then be used to complete a ~~in a formal~~ risk assessment.

The current scenario assumes the site remains essentially as it is; i.e., a "no action" alternative. The exposure assessment for the current scenario, illustrated in Table 6-1, identifies pathways by which people may be potentially exposed to compounds at the site under the current site conditions. The future scenario assumes the site will undergo some form of remedial action to reduce or eliminate the risk for certain exposure pathways. The exposure assessment for the future scenario, illustrated in Table 6-2, identifies pathways by which humans may be potentially exposed to compounds at the site under future site conditions or activities such as remedial actions.

In the exposure assessment, reasonable maximum estimates of exposure are developed for both current and future land use scenarios. Estimates of current exposures are used to determine whether health effects could arise based on the current land use scenario at the site. Estimates of future exposures are used to evaluate the potential for future effects and include a qualitative estimate of the likelihood that such exposures would actually occur. This site conceptual model has the following elements:

- discussion of potential sources and migration pathways;
- identification of potential human receptors; and
- delineation of potential receptor-specific exposure pathways.

The exposure assessment characterizes potential exposures to receptors to COI.

## 6.1 Potential Sources and Migration Pathways

The media of concern are ~~is~~ identified as solid waste material, leachate from the solid waste, impacted subsurface soil in contact with solid waste, seeps from solid waste leachate, surface soil in contact with leachate, ~~and~~ surface water and sediments. Another media of interest may be groundwater which may have been impacted from the waste or leachate.

# Table 6-1 Exposure Assessment - Current Risk Scenarios

| AUSTIN COMMUNITY LANDFILL RISK PATHWAY ANALYSIS | | |
|---|---|---|
| **Receptor** | **Pathway** | **Media** |
| **Current Scenario - On Site** | | |
| Truck Drivers | Inhalation of VOCs and particulates | Seeps, Surface Water, Sediments, Surface Soil |
| Landfill Operators, esp. during repair of seep areas | Inhalation of VOCs and particulates | Seeps, Surface Water, Sediments, Surface Soil |
| | Dermal Contact | Seeps, Surface Water, Sediments, Surface Soil |
| | Incidental Ingestion | Seeps, Surface Water, Sediments, Surface Soil |
| Visitors | Inhalation of VOCs and particulates | Seeps, Surface Water, Sediments, Surface Soil |
| Trespassers | Inhalation of VOCs and particulates | Seeps, Surface Water, Sediments, Surface Soil |
| | Dermal Contact | Seeps, Surface Water, Sediments, Surface Soil |
| | Incidental Ingestion | Seeps, Surface Water, Sediments, Surface Soil |
| **Current Scenario - Off Site** | | |
| Commercial Workers (e.g., Flea Market employees, Applied Materials employees) | Inhalation of VOCs and particulates | On-Site Seeps, Surface Water, Surface Soil |
| Residents (e.g., Harris Branch neighborhood) | Inhalation of VOCs and particulates | On-Site Seeps, Surface Water, Surface Soil |
| Recreational Use of Surface Water | Dermal Contact | Surface Water & Sediments |
| | Inhalation of VOCs | Surface Water & Sediments |
| | | Surface Water & Sediments |

# Table 6-2 Exposure Assessment - Future Risk Scenarios

| AUSTIN COMMUNITY LANDFILL RISK PATHWAY ANALYSIS | | |
|---|---|---|
| **Receptor** | **Pathway** | **Media** |
| **Future Scenario (Source Removal) - On-Site** | | |
| Truck Drivers | Inhalation of VOCs and particulates during removal action | Source Material, Leachate, Subsurface Soil |
| | Traffic Accidents | While hauling material off-site for disposal |
| Landfill Operators | Inhalation of VOCs and particulates during removal action | Source Material, Leachate, Subsurface Soil |
| | Dermal Contact | Source Material, Leachate, Subsurface Soil |
| | Incidental Ingestion | Source Material, Leachate, Subsurface Soil |
| | Mechanical Accidents | During Excavation Activities |
| Visitors | Inhalation of VOCs and particulates during removal action | Source Material, Leachate, Subsurface Soil |
| Trespassers | Inhalation of VOCs and particulates during removal action | Source Material, Leachate, Subsurface Soil |
| | Dermal Contact during removal action | Source Material, Leachate, Subsurface Soil |
| | Incidental Ingestion during removal action | Source Material, Leachate, Subsurface Soil |
| Remedial Construction Workers | Inhalation of VOCs and particulates during removal action | Source Material, Seeps, Surface Water, Surface Soil |
| | Dermal Contact during removal action | Source Material, Seeps, Surface Water, Surface Soil |
| | Incidental Ingestion during removal action | Source Material, Seeps, Surface Water, Surface Soil |
| **Future Scenario (Source Removal) - Off-Site** | | |
| Commercial Workers (e.g., Flea Market employees, Applied Materials employees) | Inhalation of VOCs and particulates | Sediments |
| | Inhalation of VOC and particulates | Source Material, Leachate, Surface Water, Subsurface Soil |
| Residents (e.g., Harris Branch neighborhood) | Inhalation of VOCs and particulates | Sediments |
| | Inhalation of VOC and particulates | Source Material, Leachate, Surface Water, Subsurface Soil |
| | Dermal Contact | Groundwater Use |
| | Inhalation of VOCs | Groundwater Use |
| | Ingestion of water | Groundwater Use |
| | Ingestion of Irrigated Vegetables | Groundwater Use |
| Recreational Use of Surface Water | Dermal Contact | Surface Water & Sediments |
| | Inhalation of VOCs | Surface Water & Sediments |
| | Incidental Ingestion | Surface Water & Sediments |

## Table 6-2 Exposure Assessment - Future Risk Scenarios (Continued)

| AUSTIN COMMUNITY LANDFILL RISK PATHWAY ANALYSIS | | |
|---|---|---|
| **Receptor** | **Pathway** | **Media** |
| **Future Scenario (Extraction and Treatment of Leachate) - On-Site** | | |
| Truck Drivers | Inhalation of VOCs during extraction and treatment activities | Leachate |
| Landfill Operators | Inhalation of VOCs during extraction and treatment activities<br>Dermal Contact<br>Incidental Ingestion | Leachate |
| Treatment System Operators | Mechanical Accidents | During Extraction Well Installation Activities and Fluid Treatment |
| Visitors | Inhalation of VOCs during extraction and treatment activities | Leachate |
| Trespassers | Inhalation of VOCs during extraction and treatment activities<br>Dermal Contact<br>Incidental Ingestion | Leachate |
| Treatment System Operators | Inhalation of VOCs during extraction and treatment activities<br>Dermal Contact<br>Incidental Ingestion | Leachate<br>Leachate<br>Leachate |
| **Future Scenario (Extraction and Treatment of Leachate) - Off-Site** | | |
| Commercial Workers (e.g., Flea Market employees, Applied Materials employees) | Inhalation of VOCs<br>Inhalation of VOC from GW<br>Inhalation of VOC from On-site Sources | Surface Water<br>VOC intrusion into buildings<br>Leachate |
| Residents (e.g., Harris Branch neighborhood) | Inhalation of VOC<br>Inhalation of VOC from GW<br>Inhalation of VOC from On-site Sources<br>Dermal Contact<br>Inhalation of VOCs<br>Ingestion of Water<br>Ingestion of Irrigated Vegetables | Surface Water<br>VOC intrusion into buildings<br>Leachate<br>Groundwater Use<br>Groundwater Use<br>Groundwater Use<br>Groundwater Use |
| Recreational Use of Surface Water | Dermal Contact<br>Inhalation of VOCs<br>Incidental Ingestion | Surface Water & Sediments<br>Surface Water & Sediments<br>Surface Water & Sediments |

### 6.1.1 Solid Waste Material and Associated Leachate

On-site solid waste material may become exposed during certain remedial activities, if implemented. This material may become airborne and migrate off-site. Other possible migration pathways for solid waste material during certain remedial activities are dermal contact or incidental ingestion. Migration of the COI to groundwater from the solid waste material is also possible via occurrence of leachate.

### 6.1.2 On-Site Subsurface Soil

Residual COI on on-site subsurface soil when exposed during certain remedial activities could become airborne and migrate off-site. Other possible migration pathways for on-site subsurface soils during certain remedial activities are dermal contact or incidental ingestion. Migration of the COI to groundwater from the subsurface soil is also possible.

### 6.1.3 Seeps and Impacted Surface Soil

Exposure of on-site workers to seeps observed at the site and surface soil impacted with these seeps could occur during work conducted to patch the seeps. Exposure can occur via dermal contact, incidental ingestion, and inhalation of volatile organics and particulates from impacted surface soil. Inhalation of volatile organics and particulates from impacted surface soil can also occur to daily site workers such as solid waste workers and truck drivers delivering solid waste to the facility. Potential exposure to volatile organics and airborne particulates may also occur to off-site residents and commercial workers from seeps and surface soils.

### 6.1.4 Impacted Surface Water and Sediments

On-site surface water and sediments may be impacted from seeps that occurred at the facility. Exposure to on-site surface water and sediments may occur to facility workers during operations to patch the seeps. Exposure pathways include dermal contact, incidental ingestion, and inhalation. Potential exposure to off-site residents may occur to impacted sediments and dissolved COI in surface water migrating off-site. Exposure pathways to off-site residents may occur via dermal contact, incidental ingestion, and inhalation of volatile organics.

### 6.1.5 Groundwater

On-site groundwater if impacted from historical operations at the site may constitute another exposure medium. Exposure to impacted groundwater will occur to off-site residents if impacted groundwater plume have migrated off-site. Exposure to off-site groundwater may occur indirectly via inhalation of volatile emissions intrusions into the buildings from the groundwater plume. Under the

future scenario, exposure to groundwater may also occur if a domestic water well is installed within the groundwater plume and used for domestic purposes. Exposure pathways include ingestion of impacted groundwater, dermal contact and inhalation of the COI during showering, and ingestion of vegetables impacted with the COI from irrigation with impacted groundwater.

## 6.2 Potential Human Receptors and Exposure Pathways

Exposure pathways are routes whereby the COI could be assimilated by a potential receptor. Exposure pathways require the existence of a receptor, the presence of the COI in a medium that the receptor contacts, and an intake route associated with the receptor.

Because exposure pathways require the presence of a receptor, these pathways depend upon uses of the site and surrounding areas. Table 6-1, and Table 6-2 identifies potential human receptors for the current and future land use scenarios. These potential receptors include individuals both on-site and off-site. The on-site area is defined as the area within the current site boundary. On-site receptors include truck drivers, landfill operators, visitors, and trespassers. Receptors in the off-site areas are defined as those individuals outside of the facility boundaries, but near the site. Off-site receptors include commercial workers, residents, and recreational users of surface water.

### 6.2.1 Current Land Use Scenario

The current land use scenario assumes that there are no changes to current activities conducted at the site and that no remediation is implemented.

**On-site**

The potential on-site receptors identified for the current scenario include landfill operators during routine daily operations and especially during work done to patch seep areas. Exposure of these receptors may occur via inhalation of volatile organics and particulates from the seep areas. Dermal exposure and incidental ingestion may also occur during seep area repair activities to seeps and surface soil, surface water and sediments impacted by seeps. Additional on-site receptors include truck drivers who deliver their loads to the facility. Exposure to truck drivers may occur via inhalation of volatile organics and particulates from the seep areas.

Visitors and trespassers may also be considered as potential on-site receptors. Visitors may be exposed to inhalation of volatile organics and particulates from the seep areas. Trespassers may be exposed to inhalation of volatile organics and

particulates from the seep areas as well as to dermal contact and incidental ingestion of seeps, surface soil, surface water, and sediments.

#### Off-site

Potential off-site receptors include neighborhood residents, commercial workers, and recreational users who may use off-site surface water for recreational purposes. Off-site residents may potentially be exposed to volatile organics and particulate inhalation from on-site seeps and surface soils as well as to volatile organic vapor intrusion into the buildings from the groundwater plume assuming the plume exists and has migrated off-site (this assumption will be verified with the proposed investigation program). A similar potential exposure scenario is assumed for the off-site commercial workers. Finally, recreational users may be exposed to the COI transported with surface water from on-site activities. Exposure to the recreational users may occur via dermal contact and incidental ingestion of surface water or sediments as well as inhalation of volatile organics and particulate emissions from surface water and sediments.

## 6.2.2 Future Land Use Scenario

### 6.2.2.1 Waste Excavation

One possible future land use scenario assumes that remedial activities at the facility will take place in the form of removal of solid waste material and placement in another cell on-site. Removal and off-site disposal of material may also occur. Leachate that may have accumulated within the cell will be removed for treatment.

#### On-site

The potential on-site receptors identified for the future land use scenario include landfill operators who may be exposed to the solid waste material and leachate during remedial activities via incidental ingestion, dermal contact, and inhalation of volatile organics and particulates. Truck drivers may be exposed to solid waste material and leachate via inhalation of volatile organics and particulates.

Mechanical accidents involving the use of heavy equipment during the excavation and loading of material may occur during remedial activities presenting risk to landfill operators.

Visitors and trespassers may also be considered as potential on-site receptors. Visitors may be exposed to inhalation of volatile organics and particulates from solid waste and leachate during remedial activities. Trespassers may also be exposed to inhalation of volatile organics and particulates from these areas as well as to dermal contact and incidental ingestion of solid waste and leachate.

#### Off-site

The potential off-site receptors for the future scenario include off-site residents, off-site commercial workers, and off-site recreational users. These potential receptors could be subjected to exposure through inhalation of volatile organic and particulate emissions from the on-site subsurface soils, solid waste, and leachate during excavation and removal activities. Exposure to impacted groundwater may occur via inhalation of vapor intrusion into buildings assuming no remediation will be conducted. Another means of exposure to groundwater may also occur via the use of groundwater assuming that groundwater has been impacted and the plume has migrated off-site. This exposure scenario assumes that a residential water well is installed within the plume and used for domestic purposes. Exposure to groundwater may occur via ingestion, dermal contact, and inhalation of volatile organic during showering.

Traffic accidents during transportation of hauled material to an off-site location may occur presenting risk to truck drivers.

Recreational users may be exposed to the COI transported with surface water from on-site activities. Exposure to the recreational users may occur via dermal contact and incidental ingestion of surface water or sediments as well as inhalation of volatile organics and particulate emissions from surface water and sediments.

### 6.2.2.2 Leachate Collection

Another possible future land use scenario also assumes that extraction of leachate from within the landfill cell may occur. Extracted fluid will be evaluated for treatment options prior to discharge to the publically owned treatment works (POTW). Another option for management of extracted fluid is the immediate discharge to the POTW without treatment.

#### On-site

The potential on-site receptors identified for the future land use scenario include landfill operators who may be exposed to the leachate during removal and treatment via incidental ingestion, dermal contact, and inhalation of volatile organics. Truck drivers may be exposed to leachate via inhalation of volatile organics.

Mechanical accidents involving the use of heavy equipment during well installation, fluid extraction, and fluid treatment may occur presenting risk to treatment system operators.

Visitors and trespassers may also be considered as potential on-site receptors. Visitors may be exposed to inhalation of volatile organics from leachate during remedial activities. Trespassers may also be exposed to inhalation of volatile organics from these operations.

### Off-site

The potential off-site receptors for the future scenario include off-site residents, off-site commercial workers, and off-site recreational users. These potential receptors could be subjected to exposure through inhalation of volatile organic emissions from the on-site leachate during extraction and treatment activities. Exposure to impacted groundwater may occur via inhalation of vapor intrusion into buildings assuming no remediation will be conducted. Another means of exposure to groundwater may also occur via the use of groundwater assuming that groundwater has been impacted and the plume has migrated off-site. This exposure scenario assumes that a residential water well is installed within the plume and used for domestic purposes. Exposure to groundwater may occur via ingestion, dermal contact, and inhalation of volatile organic during showering.

Recreational users may be exposed to the COI transported with surface water from on-site activities. Exposure to the recreational users may occur via dermal contact and incidental ingestion of surface water or sediments as well as inhalation of volatile organics and particulate emissions from surface water and sediments.

The results of the risk assessment will identify the human health risks posed by the closed industrial waste unit under current and future use conditions. This will enable WM to determine the risk posed by the closed industrial waste unit following a variety of potential future remedial actions. The information provided by the risk assessment will then be used in the feasibility study to select the most appropriate remedial action for the closed industrial waste unit.

# 7 References


Carter & Burgess, 1999, *City of Austin Private Landfill Environment Assessment.* Prepared for City of Austin, February 1999.

McBride-Ratcliff and Associates, Inc., 1992, *Comprehensive Hydrogeologic Assessment Austin Community Landfill.* Prepared for Waste Management of North America, Inc.

McBride-Ratcliff and Associates, Inc., 1986, *Evaluation of Geotechnical Character of Closed Waste Bodies, Austin Community Landfill.* Prepared for Waste Management, Inc.

OHM, 1998, *Industrial Waste Area Evaluation Report — Austin Community Landfill Closed Industrial Waste Area.* Prepared for Waste Management of Texas, Inc.

RUST, 1998, *Geophysical Survey — Austin Community Recycling and Disposal Facility.* Prepared for RUST Environmental & Infrastructure, Inc.

Texas Water Quality Board, 1977, *Investigation of an Abandoned Waste Disposal Site, Travis County, Texas.*

Wimberly, 1972, *Conceptual Engineering Report Proposed Waste Treatment Facility Travis County, Texas.* Prepared for Industrial Waste Materials Management Inc.

# Appendix A

# Sampling and Analysis Plan

# Sampling and Analysis Plan

## Closed Industrial Waste Unit
## Austin Community Landfill

Prepared by:

ThermoRetec Consulting Corporation
1301 West 25th Street, Suite 406
Austin, Texas 78705

ThermoRetec Project No.: 3-4198-300

Prepared for:

Waste Management of Texas
9900 Giles Lane
Austin, Texas 78754

July 29, 1999

# Sampling and Analysis Plan

## Closed Industrial Waste Unit
## Austin Community Landfill

Prepared by:

ThermoRetec Consulting Corporation
1301 West 25th Street, Suite 406
Austin, Texas 78705

ThermoRetec Project No.: 3-4198-300

Prepared for:

Waste Management of Texas
9900 Giles Lane
Austin, Texas 78754

Prepared by:

_____
James Greacen, Senior Hydrogeologist

Technically Reviewed by:

_____
Steve Dischler ~~Andrew J. Nietupski~~, Project Manager

July 29, 1999

# Table of Contents


1 Introduction ..... 1-1

2 Soil and Waste Sampling ..... 2-1
- 2.1 Geoprobe Installation ..... 2-1
- 2.2 Soil Borings ..... 2-2
  - 2.2.1 Borings within the Closed Industrial Waste Unit ..... 2-2
  - 2.2.2 Borings Outside the Closed Industrial Waste Unit ..... 2-12
  - 2.2.3 Unweathered Clay Sampling ..... 2-13
  - 2.2.4 Decontamination and Management of Investigation Derived Waste ..... 2-14
- 2.3 Investigation Well Installation ..... 2-15
  - 2.3.1 Closed Industrial Waste Unit Wells Installed Within the Waste ..... 2-15
  - 2.3.2 Closed Industrial Waste Unit Wells Installed Beneath the Waste ..... 2-16
  - 2.3.3 Closed Industrial Waste Unit Wells Installed Within Former Ponds ..... 2-18
  - ~~2.3.4 Recovery Well ..... 2-18~~
  - 2.3.4 Wells Installed Outside the Closed Industrial Waste Unit . 2-19
  - 2.3.5 Well Development and Surveying ..... 2-19

3 Fluids Monitoring ..... 3-1
- 3.1 Fluids Level Measurements ..... 3-1
- 3.2 Investigation Well Sampling ..... 3-1
  - 3.2.1 Well Purging ..... 3-3
  - 3.2.2 Collection of Fluid Samples ..... 3-5
  - 3.2.3 Laboratory Analysis of Fluids Samples ..... 3-5

4 Hydraulic Conductivity Testing ..... 4-1

5 Surface Water and Sediments Monitoring ..... 5-1

6 Quality Assurance ..... 6-1
- 6.1 Analytical Methods and Detection Limits ..... 6-1
- 6.2 Chain of Custody ..... 6-1
- 6.3 Quality Assurance Sampling ..... 6-1
- 6.4 Calibration ..... 6-1
- 6.5 Data Validation ..... 6-1

# List of Tables


| | | |
|---|---|---|
| Table 2-1 | Soil Sampling Summary | 2-4 |
| Table 2-2 | Appendix IX Analytes | 2-6 |
| Table 2-2 | Appendix IX Analytes (Continued) | 2-7 |
| Table 2-2 | Appendix IX Analytes (Continued) | 2-8 |
| Table 2-2 | Appendix IX Analytes (Continued) | 2-9 |
| Table 2-2 | Appendix IX Analytes (Continued) | 2-10 |
| Table 2-2 | Appendix IX Analytes (Continued) | 2-11 |
| Table 3-1 | Fluid Level Monitoring Locations | 3-2 |
| Table 3-2 | Well Purging-Field Water Quality Measurements Form | 3-4 |
| Table 3-3 | Natural Attenuation Monitoring Parameters | 3-7 |
| Table 6-1 | Quality Assurance Sampling Summary | 6-2 |
| Table 6-2 | Field Sampling Equipment Calibration Frequency | 6-3 |

# List of Figures

Figure 2-1 Summary Historical Features/Proposed Sampling Locations ..... 2-4
Figure 2-2 Typical Double Cased Well Completion ..... 2-17

# Attachment 1

## ThermoRetec Standard Operating Procedures (SOP)

SOP 110 - Packing and Shipping of Samples
SOP 120 - Decontamination
SOP 210 - Soil and Sample Collection
SOP 220 - Monitoring Well Construction and Installation
SOP 221 - Groundwater Well Development
SOP 222 - Aquifer and Step-Drawdown Tests
SOP 224 - Aquifer Slug Test
SOP 230 - Groundwater Sampling
SOP 231 - Water-Level Measurements
SOP 250 - Surface Water Sampling
SOP 260 - Lake and Stream Sediment Sampling
SOP 310 - Jar Headspace Screening
SOP 320 - Operation/Calibration HNU Photoionization Detector
SOP 330 - Field Instrument Calibration, Operation and Maintenance
SOP 410 - Quality Assurance/Quality Control Data Validation

# 1 Introduction

This Sampling and Analysis Plan provides the procedures used to collect investigation data at and around the Closed Industrial Waste Unit within the Austin Community Landfill (ACL).

The sampling program has been broken down into the following work tasks:

- soil and waste sampling;
- investigation well installations;
- fluids monitoring;
- hydraulic conductivity testing;
- surface water monitoring; and
- quality assurance/quality control data validation.

The general field methods that will be followed for all investigative work are provided in the ThermoRetec Standard Operating Procedures (SOPs) included as Attachment 1 to this Sampling and Analysis Plan. These procedures cover soil and fluids sampling; well construction and installation; well development; packing and shipment of samples; decontamination; water level measurements; headspace screening; field instrument calibration, operation, and maintenance; surface water sampling; slug tests and pump tests; and quality assurance/quality control data validation. Specific investigative details are discussed in the following sections.

# 2 Soil and Waste Sampling

## 2.1 Geoprobe™ Installation

The soil and waste sampling activities will begin by installing 20 to 40 Geoprobe™ (direct push) borings for the construction of piezometers within the Closed Industrial Waste Unit. Geoprobe™ technology will be used because it will generate a minimal amount of waste soil. These Geoprobe™ borings and piezometers will collect information to allow:

- the delineation of areas that contain buried wastes and areas of placed clay fill;
- the determination of the top of the weathered clay liner; and
- a determination of moisture content or free fluid levels within the waste or the weathered clay.

This information will be used to aid in the placement and design of investigation wells that will be installed within the Closed Industrial Waste Unit. The piezometers will be used to monitor fluid levels in the waste materials. The piezometers will not be used for sampling fluids for laboratory analysis.

The Geoprobe™ soil samplers, drill rod, and other associated equipment will be decontaminated using procedures outlined in Section 2.2.4 and SOP No. 120 (Attachment 1) prior to the commencement of the Geoprobe™ operations and between the probing of each piezometer location. The soil samplers and associated equipment will be decontaminated in wash tubs using potable water and a laboratory detergent wash followed by a potable water rinse during sampling activities. All decontamination fluids will be collected and placed into labeled and sealed drums for temporary storage onsite pending proper disposal. All soil or waste debris generated during the installation of these piezometers will be collected, placed in drums and temporarily staged onsite pending proper disposal.

Geoprobe™ samples will be collected continuously from the land surface to the total depth of the boring using a 4-foot long, 2-inch diameter sampler with a clear PVC liner. The soil samples lithology will be described by a geologist and recorded on a field log. Samples will be field screened, however no samples will be collected for laboratory analysis. The samples collected for headspace screening will be placed into properly labeled plastic storage bags and allowed to equilibrate for a minimum of 30 minutes. After the headspace samples have equilibrated, an organic vapor meter (OVM) with an 11.7 ~~11.0 or greater~~ eV lamp

will be used to screen the sample by inserting the probe into the bag and recording the meter reading. All borings will be advanced to the top of the weathered clay liner or to refusal depth. After the boring has been advanced to the intended depth, and indications of soil moisture or a fluid level has been observed, the borehole will be enlarged using a 3-inch diameter probe point. A piezometer will then be constructed within the boring. A 1-inch diameter, flush jointed, 10-foot long, Schedule 80, factory slotted (0.010-inch) PVC well screen will be set across the saturated zone within the waste, or just above the weathered clay liner. A section of 1-inch diameter, flush jointed, Schedule 80, PVC well casing will extend from the top of the casing to several feet above the land surface. A sand pack will be installed in the annulus and extend at least 2 feet above the top of the well screen. A 2-foot thick hydrated bentonite seal will be placed above the sand pack. The piezometer will be allowed to sit for twenty four hours before being gauged to determine the depth to any fluid. Saturated conditions will be defined as an accumulation of more than 1.0 ~~0.2~~ feet of fluid within a piezometer in a 24 hour period. Gauging will be accomplished with an electronic water level meter or an electronic interface probe both capable of measuring the fluid depth to an accuracy of 0.01-foot. The piezometers will then be surveyed by a registered professional surveyor for location, as well as both ground level and the top of casing elevations.

## 2.2 Soil Borings

Thirteen soil borings will be installed, within the Closed Industrial Waste Unit and adjacent to the Closed Industrial Waste Unit, to verify site stratigraphy including the limits of the weathered clay and the waste materials within the Closed Industrial Waste Unit. These borings will determine if chemical constituents found in the Closed Industrial Waste Unit have migrated vertically into the weathered clay, and characterize the waste to evaluate potential disposal and treatment options. Four additional borings may be advanced into the unweathered clay depending upon results of fluids sampling and analysis (refer to Section 2.2.3). Table 2-1, a soil sampling summary, shows the type of samples, and analytical parameters to be run on each sample.

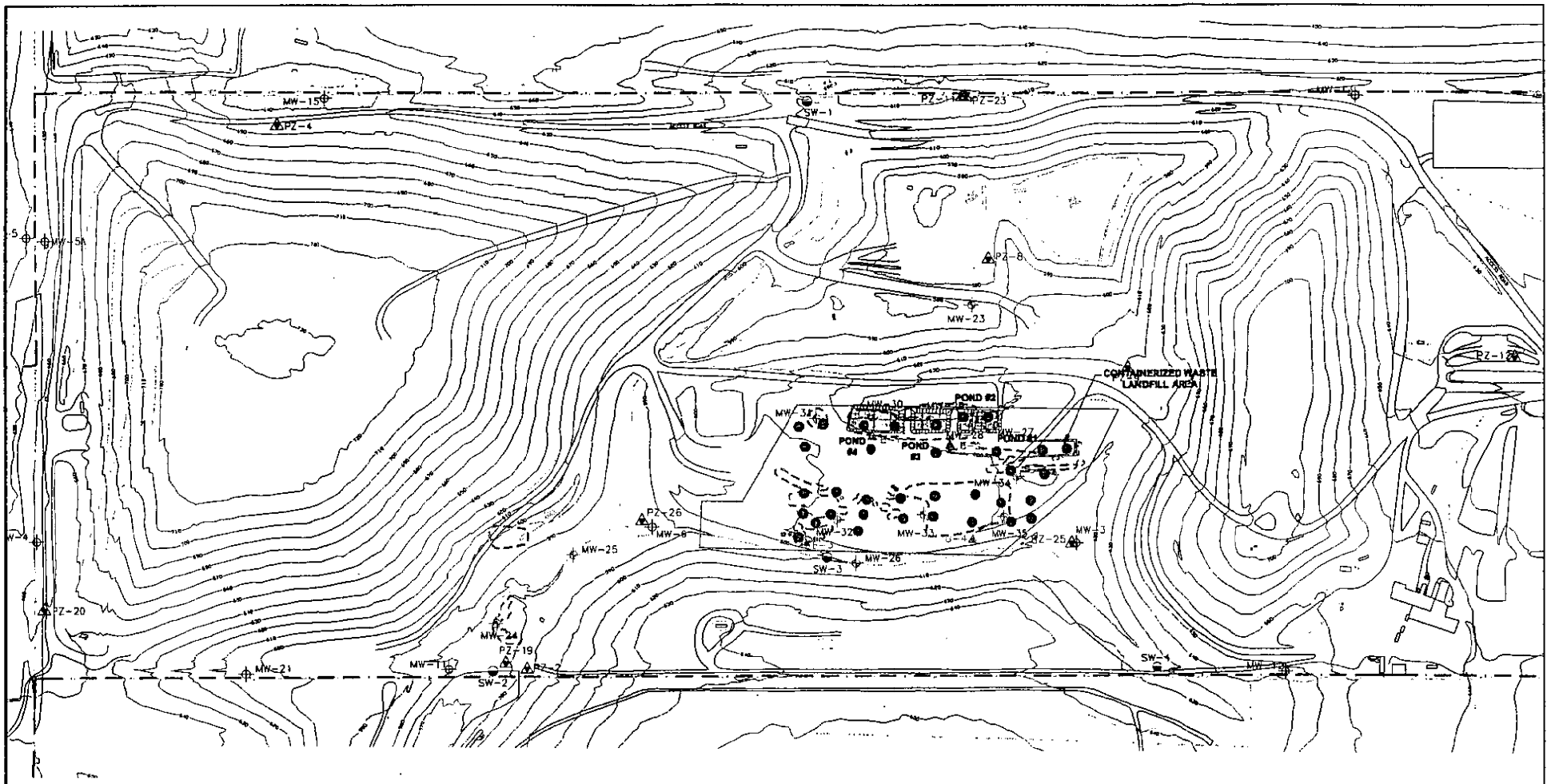
### 2.2.1 Borings within the Closed Industrial Waste Unit

The proposed nine boring locations within the Closed Industrial Waste Unit were chosen using information about the approximate positions of former liquid bulk waste ponds and the approximate locations of buried drum disposal areas. Four of the borings are located in areas of ~~if~~ suspected containerized waste and five borings are located in areas of suspected bulk waste disposal (ponds). Figure 2-1, a site layout map, shows all proposed investigation well and boring locations,

**TABLE 2-1**
**Soil Sampling Summary**
**Waste Management Inc., Austin Community Landfill**

| Sample Location | Sample ID | Sample Interval | Analytical Parameters |
|---|---|---|---|
| MW-23 | MW-23-1 | Weathered Clay | Bulk Density, TOC |
| MW-24 | MW-24-1 | Weathered Clay | Bulk Density, TOC |
| MW-25 | MW-25-1 | Weathered Clay | Bulk Density, TOC |
| MW-26 | MW-26-1 | Weathered Clay | Bulk Density, TOC |
| MW-27 | MW-27-1 | Weathered Clay | Appendix IX<br>Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| MW-28 | MW-28-1 | Weathered Clay | Appendix IX, TPH<br>Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| MW-29 | MW-29-1 | Weathered Clay | Appendix IX<br>Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| MW-30 | MW-30-1 | Weathered Clay | Appendix IX<br>Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| MW-31 | MW-31-1 | Weathered Clay | Appendix IX, TPH<br>Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| MW-32 | MW-32-1 | Clay Cap Overlying Waste | Geotechnical ASTM D5084/D2487 |
| | MW-32-2 | Waste | Appendix IX, TCLP, TPH |
| | MW-32-3 | Weathered Clay Beneath Waste | Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| MW-33 | MW-33-1 | Clay Cap Overlying Waste | Geotechnical ASTM D5084/D2487 |
| | MW-33-2 | Waste | Appendix IX, TCLP |
| | MW-33-3 | Weathered Clay Beneath Waste | Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| MW-34 | MW-34-1 | Clay Cap Overlying Waste | Geotechnical ASTM D5084/D2487 |
| | MW-34-2 | Waste | Appendix IX, TCLP |
| | MW-34-3 | Weathered Clay Beneath Waste | Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| MW-35 | MW-35-1 | Clay Cap Overlying Waste | Geotechnical ASTM D5084/D2487 |
| | MW-35-2 | Waste | Appendix IX, TCLP |
| | MW-35-3 | Weathered Clay Beneath Waste | Geotechnical ASTM D5084/D2487<br>Bulk Density, TOC |
| B-1 | B-1 | Unweathered Clay | COI |
| B-2 | B-2 | Unweathered Clay | COI |
| B-3 | B-3 | Unweathered Clay | COI |
| B-4 | B-4 | Unweathered Clay | COI |

Notes:
1. Natural Attenuation Parameters listed on Table 3-3.
2. COI Constituents of Interest determined by groundwater analytical results.
3.TPH - Total Petroleum Hydrocarbons (TNRCC Method 1005)
4. TCLP - Toxicity Characteristic Leaching Procedure is not an analytical method, but a procedure Concentrations will be determined for regulatory levels.




Remediation

WASTE MANAGEMENT OF TEXAS, INC.
AUSTIN COMMUNITY LANDFILL
3-4198-300

CURRENT DATE 4/22/99 | CADD FILE | PROPOSED SL

**SUMMARY HISTORICAL FEATURES/ PROPOSED SAMPLING LOCATIONS**

**FIGURE 2-1**

surface water sampling points, sediment sampling locations, as well as locations of existing wells and piezometers. The proposed boring locations may be revised based upon information gathered during the Geoprobe™ installation. If Geoprobe™ data indicate that the proposed sampling locations shown on Figure 2-1 should be revised, the TNRCC will be consulted prior to revising the location of any proposed soil boring.

The nine soil borings within the Closed Industrial Waste Unit will be installed using a drilling rig and hollow stem auger techniques. Prior to the commencement of drilling operations and before the drilling of each boring, the drill rig, hollow stem augers, samplers, drill rod, and other associated equipment will be decontaminated using procedures outlined in Section 2.2.4 and in SOP No. 120 located in Attachment 1.

Soil samples will be collected continuously from the ground surface to the total depth of the borings utilizing split spoon samplers or Shelby tubes. The soil sample lithology will be described by a geologist, and two composite soil samples will be collected from each advancement of the split spoon. One sample will be collected, placed in properly labeled laboratory supplied glassware, and stored in a cooler on ice for possible laboratory analysis. A second sample will be collected for headspace screening. The headspace sample will be placed into properly labeled plastic storage bags and allowed to equilibrate for a minimum of 30 minutes. After the headspace samples have equilibrated, an organic vapor meter (OVM) with an 11.7 ~~11.0 or greater~~ eV lamp will be used to screen the sample by inserting the probe into the bag and recording the meter reading. Based on visual observations of the samples and the headspace screening results, a sample from each boring will be selected for laboratory analysis.

A total of four waste samples from the drum disposal areas will be collected for laboratory analysis. All borings within the drum disposal areas will penetrate the *in situ* weathered clay liner approximately 4 feet to collect a sample of the liner for geotechnical analysis. An undisturbed Shelby tube sample (ASTM D-1587) will be collected in the overlying clay cap and the weathered clay below for geotechnical testing. Samples of the weathered clay beneath the waste will not be analyzed for chemical parameters. The unsaturated thickness between the waste and the fluid is expected to be so small that a groundwater sample will provide the necessary data. Samples of the waste will be analyzed for the chemical parameters shown on Table 2-1. Table 2-1, a soil sampling summary, shows the sample I.D., the type of sample, and analytical parameters to be run on each sample. All waste samples selected for laboratory analysis will be analyzed for Appendix IX constituents summarized in Table 2-2. Field screening and

# Table 2-2
## Appendix IX Analytes
## Waste Management Inc. Austin Community Landfill

| Compound Name | Method Used | Detection Limits | Fluid Samples | | | Soil Samples | | |
|---|---|---|---|---|---|---|---|---|
| | | | Preservation Waters | Holding Times | Sample Container | Preservation Soils | Holding Times | Sample Container |
| **Metals** | | (mg/L) | | | | | | |
| Antimony | 7041 | 0.003 | HNO3 | 6 Months | (1) 250mL Plastic | None | 6 Months | (1) 16oz Soil Jar |
| Arsenic | 7060 | 0.001 | HNO3 | 6 Months | for all metals | None | 6 Months | for all constituents |
| Barium | 6010 | 0.01 | HNO3 | 6 Months | | None | 6 Months | |
| Beryllium | 6010 | 0.005 | HNO3 | 6 Months | | None | 6 Months | |
| Cadmium | 6010 | 0.01 | HNO3 | 6 Months | | None | 6 Months | |
| Chromium | 6010 | 0.05 | HNO3 | 6 Months | | None | 6 Months | |
| Cobalt | 6010 | 0.05 | HNO3 | 6 Months | | None | 6 Months | |
| Copper | 6010 | 0.05 | HNO3 | 6 Months | | None | 6 Months | |
| Lead | 7421 | 0.001 | HNO3 | 6 Months | | None | 6 Months | |
| Mercury | 7470 | 0.0002 | HNO3 | 6 Months | | None | 6 Months | |
| Nickel | 6010 | 0.05 | HNO3 | 6 Months | | None | 6 Months | |
| Selenium | 7741 | 0.002 | HNO3 | 6 Months | | None | 6 Months | |
| Silver | 7761 | 0.002 | HNO3 | 6 Months | | None | 6 Months | |
| Thallium | 7841 | 0.001 | HNO3 | 6 Months | | None | 6 Months | |
| Tin | 6010 | 0.1 | HNO3 | 6 Months | | None | 6 Months | |
| Vanadium | 6010 | 0.05 | HNO3 | 6 Months | | None | 6 Months | |
| Zinc | 6010 | 0.01 | HNO3 | 6 Months | | None | 6 Months | |
| **Inorganics** | | (mg/L) | | | | | | |
| Cyanide | 9010 | 0.02 | NaOH & Zn AC | 14 Days | (1) 250mL Plastic | None | 14 Days | |
| Sulfide | 9030 | 1 | NaOH & Zn AC | 7 Days | | None | 7 Days | |
| **Nonhalogenated Volatile Organics** | | (ug/L) | | | | | | |
| 1,4-Dioxane | 8260 | 500 | HCL | 14 Days | (2) 40mL VOAs | None | 14 Days | |
| Acetonitrile | 8260 | 100 | HCL | 14 Days | for all Organics | None | 14 Days | |
| Isobutanol (Isobutyl alcohol) | 8260 | 100 | HCL | 14 Days | and | None | 14 Days | |
| **Volatile Haloginated Organics** | | (ug/L) | | | Volatile Organics | | | |
| Chlorobenzene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,2-Dichlorobenzene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,3-Dichlorobenzene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,4-Dichlorobenzene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,1,1,2-Tetrachloroethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,1,2,2-Tetrachloroethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,1,2-Trichloroethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,1-Dichloroethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,1-Dichloroethene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,2,3-Trichloropropane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,2-Dibromoethane (EDB) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,2-Dichloroethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,2-Dichloropropane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 2-Chloro-1,3-butadiene (Chloroprene) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Allyl chloride (3-Chloroproprene) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Bromodichloromethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |

**Table 2-2**
**Appendix IX Analytes**
**Waste Management Inc. Austin Community Landfill**

| Constituent Name | Method Used | Detection Limit | Preservation Water | Holding Time | Sample container | Preservation Soil | Holding Time | Sample container |
|---|---|---|---|---|---|---|---|---|
| Bromoform (Tribromomethane) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Carbon tetrachloride (Tetrachloromethane) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Chloroethane (ethyl chloride) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Chloroform (Trichloromethane) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Chloromethane (Methyl chloride) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| cis-1,3-Dichloropropene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Dibromochloromethane (Chlorodibromomethane) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Dibromomethane (Methylene bromide) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Dichlorodifluoromethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Methyl iodide (Iodomethane ) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Methylene chloride (Dichloromethane) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Tetrachloroethene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| trans-1,2-Dichloroethene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| trans-1,3-Dichloropropene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Trichloroethene (Trichloroethylene) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Trichlorofluoromethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Vinyl chloride | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 1,2-Dibromo-3-chloropropane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| **Nonhalogenated Volatile Organics** | | (ug/L) | | | | | | |
| 2-Butanone (MEK) | 8260 | 50 | HCL | 14 Days | | None | 14 Days | |
| 4-Methyl-2-pentanone (MIBK) | 8260 | 50 | HCL | 14 Days | | None | 14 Days | |
| Methacrylonitrile | 8260 | 100 | HCL | 14 Days | | None | 14 Days | |
| Methyl methacrylate | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Propanenitrile (Propionitrile) (Ethyl cyanide) | 8260 | 100 | HCL | 14 Days | | None | 14 Days | |
| Ethyl methacrylate | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| **Volatile Aromatics** | | (ug/L) | | | | | | |
| Benzene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Ethylbenzene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| m,p-Xylene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| o-Xylene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Styrene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Toluene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| | | | HCL | 14 Days | | None | 14 Days | |
| Acrolein | 8260 | 100 | HCL | 14 Days | | None | 14 Days | |
| Acrylonitrile | 8260 | 100 | HCL | 14 Days | | None | 14 Days | |
| | | | HCL | 14 Days | | None | 14 Days | |
| Bromomethane (methyl bromide) | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |

## Table 2-2
## Appendix IX Analytes
## Waste Management Inc. Austin Community Landfill

| Analyte Name | Method | Practical Quantitation Limit | Preservative for Water | Holding Time for Water | Special Container for Water | Preservative for Soil | Holding Time for Soil | Special Container for Soil |
|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | (ug/L) | | | | | | |
| 1,1,1-Trichloroethane | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| 2-Hexanone | 8260 | 50 | HCL | 14 Days | | None | 14 Days | |
| Acetone | 8260 | 100 | HCL | 14 Days | | None | 14 Days | |
| Carbon disulfide | 8260 | 50 | HCL | 14 Days | | None | 14 Days | |
| cis&trans-1,4-Dichloro-2-butene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| Vinyl Acetate | 8260 | 50 | HCL | 14 Days | | None | 14 Days | |
| 1,2,4-Trichlorobenzene | 8260 | 5 | HCL | 14 Days | | None | 14 Days | |
| **Chlorinated Herbicides** | | (ug/L) | | | | | | |
| 2,4-D | 8150 | 2 | None | 7 Days to extract/40 days to run extract | (4 - 5) 1L Amber Glass for all Semi-Volatile Organics head | None | 14 Days to extract/40 days to run extract | |
| Dinoseb [2-[1-methylpropyl]-4,6-dinitrophenol] | 8150 | 20 | None | | | None | | |
| 2,4,5-TP (Silvex) | 8150 | 2 | None | | | None | | |
| 2,4,5-T | 8150 | 2 | None | | | None | | |
| **Semi-Volatile Organic Compounds** | | (ug/L) | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | 8270 | 10 | None | | | None | | |
| 1,2-Dinitrobenzene | 8270 | 20 | None | | | None | | |
| 1,3,5-Trinitrobenzene | 8270 | 10 | None | | | None | | |
| 1,4-Naphthoquinone | 8270 | 10 | None | | | None | | |
| 1,4-Phenylenediamine | 8270 | 10 | None | | | None | | |
| 1-Naphthylamine | 8270 | 10 | None | | | None | | |
| 2,3,4,6-Tetrachlorophenol | 8270 | 10 | None | | | None | | |
| 2,4,5-Trichlorophenol | 8270 | 10 | None | | | None | | |
| 2,6-Dichlorophenol | 8270 | 10 | None | | | None | | |
| 2-Acetylaminofluorene | 8270 | 20 | None | | | None | | |
| 2-Methylnaphthalene (or 1-Methylnaphthalene) | 8270 | 10 | None | | | None | | |
| 2-Methylphenol (o-Cresol) | 8270 | 10 | None | | | None | | |
| 2-Naphthylamine | 8270 | 10 | None | | | None | | |
| 2-Nitroaniline | 8270 | 50 | None | | | None | | |
| 2-Picoline | 8270 | 50 | None | | | None | | |
| 3,3'-Dichlorobenzidene | 8270 | 10 | None | | | None | | |
| 3,3'-Dimethylbenzidine | 8270 | 10 | None | | | None | | |
| 3-Methylcholanthrene | 8270 | 10 | None | | | None | | |
| 3-Methylphenol (m-Cresol) | 8270 | 10 | None | | | None | | |
| 3-Nitroaniline | 8270 | 50 | None | | | None | | |
| 4-Aminobiphenyl | 8270 | 20 | None | | | None | | |
| 4-Bromophenyl phenyl ether | 8270 | 10 | None | | | None | | |
| 4-Chloroaniline (p-Chloroaniline) | 8270 | 20 | None | | | None | | |
| 4-Chlorophenyl phenyl ether | 8270 | 10 | None | | | None | | |
| 4-Methylphenol (p-Cresol) | 8270 | 10 | None | | | None | | |
| 4-Nitroaniline | 8270 | 20 | None | | | None | | |
| 4-Nitroquinoline 1-oxide | 8270 | 20 | None | | | None | | |
| 5-Nitro-o-toluidine | 8270 | 10 | None | | | None | | |

## Table 2-2
## Appendix IX Analytes
## Waste Management Inc. Austin Community Landfill

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7,12-Dimethylbenz[a]anthracene | 8270 | 10 | None | | | None | | | |
| a,a-Dimethylphenethylamine | 8270 | 100 | None | | | None | | | |
| Acetophenone | 8270 | 10 | None | | | None | | | |
| Aniline | 8270 | 10 | None | | | None | | | |
| Aramite | 8270 | 10 | None | | | None | | | |
| Benzyl alcohol | 8270 | 20 | None | | | None | | | |
| bis[2-Chloroethoxy]methane | 8270 | 10 | None | | | None | | | |
| bis[2-Chloroethyl]ether | 8270 | 10 | None | | | None | | | |
| Chlorobenzilate | 8270 | 10 | None | | | None | | | |
| Diallate (cis or trans) | 8270 | 10 | None | | | None | | | |
| Dibenzofuran | 8270 | 10 | None | | | None | | | |
| Dimethoate | 8270 | 20 | None | | | None | | | |
| Diphenylamine | 8270 | 10 | None | | | None | | | |
| Ethyl methanesulfonate | 8270 | 20 | None | | | None | | | |
| ethyl-Parathion (Parathion) | 8270 | 10 | None | | | None | | | |
| Famphur | 8270 | 20 | None | | | None | | | |
| Hexachlorophene | 8270 | 10 | None | | | None | | | |
| Hexachloropropene | 8270 | 10 | None | | | None | | | |
| Isodrin | 8270 | 20 | None | | | None | | | |
| Isosafrole | 8270 | 10 | None | | | None | | | |
| Kepone | 8270 | 20 | None | | | None | | | |
| Methapyrilene | 8270 | 100 | None | | | None | | | |
| Methylmethanesulfonate | 8270 | 10 | None | | | None | | | |
| N-Nitrosodi-n-butylamine (N-Nitrosobutylamine) | 8270 | 10 | None | | | None | | | |
| N-Nitrosodi-n-propylamine (Di-n-propylnitrosamine) | 8270 | 10 | None | | | None | | | |
| N-Nitrosodiethylamine | 8270 | 20 | None | | | None | | | |
| N-Nitrosodimethylamine | 8270 | 10 | None | | | None | | | |
| N-Nitrosodiphenylamine | 8270 | 10 | None | | | None | | | |
| N-Nitrosomethylethylamine | 8270 | 100 | None | | | None | | | |
| N-Nitrosomorpholine | 8270 | 20 | None | | | None | | | |
| N-Nitrosopiperidine | 8270 | 20 | None | | | None | | | |
| N-Nitrosopyrrolidine | 8270 | 20 | None | | | None | | | |
| O,O,O-Triethylphosphorothioate | 8270 | 10 | None | | | None | | | |
| o-Toluidine | 8270 | 10 | None | | | None | | | |
| p-Dimethylaminoazobenzene | 8270 | 10 | None | | | None | | | |
| Pentachlorobenzene | 8270 | 10 | None | | | None | | | |
| Pentachloroethane | 8270 | 10 | None | | | None | | | |
| Pentachloronitrobenzene (PCNB) | 8270 | 20 | None | | | None | | | |
| Phenacetin | 8270 | 20 | None | | | None | | | |
| Pronamide | 8270 | 10 | None | | | None | | | |
| Pyridine | 8270 | 10 | None | | | None | | | |
| Safrole | 8270 | 10 | None | | | None | | | |
| Tetraethyldithiopyrophosphate (Sulfotepp) | 8270 | 100 | None | | | None | | | |
| Thionazine (O,O-Diethyl-O-2-pyrazinylphosphorothioate) | 8270 | 100 | None | | | None | | | |

**Table 2-2**
**Appendix IX Analytes**
**Waste Management Inc. Austin Community Landfill**

| Compound Name | Method | Detection Limit | Groundwater Preservation | Groundwater Holding Time | Groundwater Container | Soil Preservation | Soil Holding Time | Soil Container |
|---|---|---|---|---|---|---|---|---|
| **Phenols** | | (ug/L) | | | | | | |
| 2,4,6-Trichlorophenol | 8270 | 10 | None | | | None | | |
| 2,4-Dichlorophenol | 8270 | 10 | None | | | None | | |
| 2,4-Dimethylphenol | 8270 | 10 | None | | | None | | |
| 2,4-Dinitrophenol | 8270 | 50 | None | | | None | | |
| 2-Chlorophenol | 8270 | 10 | None | | | None | | |
| 2-Nitrophenol | 8270 | 10 | None | | | None | | |
| 4,6-Dinitro-2-methylphenol (4,6-dinitro-o-methylphenol) | 8270 | 50 | None | | | None | | |
| 4-Chloro-3-methylphenol (p-Chloro-m-cresol) | 8270 | 20 | None | | | None | | |
| 4-Nitrophenol | 8270 | 50 | None | | | None | | |
| Pentachlorophenol | 8270 | 50 | None | | | None | | |
| Phenol | 8270 | 10 | None | | | None | | |
| **Nitroaromatics & cyclic ketones** | | (ug/L) | | | | | | |
| 2,4-Dinitrotoluene | 8270 | 10 | None | | | None | | |
| 2,6-Dinitrotoluene | 8270 | 10 | None | | | None | | |
| Isophorone | 8270 | 10 | None | | | None | | |
| Nitrobenzene | 8270 | 10 | None | | | None | | |
| **Chlorinated Hydrocarbons** | | (ug/L) | | | | | | |
| 2-Chloronaphthalene | 8270 | 10 | None | | | None | | |
| Hexachlorobenzene | 8270 | 10 | None | | | None | | |
| Hexachlorobutadiene | 8270 | 10 | None | | | None | | |
| Hexachlorocyclopentadiene | 8270 | 10 | None | | | None | | |
| Hexachloroethane | 8270 | 10 | None | | | None | | |
| **Pesticides and PCBs** | | (ug/L) | | | | | | |
| 4,4'-DDD | 8270 | 10 | None | | | None | | |
| 4,4'-DDE | 8270 | 10 | None | | | None | | |
| 4,4'-DDT | 8270 | 10 | None | | | None | | |
| Aldrin | 8270 | 10 | None | | | None | | |
| alpha-BHC | 8270 | 10 | None | | | None | | |
| Arochlor 1016 | 8270 | 20 | None | | | None | | |
| Arochlor 1221 | 8270 | 20 | None | | | None | | |
| Arochlor 1232 | 8270 | 20 | None | | | None | | |
| Arochlor 1242 | 8270 | 20 | None | | | None | | |
| Arochlor 1248 | 8270 | 20 | None | | | None | | |
| Arochlor 1254 | 8270 | 20 | None | | | None | | |
| Arochlor 1260 | 8270 | 20 | None | | | None | | |
| beta-BHC | 8270 | 10 | None | | | None | | |
| Chlordane | 8270 | 50 | None | | | None | | |
| delta-BHC | 8270 | 10 | None | | | None | | |
| Dieldrin | 8270 | 10 | None | | | None | | |
| Endosulfan I | 8270 | 10 | None | | | None | | |
| Endosulfan II | 8270 | 10 | None | | | None | | |
| Endosulfan sulfate | 8270 | 10 | None | | | None | | |
| Endrin | 8270 | 10 | None | | | None | | |

## Table 2-2
## Appendix IX Analytes
## Waste Management Inc. Austin Community Landfill

| Compound | Method | Detection Limit | Preservation | Holding Time | Sample Container | Preservation | Holding Time | Sample Container |
|---|---|---|---|---|---|---|---|---|
| Endrin aldehyde | 8270 | 10 | None | | | None | | |
| gamma-BHC (Lindane) | 8270 | 10 | None | | | None | | |
| Heptachlor | 8270 | 10 | None | | | None | | |
| Heptachlor epoxide | 8270 | 10 | None | | | None | | |
| Methoxychlor | 8270 | 10 | None | | | None | | |
| Toxaphene | 8270 | 10 | None | | | None | | |
| **PAH's/PNA's** | | (ug/L) | | | | | | |
| Acenaphthene | 8270 | 10 | None | | | None | | |
| Acenaphthylene | 8270 | 10 | None | | | None | | |
| Anthracene | 8270 | 10 | None | | | None | | |
| Benzo[a]anthracene | 8270 | 10 | None | | | None | | |
| Benzo[a]pyrene | 8270 | 10 | None | | | None | | |
| Benzo[b]fluoranthene | 8270 | 10 | None | | | None | | |
| Benzo[ghi]perylene | 8270 | 10 | None | | | None | | |
| Benzo[j or k]fluoranthene | 8270 | 10 | None | | | None | | |
| Chrysene | 8270 | 10 | None | | | None | | |
| Dibenz[a,h]anthracene | 8270 | 10 | None | | | None | | |
| Fluoranthene | 8270 | 10 | None | | | None | | |
| Fluorene | 8270 | 10 | None | | | None | | |
| Indeno[1,2,3-cd]pyrene | 8270 | 10 | None | | | None | | |
| Naphthalene | 8270 | 10 | None | | | None | | |
| Phenanthrene | 8270 | 10 | None | | | None | | |
| Pyrene | 8270 | 10 | None | | | None | | |
| **Volatile Halogenated Organics** | | (ug/L) | | | | | | |
| bis[2-Chloroisopropyl]ether | 8270 | 10 | None | | | None | | |
| **Phthlate Esters** | | (ug/L) | | | | | | |
| bis[2-Ethylhexyl]phthalate | 8270 | 10 | None | | | None | | |
| Butyl benzyl phthalate | 8270 | 10 | None | | | None | | |
| Di-n-butyl phthalate (Dibutyl phthalate) | 8270 | 10 | None | | | None | | |
| Di-n-octylphthalate (Dioctyl phthalate) | 8270 | 10 | None | | | None | | |
| Diethylphthalate | 8270 | 10 | None | | | None | | |
| Dimethylphthalate | 8270 | 10 | None | | | None | | |
| **Organophosphorus Pesticides** | | (ug/L) | | | | | | |
| Disulfoton | 8270 | 10 | None | | | None | | |
| Methyl parathion | 8270 | 10 | None | | | None | | |
| Phorate | 8270 | 10 | None | | | None | | |
| **Dioxins and Dibenzofurans** | | (ug/L) | | | | | | |
| Hexachlorodibenzo-p-dioxins | 8280 | 0.01 | None | | | None | | |
| Hexachlorodibenzofurans | 8280 | 0.01 | None | | | None | | |
| Pentachlorodibenzo-p-dioxins | 8280 | 0.01 | None | | | None | | |
| Pentachlorodibenzofurans | 8280 | 0.01 | None | | | None | | |
| Tetrachlorodibenzo-p-dioxins | 8280 | 0.01 | None | | | None | | |
| Tetrachlorodibenzofurans | 8280 | 0.01 | None | | | None | | |
| TCDD | 8280 | 0.01 | None | | | None | | |

groundwater quality will determine whether COCs are present in the soil samples that may affect TOC values. After the *in situ* weathered clay liner sample has been collected, and if the waste material is saturated, the portion of the boring below the waste in the clay liner will be plugged back with hydrated bentonite up to the waste material. The bentonite will be allowed to set for one hour before one foot of sand will be placed on top of the bentonite to protect the well screen. An investigation well will then be constructed in the boring as described in Section 2.3.1. If the waste material is not saturated, the boring will be abandoned by grouting back to the surface and a location outside of the waste area will be selected for the installation of a well screened ~~advanced to the weathered/unweathered clay contact, and a well screen will be set~~ in the weathered clay at the weathered/unweathered clay contact as described in Section 2.3.2. Telescoping drilling methods will be employed to prevent downward migration of any ~~the~~ waste material into the weathered clay.

A total of five soil samples at the former neutralization or evaporation ponds will also be collected for laboratory analysis. Soil samples of the weathered clay underlying ~~from~~ the former ponds will be analyzed for chemical parameters, ~~and the underlying clay will be analyzed for chemical~~ and geotechnical parameters related to the potential downward migration of constituents. Sampling without laboratory analysis will continue to the weathered/unweathered clay contact. Borings for investigation ~~Investigation~~ wells at neutralization or evaporation ponds will be moved downgradient of each pond and installed ~~set~~ at the weathered/unweathered clay contact.

## 2.2.2 Borings Outside the Closed Industrial Waste Unit

A total of four soil borings (MW-23 through MW-26) will be drilled to install investigation wells outside the Closed Industrial Waste Unit (refer to Figure 2-1).

These soil borings will be installed using a rotary drilling rig and hollow stem auger techniques. The drill rig, hollow stem augers, samplers, drill rod, and other associated equipment will be decontaminated using procedures outlined in Section 2.2.4 and in SOP No. 120 (Attachment 1) prior to the commencement of drilling operations and before the drilling of each boring. All soil or waste debris generated during the installation of these borings will be collected, placed in labeled and sealed drums and temporarily staged onsite pending proper disposal.

During the installation of the borings, soil samples will be collected continuously from the ground surface to the weathered/unweathered clay contact utilizing a split spoon sampler. The soil sample lithology from each split spoon sample will

be described by a geologist, and a composite soil sample will be collected for headspace screening. The headspace sample will be placed into sealed plastic storage bags that have been properly labeled, and allowed to equilibrate for a minimum of 30 minutes. After the headspace samples have equilibrated, an OVM with an 11.7 ~~11.0 or greater~~ eV lamp will be used to screen the sample by inserting the probe into the bag and recording the meter reading. One sample will be analyzed for the parameters listed in Table 2-1. ~~No laboratory analysis of these soil samples is planned.~~ ~~All borings~~ Borings outside the Closed Industrial Waste Unit will be advanced to the weathered/unweathered ~~unweathered/weathered~~ clay contact. When the weathered/unweathered clay contact is encountered, an additional split spoon sample will be collected to confirm that the contact has been reached. An investigation well will then be constructed in each boring as described in Section 2.3.

## 2.2.3 Unweathered Clay Sampling

Sampling of the unweathered clay will be performed based upon results of groundwater sampling. If results of groundwater sampling indicate that constituents of interest are not present in the weathered clay beneath the Closed Industrial Waste Unit, soil sampling in the unweathered clay is unwarranted. If Appendix IX analysis of groundwater samples collected beneath the Closed Industrial Waste Unit contain concentrations of constituents of interest (COI), four additional soil borings will be advanced through the Closed Industrial Waste Unit and 30 feet into the unweathered clay to collect a sample unweathered clay for laboratory analysis. The specific locations of the samples will be based upon earlier stages of the investigation. Locations will be selected within the Closed Industrial Waste Unit that do not contain waste to avoid inadvertent migration of waste materials into the unweathered clay during drilling. The TNRCC will be consulted prior to the selection of drilling locations.

These investigation borings will be installed using a rotary drilling rig and hollow stem auger techniques. During the advancement of the borings, continuous soil samples will be collected beginning 10 feet above the estimated elevation of the contact between the weathered and unweathered clay units. Soil samples will be collected continuously utilizing a split spoon sampler. The soil sample lithology from each split spoon sample will be described by a geologist, and a composite soil sample will be collected for headspace screening. The headspace sample will be placed into sealed plastic storage bags that have been properly labeled, and allowed to equilibrate for a minimum of 30 minutes. After the headspace samples have equilibrated, an OVM with an 11.7 ~~11.0 or greater~~ eV lamp will be used to screen the sample by inserting the probe into the bag and recording the meter

readings. Once the contact is confirmed, the borings will be advanced 30 feet into the unweathered clay without sampling.

Telescoping drilling techniques will be employed avoid any downward migration of contaminants. Once the weathered/unweathered clay contact is encountered, a six-inch or larger Schedule 40, PVC casing will be set into the top of the unweathered clay. The annulus of the casing will be sealed by pressure grouting with cement/bentonite grout. Any groundwater in the boring and casing will be removed prior to any further advancement of the boring. After allowing 24 hours for the cement grout to harden, the boring will then be advanced 30 feet into the unweathered clay prior to sample collection.

A split spoon sample of the unweathered clay at the bottom of the boring will be collected, placed in properly labeled laboratory supplied glassware, and stored in a cooler on ice for delivery to an approved laboratory for analysis. This sample will be analyzed for COI detected in groundwater samples. The soil sample lithology will be described by a geologist, and a composite soil sample will be collected for headspace screening. The headspace sample will be placed into sealed plastic storage bags that have been properly labeled, and allowed to equilibrate for a minimum of 30 minutes. After the headspace samples have equilibrated, an organic OVM with an 11.7 ~~11.0 or greater~~ eV lamp will be used to screen the sample by inserting the probe into the bag and recording the meter reading.

After the sampling is complete, the bore hole will be abandoned by the placement of neat cement grout from the total depth back to the surface. The casing will remain in place after being filled with cement grout from total depth back to the surface.

### 2.2.4 Decontamination and Management of Investigation Derived Waste

Prior to the commencement of drilling operations and before the drilling of each boring, the drill rig, hollow stem augers, samplers, drill rod, and other associated equipment will be decontaminated with a high pressure spray washer. During sampling activities, the split spoon samplers and associated equipment will be decontaminated in wash tubs using potable water and a laboratory detergent wash followed by a potable water rinse. All decontamination fluids will be collected and placed into labeled and sealed drums for temporary storage onsite pending proper disposal. Also, all soil or waste debris generated during the installation of these borings will be collected, placed in labeled and sealed drums and temporarily staged onsite pending proper disposal. All investigation derived waste

drums will be stored on pallets and covered to prevent drum deterioration. Samples of all liquid and solid investigation derived waste will be collected for laboratory analysis to characterize the materials for proper disposal. Liquid samples will be analyzed for constituents detected in water samples collected from investigation wells within the closed industrial waste unit. Soil and waste debris will be analyzed to determine Toxicity Characteristic Leaching Procedures (TCLP) concentrations and the 7-Day Distilled Water Leachate Test's Maximum Contamination Levels.

## 2.3 Investigation Well Installation

Investigation wells will be constructed in the nine soil borings installed within the Closed Industrial Waste Unit to assess the hydraulic behavior and fluid quality within the Closed Industrial Waste Unit. Wells installed in the Closed Industrial Waste Unit will be installed either in the waste material or in the weathered clay beneath the waste depending upon the saturation level of the waste. Those wells that are advanced into former ponds may not encounter waste. These wells will be installed across the water table or to ~~at~~ the base of the weathered clay unit (weathered/unweathered clay contact). The installation of PVC well screens and casings are planned for all investigation well completions. However, wells completed within the Closed Industrial Waste Unit may require the installation of stainless steel well screens due to the possibility of encountering fluids that are incompatible with the PVC well screens.

### 2.3.1 Closed Industrial Waste Unit Wells Installed Within the Waste

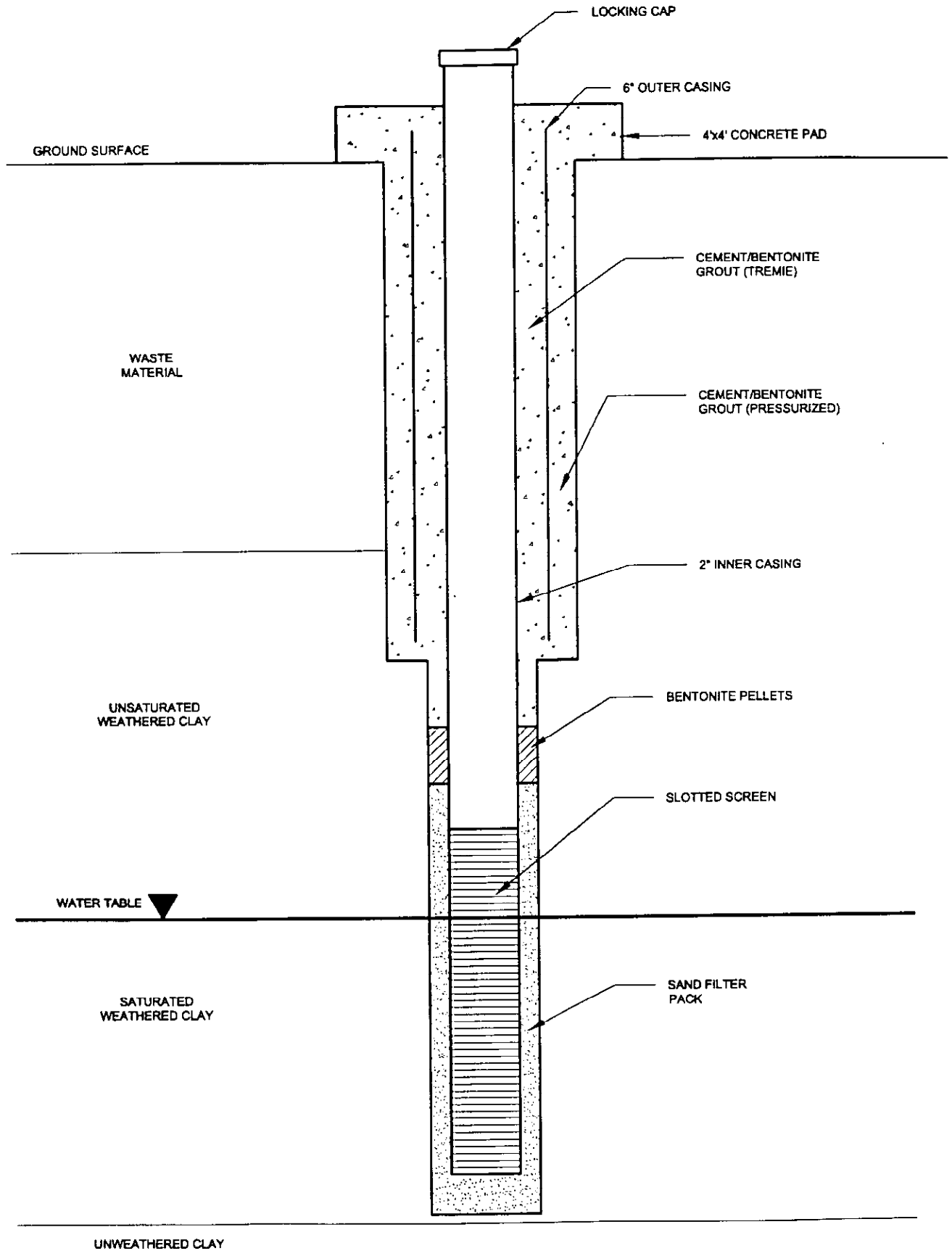
All borings within the Closed Industrial Waste Unit will be sampled to identify the presence of waste. In those borings where waste is encountered, samples will be collected to identify the base of the waste. If the waste appears saturated, a well will be installed within the waste to evaluate fluids quality within the waste. Soil borings for these wells will penetrate the *in situ* weathered clay liner to collect a sample and identify the base of the waste, and will be plugged back with hydrated bentonite into the waste material before wells are installed. The bentonite plug will be allowed to sit for one hour before one foot of sand is placed on top of the bentonite to protect the well screen.

A 2-inch diameter, flush jointed, 10-ft long, Schedule 40 PVC well screen, factory slotted (0.010-inch slot) will be set below the top of the fluid within the waste material. A longer well screen will be used if the distance between the top of the fluid and the base of the waste is greater than 10 feet. If the presence of non-

aqueous phase liquid (NAPL) is suspected, a stainless steel well screen will be used. A sand pack will be installed in the annulus and extend 2 feet above the top of the well screen but below the top of the fluid. A 2-foot thick hydrated bentonite seal will be placed above the sand pack, and the well will be grouted with neat cement grout to the surface. The wells will be capped with a locking well cap, and protected with a steel stick-up well vault with a padlock, and a ~~4 foot by 4 foot~~ concrete pad.

## 2.3.2 Closed Industrial Waste Unit Wells Installed Beneath the Waste

If waste is encountered during soil sampling, but the waste does not appear to be saturated, the boring will be grouted to the surface and a location outside of the waste area will be selected for the installation of an investigation well ~~will be installed~~ screened in the weathered clay. ~~beneath the waste to evaluate fluids quality beneath the waste.~~ For these wells, an enlarged boring diameter will be advanced several feet into the weathered clay where a protective string of Schedule 40, PVC casing (8 inches or larger in diameter) will be set into the clay liner beneath the waste to avoid any downward migration of contaminants. The annulus of the casing will be pressure grouted with neat cement/bentonite grout. Any groundwater in the boring and casing will be removed prior to any further advancement of the boring. The boring will then be advanced, through the casing, to the weathered/unweathered clay contact. A 10-foot section of 2-inch diameter, flush jointed, Schedule 40 PVC well screen (0.010-inch slot) will be place at the base of the boring. The well screen, sand pack, and bentonite seal will be constructed such that the well is isolated from the overlying waste. A shorter well screen will be used, if necessary, to allow the top of the screen to be set below the fluid level, and construction of the well within the weathered clay beneath the waste. The well ~~Well~~ casing will extend from the top of the well screen to approximately 4 feet above land surface. A sand pack will be installed in the annulus and extend 2 feet above the top of the well screen. A 2-foot thick hydrated bentonite seal will be placed above the sand pack, and the well will be grouted with neat cement grout to the surface. The wells will be capped with a locking well cap, and protected with a steel stick-up well vault with a padlock, and a ~~4 foot by 4 foot~~ concrete pad. Figure 2-2 shows a typical double cased well completion.




ThermoRetec

WASTE MANAGEMENT
AUSTIN COMMUNITY LANDFILL
3-4198-300

| NO | DRWN | DATE | REVISION | CHKD | DATE | APPVD | DATE |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 0 | GWC | 6/8/99 | ORIGINAL ISSUE | MR | 6/8/99 | MR | |

DATE 6/8/99

FILE WELL

TYPICAL DOUBLE CASE WELL

DRAWING NO. FIGURE 2-2

REVISION

### 2.3.3 Closed Industrial Waste Unit Wells Installed Within Former Ponds

Waste may not be encountered in borings advanced into former ponds (MW-27 through MW-31). If waste is not encountered at these locations, the screened interval of the investigation well will be determined based upon field observations. If headspace screening of soil samples indicate above background levels of VOCs in saturated soils and saturated conditions are encountered, the well will be screened at that interval. Otherwise, the well will be moved downgradient of each pond and installed at the weathered/unweathered clay contact. The borehole will be grouted as necessary to the elevation of the base of the monitoring well. A minimum of 1 foot of sand will be placed between the base of the well and the grout prior to installing the well. Well installation techniques will be the same as for other wells within the Closed Industrial Waste Unit. A 10-foot section of 2-inch diameter, flush jointed, Schedule 40 PVC well screen (0.010-inch slot) will be placed at the base of the boring. Well casing will extend from the top of the well screen to approximately 4 feet above land surface. A sand pack will be installed in the annulus and extend 2 feet above the top of the well screen. A 2-foot thick hydrated bentonite seal will be placed above the sand pack, and the well will be grouted with neat cement grout to the surface. The wells will be capped with a locking well cap, and protected with a steel stick-up well vault with a padlock, and a 4 foot by 4 foot concrete pad.

### ~~2.3.4 Recovery Well~~

~~A recovery well will be installed, adjacent to one of the investigation wells located within the Closed Industrial Waste Unit. The recovery well will be installed adjacent to an investigation well that appears to be placed within saturated waste materials most capable of yielding recoverable quantities of fluids. No soil samples will be collected during the installation of this boring. This well will be constructed with a 4-inch diameter, flush jointed, Schedule 40, factory slotted (0.010-inch) well screen set from the base of the waste to across the water table within the waste material. A section of 4-inch diameter, flush jointed, Schedule 40 well casing will extend from the top of the well screen to approximately 2 feet above land surface. A sand pack will be installed in the annulus and extend 2 feet above the top of the well screen. A 2-foot thick hydrated bentonite seal will be placed above the sand pack, and the well will be grouted with neat cement grout to the surface. The well will be capped with a locking well cap, and protected with a steel stick-up well vault with a padlock, and a 4 foot by 4 foot concrete pad.~~

## 2.3.4 ~~2.3.5~~ Wells Installed Outside the Closed Industrial Waste Unit

An investigation well will also be constructed in each of the four borings completed outside the Closed Industrial Waste Unit to evaluate the potential for lateral migration, and to investigate potential mounding effects of nearby municipal solid waste cells. A 2-inch diameter, flush jointed, 10-ft long, Schedule 40, factory slotted (0.010-inch) well screen will be set in each boring at the weathered/unweathered clay contact. A section of 2-inch diameter, flush jointed, Schedule 40 well casing will extend from the top of the well screen to approximately 4 feet above land surface. A sand pack will be installed in the annulus and extend 2 feet above the top of the well screen. A 2-foot thick hydrated bentonite seal will be placed above the sand pack, and the well will be grouted with neat cement grout to the surface. The wells will be capped with a locking well cap, and protected with a steel stick-up well vault with a padlock, and a 4 foot by 4 foot concrete pad.

## 2.3.5 ~~2.3.6~~ Well Development and Surveying

All wells will be gauged to determine water level elevations and/or the presence of lighter-than-water nonaqueous phase liquid (LNAPL) or denser-than-water nonaqueous phase liquid (DNAPL) using an electronic interface probe. The wells will be developed remove fine materials and correct any formation damage caused by drilling. Well development will be considered complete when at least three well volumes of water has been removed from each well, or ~~and~~ the water is free of fine material.

All borings and investigation wells installed as part of this work plan will be surveyed under the direction of ~~by~~ a registered professional surveyor for location, as well as both ground level and the top of casing elevations.

# 3 Fluids Monitoring

Fluids monitoring consists of water level measurements, fluids sampling, and hydraulic conductivity testing. Water level measurements will be performed at all ~~a~~ wells within the ACL. Fluids sampling and hydraulic conductivity testing will be performed at newly installed wells.

## 3.1 Fluids Level Measurements

Fluids level measurements will be performed following installation of investigation monitoring wells. All newly installed investigation wells, as well as other accessible site wells will be gauged to determine fluids elevations and the presence of ~~non-aqueous phase liquid (~~NAPL~~)~~ using an electronic interface probe. Table 3-1 lists the existing wells at the ACL, and wells to be installed. Water level measurements will be made from the referenced top of casing to the fluids surface and to the bottom of the well. Measurements will be performed in a single day and in accordance with SOP No. 231 in Attachment 1.

## 3.2 Investigation Well Sampling

Sampling of investigation wells will occur during two sampling events. The first sampling event will include newly installed wells MW-27 through MW-35 installed within the Closed Industrial Waste Unit. These wells will be analyzed for Appendix IX constituents as shown on Table 2-2. Newly installed wells outside the Closed Industrial Waste Unit will be sampled once the results of the first round of sampling are received and evaluated. Newly installed wells MW-23 through MW-26 outside the Closed Industrial Waste Unit and existing wells MW-3, MW-6, and MW-11 will be analyzed for those constituents observed in samples collected from investigation wells installed in the unweathered clay within the Closed Industrial Waste Unit. TNRCC will be consulted prior to selecting an analyte list for wells outside the Closed Industrial Waste Unit.

Fluids level measurements will be taken at monitoring wells prior to fluid sampling to establish a baseline for monitoring drawdown during well purging. Measuring the depth of the well should be avoided prior to sampling in order to minimize any disturbance of fine grained material induced by water level measurement. The depth of fluid is measured from a notch or marking on the top of the inner casing of the monitoring well using an electric water level meter. The meter consists of a probe attached to a tape which is marked at 0.01-foot increments. The probe and any tape which enters the monitoring well will be decontaminated before it is placed in the next well.

## Table 3-1 Fluid Level Monitoring Locations

| Existing Wells | Existing Piezometers | Proposed Investigation Wells |
|---|---|---|
| MW-1A | PZ-2 | MW-23 |
| MW-1B | PZ-5 | MW-24 |
| MW-2A | PZ-12 | MW-25 |
| MW-2B | PZ-15 | MW-26 |
| MW-3 | PZ-16 | MW-27 |
| MW-4 | PZ-17 | MW-28 |
| MW-5A | PZ-18 | MW-29 |
| MW-6 | PZ-20 | MW-30 |
| MW-11 | PZ-21 | MW-31 |
| MW-12 | PZ-22 | MW-32 |
| MW-13 | PZ-24 | MW-33 |
| MW-15 | PZ-25 | MW-34 |
| MW-20 | PZ-26 | MW-35 |
| MW-21 | | |

### 3.2.1 Well Purging

Before fluid samples are collected, each well will be purged to insure that the analytical results of the samples collected are representative of the aquifer surrounding the well. Fluid will be purged with an adjustable rate electric submersible, bladder, Wattera™ or peristaltic pump equipped with Teflon, polyethylene or other nonreactive tubing. Small diameter (¼-inch or ⅜-inch) tubing is preferred. Peristaltic pumps should be limited to shallow applications as they can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. The inlet of the tubing or submersible pump will be lowered to the center of the screen interval of the well. Care will be taken to avoid disturbing any sediment that may have accumulated in the bottom of the well. Water will then be pumped from the well at a low flow rate so that fine-grained soil is not disturbed in the well casing, sandpack, or surrounding formation. During purging the maximum sustainable pumping rate will be measured for reference during sampling. The maximum sustainable pumping rate will be defined as the rate which does not lower the water level in the well by more than six inches. Purging rates of less than one liter per minute are preferred.

Fluid will be pumped from the well into a flow-through chamber containing probes to measure the water temperature, pH, turbidity, conductivity, oxidation-reduction potential, and dissolved oxygen using a properly calibrated YSI Model 610-D Water Quality Logger or equivalent. Other monitoring equipment that may be used include the Horiba U-10 Water Quality meter. During well purging, monitor indicator field parameters every five minutes (or less frequently if appropriate). Ä ~~An~~ form for recording indicator field parameters is included as Table 3-2. Copies of this form may be used in the field to record purge parameters.

Specific equipment may not monitor all six of the above-mentioned parameters. To maintain flexibility with the equipment to be used, a minimum of four of the six parameters be monitoring during purging. After passing through the flow-through chamber, the water will be discharged to a five-gallon bucket or other graduated container where the pumping rate will be measured with a watch. Water collected in the container will be transferred to a transportable container or onsite tank where it will be stored at the site for future disposal.

Fluid samples will be collected for laboratory analysis when the fluid monitoring parameters have stabilized; the change between a minimum of successive readings of temperature, pH, conductivity, oxidation-reduction potential, and dissolved oxygen are less than 10%. Stabilization of turbidity will also be achieved when turbidity is reduced to 5 NTU or less. This may occur prior to removal of three

# Table 3-2

EXAMPLE (Minimum Requirements)



## Well PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name) _____ Depth to _____/_____ of screen
Well Number _____ Date _____ (below MP) top bottom
Field Personnel _____ Pump Intake at (ft. below MP) _____
Sampling Organization _____ Purging Device; (pump type) _____
Identify MP _____

| Clock Time 24 HR | Water Depth below MP ft | Pump Dial[1] | Purge Rate ml/min | Cum. Volume Purged liters | Temp. °C | Spec. Cond.[2] µS/cm | pH | ORP/ Eh[3] mv | DO mg/L | Turb-idity NTU | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Notes:
1. Pump dial setting (for example: hertz, cycles/min, etc.).
2. µSiemens per cm(same as µmhos/cm) at 25 °C.
3. Oxidation reduction potential (stand in for Eh).

well volumes. Stabilization of fluid measurements are considered indicative of sampling fresh formation fluids and is a more reliable indicator of purging than removal of a standard volume of water. The final purge volume will be greater than the stabilized drawdown volume plus the extraction tubing volume.

Stabilization of field parameters indicate that conditions are suitable for sampling. Achievement of stable drawdowns of less than six inches and turbidity levels of less than 5 NTU, while desirable, are not likely given the permeability of the clays at the ACL. Stabilization of other parameters may indicate that conditions are suitable for sampling ~~pumping~~. If after one hour of purging field parameters have not stabilized, the sampler may continue purging or collect a sample and note that stabilization of field parameters was not achieved.

Given the low permeability of the clays at the ACL, stabilization of drawdown even at low flow rates may not be feasible. For these wells that recharge more slowly than the extraction rate and the well is dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect a sample. The sample may be collected even though indicator field parameters have not stabilized.

## 3.2.2Collection of Fluid Samples

Laboratory samples will be obtained following the completion of purging and fluid stabilization. To obtain the samples, the pumping rate should be lowered to less than or equal to the maximum sustainable pumping rate. The laboratory supplied containers will be filled directly from the outlet of the sampling pump tubing with minimal disturbance and placed on ice in a cooler for submittal to the laboratory. For collection of samples for VOC analysis, the outlet tubing should be completely filled with water. Methods to ensure this occurs include adjusting the tubing angle upward to completely fill the tubing, restricting the diameter of the tubing near the outlet of the tubing, or a slightly increasing the flow rate to completely fill the tubing.

Although low flow sampling can eliminate the need for field filtering samples, if turbidity remains high, ~~and~~ field filtering may ~~will~~ be conducted using an in-line, 0.45 micron filter.

## 3.2.3Laboratory Analysis of Fluids Samples

Water samples will be collected from the nine investigation wells within the Closed Industrial Waste Unit, (MW-27 through MW-35) for laboratory analysis. All water samples will be analyzed for Appendix IX constituents and natural

attenuation parameters. Table 2-2 summarizes the laboratory analytical methods, sample preservation, holding times and detection limits. Table 3-3 lists the natural attenuation parameters. Additional analysis for isotopes and geochemical parameters may also be performed to characterize fluids within the waste and underlying weathered clay. All development water, as well as decontamination water will be collected in labeled and sealed, 55-gallon drums and temporarily staged at the site pending proper disposal.

After receiving the analytical results from the investigation wells within the Closed Industrial Waste Unit, water samples will then be collected for laboratory analysis from the four investigation wells located outside the Closed Industrial Waste Unit, and existing monitoring wells MW-3, MW-6, MW-11. The analyte list will be based upon the constituents detected in samples collected from investigation wells within the Closed Industrial Waste Unit. TNRCC will be consulted prior to selecting the analyte list for fluids samples collected outside of the Closed Industrial Waste Unit. Samples will be collected using the low flow sampling methodology outlined above.

## Table 3-3 Natural Attenuation Monitoring Parameters

| Parameter | Analytical Method |
|---|---|
| pH | Field Measured |
| Specific Conductance | Field Measured |
| Turbidity | Field Measured |
| Temperature | Field Measured |
| Oxygen Reduction Potential | Field Measured |
| Dissolved Oxygen | Field Measured |
| Dissolved Oxygen | AM 15.2 |
| Carbon Dioxide | AM 15.2 |
| Nitrate/Nitrite | EPA 353.1 |
| Nitrogen | AM 15.2 |
| Methane | AM 15.2 |
| Total Iron | EPA 6010 |
| Ferrous Iron | Field Measured |
| Total Manganese | EPA 6010 |
| Dissolved Manganese | EPA 6010 |
| Sulfate | EPA 9038 |
| Sulfide | EPA 9030 |
| Chloride | EPA 9251 |
| Alkalinity | EPA 310.1 |
| Total Dissolved Solids | EPA 160.1 |

Notes:

1. AM - Air Method
2. EPA - United States Environmental Protection Agency

# 4 Hydraulic Conductivity Testing

Slug tests will be conducted on all thirteen ~~twelve~~ of the newly installed investigation wells. These test results will be used to estimate the hydraulic conductivity of the waste materials within the Closed Industrial Waste Unit and the weathered clay. Rising head and falling head slug tests will be conducted using a weighted slug, and a data logger and pressure transducer. Additional details regarding slug testing procedures are included in SOP No. 224 located in Attachment 1. Water derived from the slug tests will be collected in labeled and sealed containers and temporarily staged at the site pending proper disposal.

~~A 72-hr sustainable yield test will be conducted on the newly installed recovery well. The purpose of this test is to determine whether fluids extraction is a viable remedial alternative for the waste. Although drawdown data will be collected as part of the test, the objective of the test is not to obtain detailed hydraulic characteristics. Rather, the test is designed to obtain an estimate of the volume of water that may be withdrawn from a representative area of the waste.~~

~~This test will be conducted with a submersible pump. After initial drawdown, the pumping rate will be adjusted until the maximum sustainable yield of the waste material is established. Pumping will continue at a constant drawdown for 72-hours. Drawdowns in the pumping well and the nearby investigation monitoring well will be measured periodically throughout the sustainable yield test. If flow rates are excessive, the pumping test may be discontinued prior to 72 hours. Details on these test procedures are provided in SOP No. 222 included in Attachment 1. All water derived from the slug tests and sustainable yield tests will be collected in labeled and sealed containers and temporarily staged at the site pending proper disposal.~~

# 5 Surface Water and Sediments Monitoring

Surface water samples and sediment samples will be collected at four locations within drainage areas at the ACL. One surface water sample and one sediment sample will be collected at each of the four locations.

Surface water samples will be collected from the drainage system entering and exiting the Austin Community Landfill to assess surface water quality. Two separate surface water sampling events will be conducted. One sampling event will be completed during a period of normal surface water flow. The second event will be conducted 24 hours after a significant rain event, to collect samples during a higher surface water flow rate. Samples will be collected at four sampling points (SW-1, SW-2, SW-3, and SW-4) as shown on Figure 2-1. Staff gauges will be installed at each sampling location, and will be surveyed by a registered professional surveyor to enable surface water elevations to be determined.

One sample will be collected from the drainage as it enters the facility from the north. A second sample will be collected from the drainage as if exits the facility to the south. A third sample will be collected from a drainage adjacent to the south side of the Closed Industrial Waste Unit. A fourth sample will be collected from the drainage as it enters the facility from the south. The sample containers will be filled directly from the surface water using procedures outlined in SOP No. 250 in Attachment 1. Samples will be analyzed for the constituents of interest identified in soil samples collected within the Closed Industrial Waste Unit.

One set of sediment ~~Sediment~~ samples will be collected in the same four locations as the surface water samples. Samples will be collected with a hand trowel or similar device in accordance with SOP No. 260 in Attachment 1. As with the surface water samples, sediment samples will be analyzed for selected Appendix IX constituents identified during the investigation within the Closed Industrial Waste Unit. Table 2-2 summarizes the laboratory analytical methods, sample preservation, and holding times.

# 6 Quality Assurance

This section describes the field and laboratory quality assurance requirements for the work described in this plan.

## 6.1 Analytical Methods and Detection Limits

Table 2-2 summarizes quality assurance requirements for specific analytes included in the ACL laboratory analysis program including analytical method, preservation requirements, maximum holding times, and estimated detection limits for soil and groundwater.

## 6.2 Chain of Custody

Chain-of-custody procedures have been developed to document sample possession in the field, during shipment, and in the laboratory from the time of collection to disposal. This information is critical in order to demonstrate that samples have remained under the control of responsible and accountable field and laboratory personnel. Field chain-of-custody procedures are detailed in SOP No. 110 in Attachment 1. These procedures are designed to document the history of sample custody from collection through shipping.

## 6.3 Quality Assurance Sampling

Table 6-1 summarizes field and laboratory quality assurance sampling which will be performed as part of the work described in this work plan. The table indicates when sample collection or preparation is required by field personnel.

## 6.4 Calibration

Table 6-2 summarizes calibration requirements for field screening equipment. Calibration requirements for laboratory analytical equipment are detailed in the particular laboratory's QA manual. Depending upon the laboratory selected to perform analysis of the samples collected in this investigation, the specific calibration requirements may vary.

## 6.5 Data Validation

Data validation is the process by which the results of quality assurance sampling described in the previous section are used to quantitatively and qualitatively evaluate the results of laboratory analysis. Procedures for data validation are presented in SOP 410, which is located in Attachment 1.

## Table 6-1 Quality Assurance Sampling Summary
### Austin Community Landfill

| SAMPLE | FREQUENCY | SAMPLE REQUIREMENTS |
|---|---|---|
| **FIELD QA SAMPLES** | | |
| Field Duplicate | 1 per 10 samples | Bottles provided by lab. Sample collected in field. |
| Field Blank | 1 per 20 samples | Bottles and deionized water provided by lab. Samples prepared in field. |
| Trip Blank | 1 per cooler with groundwater VOC samples. | Prepared samples provided by lab. Samples should be kept in cooler and shipped with samples. |
| Equipment Rinseate Blank | 1 per 10 samples | Bottles and deionized water provided by lab. Samples prepared in field. |
| **LABORATORY QA SAMPLES** | | |
| Blank Spike | 1 per 20 samples | Laboratory specific requirement |
| MS/MSD | 1 per 20 samples | Laboratory specific requirement |
| Surrogate Analysis | every sample | Laboratory specific requirement |
| Method Blank | 1 per 20 samples | Laboratory specific requirement |

## Table 6-2 Field Sampling Equipment Calibration Frequency
### Austin Community Landfill

| INSTRUMENT | MODEL | CALIBRATION PROCEDURE | CALIBRATION FREQUENCY |
|---|---|---|---|
| pH meter | YSI Model 3560 or equivalent | Two-point calibration with pH buffers 7 and 4, or 7 and 10, as appropriate | Daily |
| Conductivity meter | YSI Model 3560 or equivalent | Conductivity solution standard | Monthly |
| Thermometer | YSI Model 3560 or equivalent | Check with ohm meter or standard thermometer | Annually |
| Photo ionization detector | HNu PI 101 or equivalent | Isobutylene gas standard | Daily |
| Electric water-level probe | Solinst Model 101 or equivalent | Test probe in tap water; check tape against known length | Probe: as needed if malfunctions; tape length: annually |
| Electric oil/water probe | Keck KIR 89 or equivalent | Test probe in sample of liquid to be measured; check tape against known length | Probe: at start of site measurements; tape length: annually |

# Attachment 1
# ThermoRetec Standard Operating Procedures (SOP)

SOP 110 - Packing and Shipping of Samples
SOP 120 - Decontamination
SOP 210 - Soil and Sample Collection
SOP 220 - Monitoring Well Construction and Installation
SOP 221 - Groundwater Well Development
SOP 222 - Aquifer and Step-Drawdown Tests
SOP 224 - Aquifer Slug Test
SOP 230 - Groundwater Sampling
SOP 231 - Water-Level Measurements
SOP 250 - Surface Water Sampling
SOP 260 - Lake and Stream Sediment Sampling
SOP 310 - Jar Headspace Screening
SOP 320 - Operation/Calibration HNU Photoionization Detector
SOP 330 - Field Instrument Calibration, Operation and Maintenance
SOP 410 - Quality Assurance/Quality Control Data Validation

# ATTACHMENT 1

## ThermoRetec's Standard Operating Procedures

# Attachment 1
# ThermoRetec Standard Operating Procedures (SOP)

SOP 110 - Packing and Shipping of Samples
SOP 120 - Decontamination
SOP 210 - Soil and Sample Collection
SOP 220 - Monitoring Well Construction and Installation
SOP 221 - Groundwater Well Development
SOP 222 - Aquifer and Step-Drawdown Tests
SOP 224 - Aquifer Slug Test
SOP 230 - Groundwater Sampling
SOP 231 - Water-Level Measurements
SOP 250 - Surface Water Sampling
SOP 260 - Lake and Stream Sediment Sampling
SOP 310 - Jar Headspace Screening
SOP 320 - Operation/Calibration HNU Photoionization Detector
SOP 330 - Field Instrument Calibration, Operation and Maintenance
SOP 410 - Quality Assurance/Quality Control Data Validation

# STANDARD OPERATING PROCEDURE (SOP) 110
# PACKING AND SHIPPING OF SAMPLES

## 1.0 PURPOSE AND APPLICABILITY

This SOP 110 describes proper packaging methods and shipment of samples to: (a) minimize the potential for sample breakage, leakage, or cross contamination, and (b) provide a clear record of sample custody from collection to analysis. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

The EPA RCRA regulations (40 CFR Section 261.4 [d]) specify that samples of solid waste, water, soil, or air collected for the purpose of testing are exempt from regulation when any of the following conditions apply:

- Samples are being transported to a laboratory for analysis;
- Samples are being transported to the collector from the laboratory after analysis;
- Samples are being stored: (a) by the collector prior to shipment for analyses, (b) by the analytical laboratory prior to analyses, or (c) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

Samples collected by ThermoRetec are generally qualified for these exemptions. SOP 110 deals only with these sample types.

## 2.0 RESPONSIBILITIES

The field sampling coordinator is responsible for the enactment and completion of the chain-of-custody and the packaging and shipping requirements outlined here and in project specific sampling plans.

## 3.0 SUPPORTING MATERIALS

The following materials must be on hand in sufficient quantity to ensure that proper packing and shipping methods and procedures may be followed:

- Chain-of-custody forms and tape;
- Sample container labels;
- Coolers or similar shipping containers;
- Duct tape or transparent packaging tape;
- Zip-lock type bags;
- Protective wrapping and packaging materials;
- Ice or cold packs;
- Shipping labels for the exterior of the ice chest; and
- Transportation carrier forms (Federal Express, Airborne, etc.).

## 4.0 METHODS AND PROCEDURES

All samples must be packaged so that they do not leak, break, vaporize, or cause cross-contamination of other samples. Waste samples and environmental samples (e.g., groundwater, soil, etc.) should not be placed in the same container. Each individual sample must be properly labeled and identified. Each shipping container must be accompanied by a chain-of-custody record. When refrigeration is required for sample preservation, samples must be kept cool during the time between collection and final packaging.

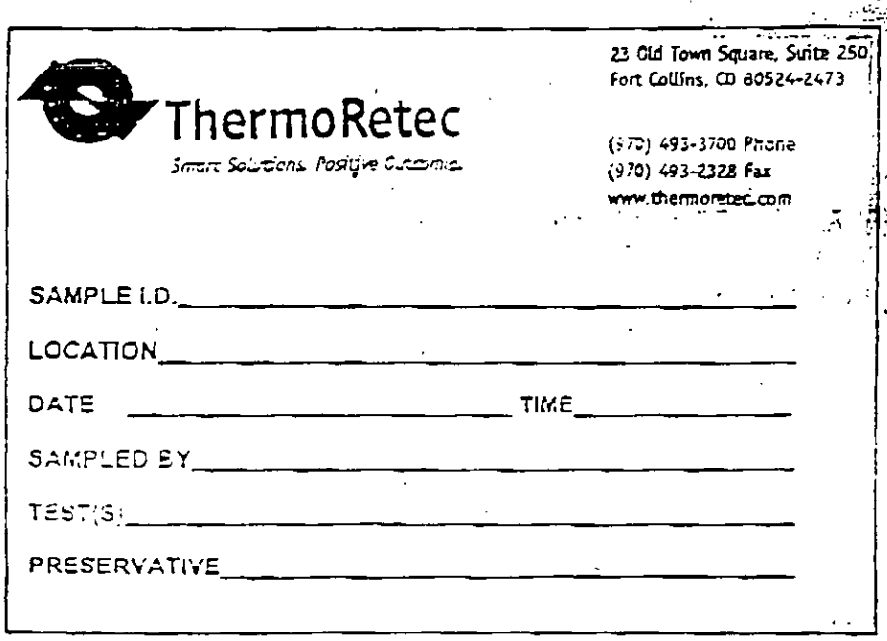
All samples must be clearly identified immediately upon collection. Each sample bottle label (Figure 1) will include the following information:

- Client or project name, or unique identifier, if confidential;
- A unique sample description;
- Sample collection date and time;
- Sampler's name or initials;
- Indication of filtering or addition of preservative, if applicable; and
- Analyses to be performed.

After collection, identification, and preservation (if necessary), the samples will be maintained under chain-of-custody procedures as described below.

ThermoRetec
Smart Solutions. Positive Outcomes.

Figure 1
Sample Label






A subsidiary of Tetra Tech, Inc.

## 4.1 CHAIN-OF-CUSTODY

A sample is considered to be under custody if it is in one's possession, view, or in a designated secure area. Transfers of sample custody must be documented by chain-of-custody forms (Figure 2). The chain-of-custody record will include, at a minimum, the following information:

- Client or project name, or unique identifier, if confidential;
- Sample collector's name;
- Company's (ThermoRetec) mailing address and telephone number;
- Designated recipient of data (name and telephone number);
- Analytical laboratory's name and city;
- Description of each sample (i.e., unique identifier and matrix);
- Date and time of collection;
- Quantity of each sample or number of containers;
- Type of analysis required; and
- Date and method of shipment.

Additional information may include type of sample containers, shipping identification airbill numbers, etc.

When transferring custody, both the individual(s) relinquishing custody of samples and the individual(s) receiving custody of samples will sign, date, and note the time on the form. If samples are to leave the collector's possession for shipment to the laboratory, the subsequent packaging procedures will be followed.

## 4.2 PACKING FOR SHIPMENT

To prepare a cooler for shipment, the sample bottles should be inventoried and logged on the chain-of-custody form. At least one layer of protective material should be placed in the bottom of the container. As each sample bottle is logged on the chain-of-custody form, it should be wrapped with protective material (e.g. bubble wrap, matting, plastic gridding, or similar material) to prevent breakage. Each sample bottle should be placed upright in the shipping container. Each sample bottle cap should be checked during wrapping and tightened if needed. Avoid overtightening, which may cause bottle cap to crack and allow leakage. Additional packaging material such as bubble wrap or styrofoam pellets should be spread throughout the voids between the sample bottles.

ThermoRetec

*Smart Solutions. Positive Outcomes.*

# Figure 2
## Chain of Custody Record

PROJECT NAME:
SEND REPORT TO:
ADDRESS:
PHONE:
FAX:

PROJECT NUMBER:
SAMPLER (PRINT NAME)
SAMPLER (PRINT NAME)
SHIPMENT METHOD:
AIRBILL NUMBER:
LABORATORY RECEIVING:

ANALYSIS REQUESTED

PAGE __ OF __

| FOR SAMPLE ID | SAMPLE DATE | SAMPLE TIME | SAMPLE MATRIX | NUMBER OF CONTAINERS | | | | | | | | | | | | COMMENTS, SPECIAL INSTRUCTIONS, ETC. | LAB SAMPLE ID (to be completed by lab) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

| Relinquished by: (Signature) | Received by: (Signature) | Date: | Time: |
|---|---|---|---|
| Relinquished by: (Signature) | Received by: (Signature) | Date: | Time: |
| Relinquished by: (Signature) | Received by: (Signature) | Date: | Time: |

SAMPLE CUSTODIAN REMARKS (COMPLETED BY LABORATORY):

| QA/QC LEVEL | | TURNAROUND: | |
|---|---|---|---|
| LEVEL I | ☐ | ROUTINE | ☐ |
| LEVEL II | ☐ | 24 HOUR | ☐ |
| LEVEL III | ☐ | 1 WEEK | ☐ |
| OTHER | ☐ | OTHER | ____ |

| SAMPLE RECEIPT | |
|---|---|
| TOTAL # CONTAINERS RECEIVED ? | |
| COC SEALS PRESENT ? | |
| COC SEALS INTACT ? | |
| RECEIVED CONTAINERS INTACT ? | |
| TEMPERATURE ? | |

Most samples require refrigeration as a minimum preservative. Reusable cold packs or ice placed in heavy duty zip-lock type bags should be distributed over the top of the samples. Two or more cold packs or bags should be used. Additional packing material should then be placed to fill the balance of the cooler or container.

Place the original completed chain-of-custody record in a zip-lock type plastic bag and place the bag on the top of the contents within the cooler or shipping container. Alternatively, the bag may be taped to the underside of the container lid. Retain a copy of the chain-of-custody record with the field records.

Close the top or lid of the cooler or shipping container and rotate/shake the container to verify that the contents are packed so that they do not move. Add additional packaging if needed and reclose.

Place signed and dated chain-of-custody seal (Figure 3) at two different locations (front and back) on the cooler or container lid and overlap with transparent packaging tape. The chain-of-custody tape should be placed on the container in such a way that opening the container will destroy the tape. Packaging tape should encircle each end of the cooler at the hinges.

Sample shipment should be sent via an overnight express service that can guarantee 24-hour delivery. Retain copies of all shipment records as provided by the shipper.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

Recipient of sample container should advise shipper and/or transporter immediately of any damage to container, breakage of contents, or evidence of tampering.

## 6.0 DOCUMENTATION

The documentation for support of proper packaging and shipment will include ThermoRetec or the laboratory chain-of-custody records and transportation carrier's airbill or delivery invoice. All documentation will be retained in the project files.

ThermoRetec
Smart Solutions. Positive Outcomes.

Figure 3
Chain of Custody Seal

CUSTODY SEAL

DATE _____

SIGNATURE _____

SEAL NO. _____

ThermoRetec
Smart Solutions. Positive Outcomes.

23 Old Town Square, Suite 250
Fort Collins, CO 80524-2471

(970) 493-3700 Phone
(970) 493-2328 Fax
www.thermoretec.com

# SOP 120

# DECONTAMINATION

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the methods to be used for the decontamination of items which may become contaminated during field operations. Decontamination is performed as a quality assurance measure and as a safety precaution. It prevents cross-contamination between samples and also helps maintain a clean working environment. The equipment requiring decontamination may include hand tools, monitoring and testing equipment, personal protective equipment, or heavy equipment (e.g., loaders, backhoes, drill rigs, etc.).

Decontamination is achieved mainly by rinsing with liquids which may include: soap and/or detergent solutions, tap water, distilled water, and methanol. Equipment may be allowed to air dry after being cleaned or may be wiped dry with paper towels or chemical-free cloths.

All sampling equipment will be decontaminated prior to use and between each sample collection point. Waste products produced by the decontamination procedures such as rinse liquids, solids, rags, gloves, etc. will be collected and disposed of properly based on the nature of contamination and site protocols. Any materials and equipment which will be reused must be decontaminated or properly protected before being taken off site.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

It is the responsibility of the field sampling coordinator to ensure that the proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of any subcontractors (e.g., drilling or sampling contractors) to follow the proper designated decontamination procedures that are stated in their contracts and outlined in the project health and safety plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that no contaminants are negligently introduced into the environment.

## 3.0 SUPPORTING MATERIALS

The following materials should be on hand in sufficient quantity to ensure that proper decontamination methods and procedures may be followed:

- Cleaning liquids and dispensers (soap and/or detergent solutions, tap water, distilled water, methanol, or isopropyl, etc.);
- Personal safety gear, as defined in the project health and safety plan;
- Paper towels or chemical-free cloths;
- Disposable gloves;
- Waste-storage containers (e.g., drums, boxes, plastic bags);
- Drum labels, if necessary;
- Cleaning containers (e.g., plastic and/or galvanized steel pans or buckets);
- Cleaning brushes; and
- Plastic sheeting.

## 4.0 METHODS AND PROCEDURES

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated.

The standard procedures listed below describe the method for full field decontamination. If different technical procedures are required for a specific project, they will be spelled out in the project plans. Such variations in decontamination may include all or an expanded scope of the decontamination procedure stated herein.

- Remove gross contamination from the equipment by brushing and then rinsing with tap water.
- Wash with a detergent or soap solution (e.g., Alconox and tap water).

- Rinse with tap water.
- Rinse with methanol or isopropyl.
- Rinse with distilled water.
- Repeat entire procedure or any parts of the procedure as necessary.
- After decontamination procedure is completed, avoid placing equipment directly on ground surface to avoid re-contamination.

Downhole drilling equipment, such as augers, split spoons, Shelby tubes, and sandlines, will be decontaminated with a pressurized hot water or steam wash followed by a fresh water rinse. No additional decontamination will be required if the equipment appears visually clean. If contamination is visible after hot water/steam cleaning, a detergent wash solution and brushes (if necessary) will be used.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

To assess the adequacy of decontamination procedures, rinsate blanks should be collected and analyzed for the same parameters as the field samples. The specific number of blanks will be defined in the project specific sampling plan. In general, one rinsate blank will be collected per ten samples.

## 6.0 DOCUMENTATION

Field notes describing the procedures used to decontaminate equipment/personnel and to collect the rinsate blanks will be documented by on-site personnel. These field notes will be kept in the project files.

# STANDARD OPERATING PROCEDURE (SOP) 210
# SOIL SAMPLE COLLECTION

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the methods used in obtaining soil samples for physical testing, stratigraphic correlations, and chemical analysis. Soil samples are obtained in conjunction with surface sampling, test pit excavation, soil boring, and monitoring well installation programs. These procedures provide direct information as to the physical makeup of the surface and subsurface environment as well as to estimate the extent and magnitude of soil contamination, if present. This SOP will discuss sampling of the surface material with hand tools and sampling of the subsurface material by augers and split spoons, and within test pits by backhoes and hand tools.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project geologist/engineer will be responsible for the proper use and maintenance of all types of equipment used for obtaining soil samples. The geologist/engineer will determine the location, total depth, and overall size of each surface sample collection point and test pit, and the location and depth of all subsurface borings based on the project specific sampling plan. The project geologist/engineer will be responsible for locating any subsurface utilities or structures, and disseminating this information to the contractor prior to commencing the sampling program. The location of overhead utilities and obstructions relative to the sampling locations will also be noted.

It shall be the responsibility of the project geologist/engineer to observe all activities pertaining to soil sampling and subsurface investigations to ensure that all the standard procedures are followed properly, and to record all pertinent data on a field log or field book. The collection, handling, and storage of all samples will be the responsibility of the geologist/engineer.

It is the responsibility of the contractors to provide the necessary equipment for obtaining subsurface samples in borings and for the decontamination of the equipment. Test pit construction, split-spoon sampling, and subsurface augering will be conducted by the contractor. In addition, the contractor will be responsible for containment of cuttings, if required.

## 3.0 SUPPORTING MATERIALS

In addition to materials provided by the contractor, the geologist/engineer will provide:

- Sample bottles/containers and labels;
- Boring or test pit logs;
- Field notebook;
- Chain-of-custody forms;
- Depth-measurement device;
- Stakes and fluorescent flagging tape;
- Decontamination solutions;
- Camera for photographing sections;
- Sampling equipment (e.g., knives, trowels, shovels, hand auger, aluminum foil, etc); and
- Plastic garbage bags.

## 4.0 METHODS AND PROCEDURES

Specific sampling equipment and methodology will be dictated by the characteristics of the soil to be sampled, the type of soil samples required, and by the analytical procedures to be employed. Soil samples obtained at the surface may be collected using a shovel, trowel, or hand auger. A hand auger can be used to extract shallow soil samples up to 10 feet below the surface. Sampling to obtain uniform coverage within a specified area will often require the use of an area grid. These considerations will be followed based upon project specific requirements.

There are two types of samples that may be required by the project sampling plan: grab or composite. A grab sample is collected from a specific location or depth and placing it in the appropriate sample container. A composite sample consists of several discrete locations (or depths) mixed to provide a homogeneous, representative sample. To ensure that the sample is representative, the soil volume and collection method from each discrete location should be as identical as possible. It should be noted that samples analyzed for volatile organic compounds cannot be composited since

it is necessary to expose the soil to the atmosphere prior to transfer into the sample container.

The sampling depth interval in borings is typically one sample for every five feet with additional samples taken at the discretion of the project geologist/engineer when significant color, textural, or odor changes are encountered. Deviations in the standard operating procedure will be covered in the project specific operating procedures.

Most subsurface explorations by ThermoRetec will be on privately owned land, often an industrial facility. Prior to commencing subsurface exploration, ThermoRetec will work with the facility manager to locate any subsurface utilities or structures. Utility companies (electric, gas, water, phone, sewer, etc.) who may have equipment or transmission lines buried in the vicinity will also be notified. Many regions have organizations which represent all utilities for these notification purposes. Allow enough time after notification (typically three working days) for the utilities to respond and provide locations of any equipment which may be buried on site. Overhead lines must also be kept in consideration when a drilling rig is used. As a rule of thumb, the rig and derrick should be at least 25 feet away from overhead lines unless special shielding and grounding are provided.

## 4.1 General Applications

General locations shall be mapped by the field geologist/engineer using a stationary structure as the reference point. Specific locations for test pits and sampling locations will be documented by survey or by using topographic maps and/or plans. A preliminary log of the test pit, or boring shall be prepared in the field by the field geologist/engineer. A sketch of the test pit may be necessary to depict the strata encountered. Before measuring the depth to groundwater, if encountered, the field geologist/engineer will allow sufficient time for stabilization of the water table in the excavation or boring. All information shall be recorded on the field log or the field book.

## 4.2 Surface Sampling

Prior to surface sampling, remove all surface materials that are not to be included in the sample such as rocks, twigs, and leaves. For sample collection within the upper two to three feet use a shovel or trowel. A hand auger may be used to depths of up to 10 feet. When using the hand auger, auger the hole to the required depth, then slowly remove the auger and collect the soil sample from the auger flight or auger bucket at the point corresponding to the required depth. A tube sampler can be attached to the auger rods after augering to the desired depth, inserted into the open borehole, and

then advanced into the soil at the base of the boring. If sampling is in sandy or non-cohesive soil, a shovel may be necessary to collect samples. Sample logging is described in Section 4.5.

Photographs of specific geologic features or sample location may be required for documentation purposes. A scale or item providing a size perspective should be placed in each photograph. The frame number and picture location shall also be documented in the field book. All equipment shall be decontaminated following SOP 120 between sample locations unless otherwise specified in the project specific sampling plan.

## 4.3 Test Pit Excavation and Sampling

The test pits shall be excavated in compliance with applicable safety regulations. Walls should be cut as near vertical as possible to facilitate stratigraphic logging. Field personnel will not enter an open test pit deeper than four feet without shoring or benching present. Samples shall be collected from the backhoe bucket with a trowel or from the side of the test pit wall (depending upon the depth of the test pit and the safety precautions in place). The size, depth, and orientation of the test pit shall be recorded on the test pit log (Figure 1). Sample logging is described in Section 4.5.

Photographs of specific geologic features or sample location may be required for documentation purposes. A scale or item providing a size perspective should be placed in each photograph. The frame number and picture location shall also be documented in the field book.

The test pit shall be inspected and the test pit log reviewed to ensure that all the appropriate and/or required data and samples have been collected. All test pits will be backfilled to original grade and compacted. All equipment shall be decontaminated following SOP 120 between sample locations unless otherwise specified in the project specific sampling plan.

## 4.4 Subsurface Sampling

Borings are typically advanced by two methods: rotary drilling and augering. The casing shall be of the flush-joint or flush-couple type and of sufficient size to allow for soil sampling, coring, and/or well installation. All casing sections shall be straight and free of any obstructions. Hollow-stem augers or solid-flight augers with casing may be used according to specific project requirements. Rotary drilling with water, mud, or air may be used in dense or indurated formations to advance to the required sample depth where a split spoon sampler or a coring device will be used to obtain the sample. Recirculated water shall not be used when casing is being driven unless specified in project

specific sampling plans and/or directed and properly documented by the field geologist/engineer. If recirculated water is used, all loose material within the casing shall be removed by washing to the required sampling depth using a minimum amount of water. Care should be taken to limit recirculation of the wash water to those times when the water supply is extremely limited or unavailable. The amount of water used should be documented in the project field book or on the field form.

Generally subsurface soil samples shall be obtained using a split-tube type sampler (split spoon), however, other devices (Shelby tubes, core, etc.) may be used as specified in the project specific sampling plan. Split-spoons come in a variety of sizes with the most standard having a 2-inch OD, a 1 3/8-inch ID and a 24-inch long barrel with an 18-inch sample capacity. Split spoons shall be equipped with a check valve at the top and a flap valve or basket-type retainer at the bottom. Samples shall be obtained using the standard penetration test (SPT), which allows for qualitative determination of mechanical properties and aids in identification of material type. The number of hammer blows shall be recorded on the boring log (Figure 2) for each 6-inch drive distance.

The split spoon shall be opened immediately upon removal from the casing. If the recovery is inadequate (i.e., most of the penetrated material was not retained inside the sampler),a note will be made on the boring log stating that "no recovery" was possible at that depth. In the event that gravels or other material prevent penetration by the split spoon, samples may be collected from the auger flights. Slowly remove the auger and collect the sample at the point corresponding to the required depth. Samples collected in this manner must be documented on the boring log. Sample logging is described in Section 4.5.

Photographs of specific geologic features or sample location may be required for documentation purposes. A scale or item providing a size perspective should be placed in each photograph. The frame number and picture location shall also be documented in the field book. All equipment will be decontaminated following SOP 120 between sample locations and sample depths unless otherwise specified in the project specific sampling plan.

Upon completion of the boring, backfill may be required. The backfill may consist of native material, hydrated bentonite chips/pellets, portland cement/bentonite grout, or other low permeability material as specified in the project specific sampling plan. All applicable state/federal regulations concerning plugging of boreholes should be reviewed prior to the commencement of field activities.

ThermoRetec
Smart Solutions. Positive Outcomes.

ThermoRetec Consulting Corporation

# TEST PIT LOG

TEST PIT
SHEET OF

| PROJECT | DATE | | CONTRACTOR |
|---|---|---|---|
| PROJECT # | START | FINISH | EQUIPMENT USED |
| LOCATION | LOGGED BY | | TOTAL DEPTH |

| SAMPLE TYPE AND NUMBER | SAMPLE DEPTH RANGE | USCS | DEPTH FEET | SOIL AND ROCK DESCRIPTION & COMMENTS |
|---|---|---|---|---|
| | | | | |

TEST PIT PLAN



NORTH



GROUNDWATER

| DATE | TIME (HOURS AFTER COMPLETION) | DEPTH (FEET) |
|---|---|---|
| | | |
| | | |
| | | |



FIGURE 1

ThermoRetec
Smart Solutions. Positive Outcomes.

ThermoRetec Consulting Corporation

# BORING LOG

BORING
SHEET OF

| | | |
|---|---|---|
| PROJECT Gorn Yard | CONTRACTOR RETEC | MONUMENT |
| PROJECT # 5-3258-300 | DRILLER RETEC | RISER |
| LOCATION GLOSB-1 | RIG TYPE Hand Auger | SCREEN |
| TOTAL DEPTH 3' bgs | METHOD | FILTER PACK |
| DATE 9/9/97 | CASING ID | SEAL |
| START / FINISH | BORING ID | GROUT |
| LOGGED BY DMS | BIT TYPE | GROUND ELEV. |

| SAMPLE TYPE AND NUMBER | BLOWS PER 6 INCH | DEPTH RANGE | % REC | DEPTH FEET | SAMPLE DESCRIPTION CLASSIFICATION SCHEME |
|---|---|---|---|---|---|
| | | | | | |

GROUNDWATER DEPTH (FT) DATE/TIME

REMARKS:

FIGURE 2

## 4.5 Sample Logging

To ensure consistent descriptions of soil or rock material, the following criteria should be included on the sampling logs:

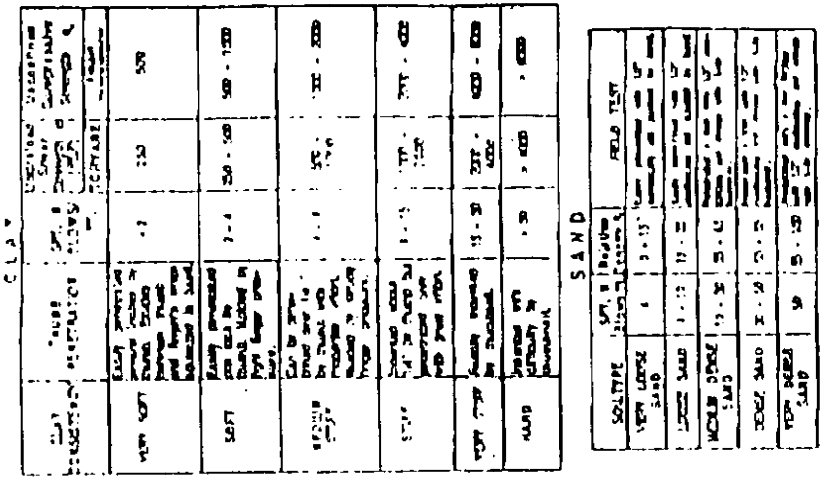
- Soil or rock type;
- Depth ranges, recorded in feet;
- Grain size;
- Roundness;
- Sorting;
- Moisture;
- Color;
- Degree of oil contamination; and
- Remarks.

Examples of soil types would be gravel, sand, silt, or clay. The soil types should be based on the Unified Soil Classification System (USCS). Figure 3 shows the USCS table. Examples of rock types include limestone, shale, claystone, siltstone, and sandstone. Soil/rock classifications determined in the field may be subject to change based upon laboratory tests. Factors to consider before changing a field determination include the expertise of the field geologist/engineer and laboratory personnel, representative character of the tested sampling, labeling errors, etc. Any changes made after this consideration shall be discussed and incorporated in the project report.

Grain size, roundness, and degree of sorting should also be included on the log if they are discernable. Field guides such as the Geotechnical Gauge (Figure 3) are available to assist in determining these properties. In addition to composition, blow counts and the length of the sample recovered should also be recorded on the sampling log. The degree of sample moisture should be described as dry, moist, and wet.

# FIELD GUIDE AND USCS CLASSIFICATION TABLE

ThermoRetec
Smart Solutions. Positive Outcomes.



Unified Soil Classification System (USCS)

| | MILLIMETERS | INCHES | SIEVE SIZES |
|---|---|---|---|
| BOULDERS | > 300 | > 11.8 | - |
| COBBLES | 75 - 300 | 2.9 - 11.8 | - |
| GRAVEL: | | | |
| COARSE | 75 - 19 | 2.9 - .75 | - |
| FINE | 19 - 4.8 | .75 - .19 | 3/4" - No. 4 |
| SAND: | | | |
| COARSE | 4.8 - 2.0 | .19 - .08 | No. 4 - No. 10 |
| MEDIUM | 2.0 - .43 | .08 - .02 | No. 10 - No. 40 |
| FINE | .43 - .08 | .02 - .003 | No. 40 - No. 200 |
| FINES: | | | |
| SILTS | < .08 | < .003 | < No. 200 |
| CLAYS | < .08 | < .003 | < No. 200 |

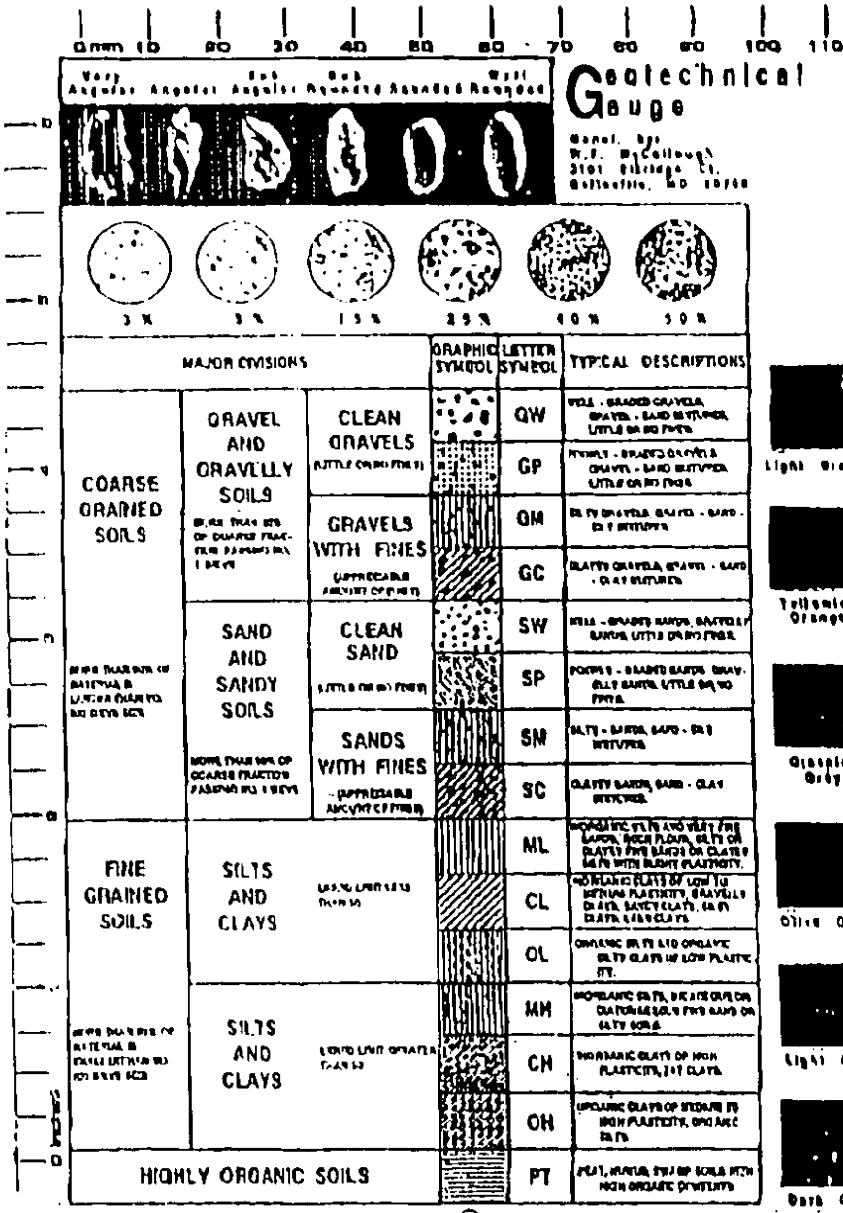



FIGURE 3

The color(s) or range of color(s) of the soil or rock type should be defined. If a Munsell color chart is used, the number designation of the color will also be recorded in the description. A notation of the degree of oil contamination should be included on the sample log. The contamination should be noted as high (≥ 30 %), medium (10-30 %), low (1-10 %), or none. Other classifiers may include odor (low to high) and mottling (low to high).

Remarks should include anything pertinent to the sample description or sample collection that is not described above. Other information to be placed on the logs as appropriate is:

- HNU readings;
- Appearance of contamination (consistency);
- Degree of fracturing or cementation in the rock;
- Drilling equipment used (rod size, bit type, pump type, rig manufacturer and model, etc.);
- Special problems and their resolution (hole caving, recurring problems at a particular depth, sudden tool drops, excessive grout takes, drilling fluid losses, lost casing, etc.);
- Dates for start and completion of borings;
- Depth of first encountered free water; and
- Definitions of special abbreviations used on log.

## 4.6 Sample Handling

Specific procedures pertaining to the handling and shipment of samples shall be in accordance with SOP 110. A clean pair of gloves and decontaminated sampling tools will be used when handling the samples during collection to prevent cross contamination. A representative sample will be placed in the sampling container. Sample containers (jars or bags) shall be labeled with the following information:

- Client or project name, or unique identifier, if confidential;

- Unique sample description (i.e., test pit, boring, or sampling point number and horizontal/vertical location);
- Sample collection date and time;
- Sampler's name or initials; and
- Analyses to be performed.

These data shall be recorded on the field logs and/or field book. Larger, bulk samples shall be placed in cloth bags with plastic liners or plastic 5-gallon buckets. Sample bags shall be marked with the information listed above.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements include, but are not limited to, blind field duplicates, blind rinsate blanks, and blind field blanks. These samples will be collected on a frequency of one QA/QC sample per 10 field samples or a minimum of one QA/QC sample per day unless otherwise specified in the project specific sampling plan.

## 6.0 DOCUMENTATION

Documentation may consist of all or part of the following:

- Test pit or boring log;
- Sample log sheets;
- Field log book;
- Chain-of-custody forms; and
- Shipping receipts.

All documentation shall be placed in the project files and retained following completion of the project.

## REFERENCES

*Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*, EPA 600/4-89/034, published by National Water Well Association, 1989.

*RCRA Ground Water Monitoring Technical Enforcement Guidance Document*, published by National Water Well Association, 1986.

*A Compendium of Superfund Field Operations*, EPA 540/P-87/001, published by the Office of Emergency and Remedial Response, Office of Waste Programs Enforcement, US EPA, 1987.

# SOP 220

# MONITORING WELL CONSTRUCTION AND INSTALLATION

## 1.0 PURPOSE AND APPLICABILITY

This SOP establishes the method for installing observation standpipes or monitoring wells. These wells will be installed to determine the depth to groundwater, monitor groundwater fluctuations, and/or obtain samples of groundwater for laboratory testing. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

It is the responsibility of the project geologist/engineer to directly supervise the construction and installation of each monitoring well by the contract driller to ensure that the well installation specifications outlined in the project plan are adhered to and to record all pertinent data on the approved forms. The project geologist/engineer will also be responsible for ensuring that all applicable permits and registrations are obtained prior to and after construction by RETEC, the contract driller, or other responsible party.

## 3.0 SUPPORTING MATERIALS

The list below identifies the types of equipment which may be used for the construction and installation of the monitoring wells. The requirements for screen/riser pipe (length, gauge, and type), sand, bentonite/grout, and material manufacturers shall be addressed in the project specific sampling plan.

Materials to be provided by the contract driller include:

- Drill rig;
- Decontamination equipment (e.g., steam cleaner, high-pressure cleaner, buckets, brushes, etc.);
- Weighted calibrated tape;
- Screen/riser pipe with flush-threaded couplings including riser and bottom caps (e.g., PVC, fiberglass, galvanized, or stainless steel);
- Clean, silica sand;
- Bentonite chips, pellets, or powder;
- Cement grout, grout tub, grout pump, and tremie pipe;
- Cement for protective pad;
- Locking steel protective casing; and
- Miscellaneous items specified in the project plan (e.g., centralizers, sediment traps, bumper posts, containers for cuttings and fluids, etc.).

Materials provided by the geologist/engineer may include:

- Weighted calibrated tape;
- Personal protective equipment;
- Field book and field forms; and
- Camera.

## 4.0 METHODS AND PROCEDURES

Specific drilling, sampling, and installation equipment and methodology will be dictated by the geologic characteristics of the site, the types of contaminants being monitored, and local and state regulations.

### 4.1 Drilling

Drilling of the monitoring well borehole may be accomplished by a variety of methods. The hollow-stem, continuous flight auger is one of the most widely used methods for installing monitoring wells in unconsolidated soils. No drilling fluids are used and the disturbance to geologic materials penetrated is minimal. Solid-stem, continuous flight auger use is limited to consolidated sediments or to fine grained unconsolidated sediments. Augering methods are limited to boreholes less than 150 feet deep. The cable tool method is useful in relatively shallow unconsolidated and consolidated formations. Disadvantages to this method are that water must be used until the water table is reached, soil samples at depth are not easily obtainable, and it is very slow. Rotary methods use air or fluids during the drilling process to maintain an open hole and to remove cuttings. Clean water must be used for water-rotary drilling and care must be taken with mud-rotary techniques so that the drilling muds do not affect collection of representative groundwater samples.

In most projects, air rotary methods will be used in dense formations and augering will be used in loose formations. Soil sampling will be performed at the appropriate depth by removing the solid-stem auger or rotary-drill stem, or by sampling within the hollow-stem auger. All drilling and soil sampling procedures will be done in accordance with SOP 210. Prior to initiating drilling activities and between drilling locations and sampling depths, the drilling equipment will be cleaned and decontaminated in accordance with SOP 120.

### 4.2 Well Construction and Installation

In the case of rotary drilling, the borehole will be blown free of material prior to well installation. With hollow-stem augers, after the removal of the plug, the augers shall be raised approximately six inches above the bottom of the borehole, rotated slowly and returned to the bottom of the hole to facilitate removal of all material within the auger.

Backfilling of the borehole with native cuttings or clean sand to the well screen tip elevation shall be required if the tip is to be above the bottom of the borehole. A heavy plumb bob or a calibrated tape shall be used to determine the depth of the boring and the depth to the top of the backfill.

The well screen and riser pipe shall then be assembled. The riser pipe/screen shall be connected by flush-threaded joints. No solvent or anti-seize compound shall be used on the joints. The length of the screened area and the gauge of the screen or slots shall be determined by the inspecting geologist depending upon the grain-size distribution of the sediments. The assembled screen and riser, or its constituent parts, shall be steam cleaned prior to installation. The riser and screen shall be carefully placed in the borehole to ensure that it is centered in the hole and is true, straight, and vertical throughout. Centering can be accomplished with well centralizers.

The annular space surrounding the screened section of the monitoring well and two feet above the top of the screen shall be filled with clean silica sand. The well screen shall have a bentonite seal placed on top of the sand. The bentonite seal shall be approximately two feet thick to prevent vertical flow within the boring from affecting the screened area.

The remaining length of the borehole shall be backfilled or tremmied with grout to within two feet of the ground surface. This grouting may consist of a bentonite/cement mixture made to required specification. The steel guard-pipe shall be placed around the riser. "Weep" holes will be drilled in the riser and the guard-pipe at separate locations. The borehole around the guard-pipe shall be dug out to a depth of two feet and a one foot radius which will be filled with concrete. Bumper posts may be necessary depending upon the location of the well. All completed wells will have identification numbers clearly painted on the cap and guard pipe with bright colored paint.

### 4.3 Telescoping Well Construction

On sites where the presence of Non-Aqueous Phase Liquids (NAPLs) is of concern or the groundwater between different aquifers is to be isolated, the construction of telescoped wells may be necessary. This method allows the construction of monitoring wells which prevent inter-aquifer fluid mixing or the vertical displacement of NAPL. Situations which may require telescoped wells include the construction of wells into aquifers hydro-stratigraphically below impacted aquifers or simply the construction of wells through a perched aquifer without creating a vertical hydraulic conduit.

Similar to conventional wells, construction of telescoped wells can be accomplished using a variety of drill rig types including hollow-stem auger, air-rotary, and mud-rotary rigs. Telescoping well construction is initiated by "keying" a large diameter, outer steel casing into a stratigraphic horizon of low-permeability at the base of the upper impacted aquifer. Typically, the boring for the outer casing should be two-inches greater than the outside diameter of the inner casing to allow sufficient annular space for tremmie or pressure grouting (discussed below). The boring should extend a minimum of 18 inches, if possible, into the keying horizon to ensure an adequate seal. The boring should never breach the keying horizon under any circumstances. Once the boring is completed the casing can be set in one of two ways. The casing may be placed to the bottom of the boring, or the casing can be depressed with the drill rig about six-inches beyond the total depth of the boring. The latter should only be done if it is known that depressing of the casing will not breach the keying horizon.

The drill rig must be capable of hoisting sections of large-diameter steel casings (standard casing length is 21-feet). If more than one section of casing is required, the driller must also have welding capabilities for connecting casing sections. Multiple section casings must be welded straight, otherwise the casing string will not reach to the bottom of the boring. Also, borings which are drilled too fast, can "corkscrew". Such borings will not accept long casing strings.

Grouting of the casing should be done by either tremmie-grouting or pressure-grouting the annular space inside of the casing to expel any fluids which could be vertically displaced into the lower aquifer(s). The grout should then be allowed a minimum of 24-hours to cure. Once the grout is cured, a smaller diameter drill pipe is used to bore through the grout to facilitate placement of a monitor well at the desired depth. The well is then constructed as described in Section 4.2. If another casing is necessary to seal an additional aquifer (triple-cased well), the outer casing is drilled out to the next keying horizon and process is repeated.

## 4.4 Drilling Fluids and Cuttings

If drilling fluids are used, no chemical additives will be mixed into the fluid to alter viscosity or lubricating properties. Fresh water for drilling will be obtained from a source not impacted by site contaminants (e.g., municipal water supply). A sample of the fresh water will be collected during the course of well installation and analyzed for parameters defined for the groundwater samples.

Spent fluids, if used, and cuttings will be contained and disposed of in a manner consistent with the project specific sampling plan.

### 4.5 Decontamination

Equipment and tools used during drilling activities will be cleaned prior to work startup. If the pre-drilling inspection reveals the presence of contamination such as visible chemical residue, an additional decontamination will be conducted to remove the residue. All equipment and tools used during drilling will be cleaned prior to leaving the site. Cleaning of drilling equipment and tools will comply with the procedures detailed in SOP 120.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

Not applicable.

## 6.0 DOCUMENTATION

During installation of each monitoring well a series of measurements shall be taken. These measurements shall include:

- Length of screen;
- Length of riser pipe;
- Total depth of well; and
- Depth to stabilized water level.

Other data include type and length of casing, diameter of the respective components, thickness and different types of filter pack and grouting materials, and elevation of the top of the guard pipe and ground surface after surveying is complete. All data shall be recorded on site onto the groundwater monitoring well completion form (Figure 1). All wells shall be surveyed and referenced onto the appropriate site map. A field book and/or boring log can be used as other means of recording data. All documentation shall be kept in the project files.

## REFERENCES

*Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*, EPA 600/4-89/034, published by National Water Well Association, 1989.

*RCRA Ground Water Monitoring Technical Enforcement Guidance Document*, published by National Water Well Association, 1986.

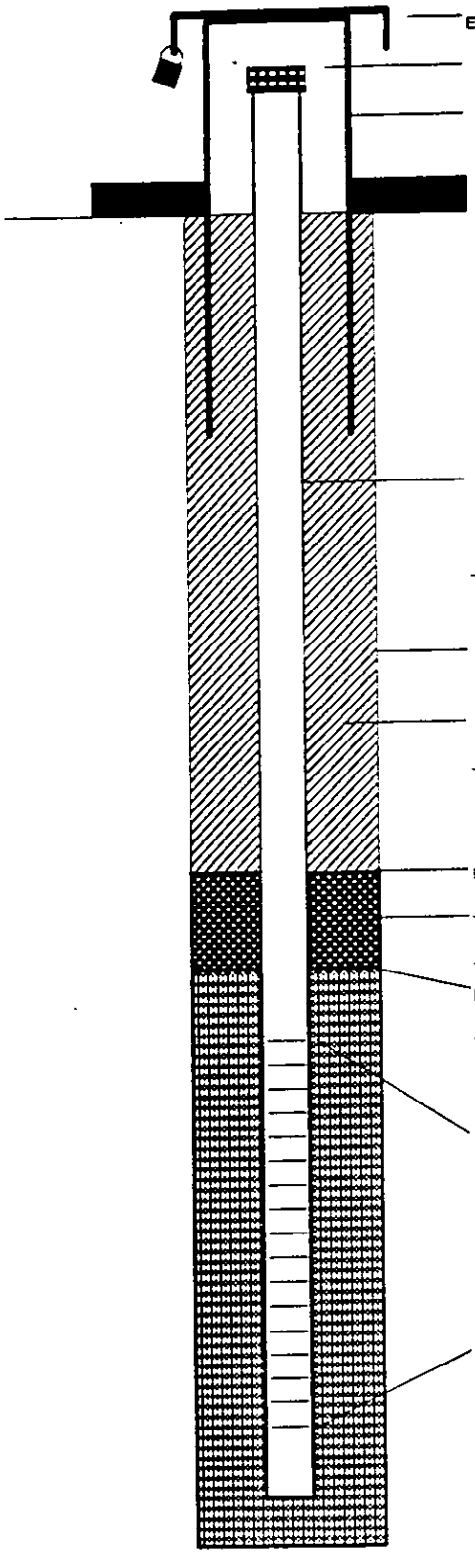
*A Compendium of Superfund Field Operations*, EPA 540/P-87/001, published by the Office of Emergency and Remedial Response, Office of Waste Programs Enforcement, US EPA, 1987.

# WELL INSTALLATION REPORT

Date of Installation _____ Well No. _____

Drilling Company _____

Field Geologist _____



Elevation of Top of Protective Casing _____

Elevation of Top of Riser Pipe _____

I.D. of Protective Casing _____

Type of Protective Casing _____

Ground Surface Elevation _____

I.D. of Riser Pipe _____

Type of Riser Pipe _____

_____

Diameter of Borehole _____

Type of Backfill _____

_____

Grout Ratio _____

Depth to Top of Seal _____

Type of Seal _____

_____

Depth to Top of Sandpack _____

Type of Sandpack _____

_____

Depth to Top of Screen _____

I.D. of Well Screen _____

Type of Well Screen _____

_____

Depth to Bottom of Screen _____

Depth to Bottom of Sediment Trap _____

Depth to Bottom of Borehole

Groundwater Levels

Initial During Drilling _____

Upon Completion of Well _____

_____

# STANDARD OPERATING PROCEDURE (SOP) 221
# GROUNDWATER WELL DEVELOPMENT

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the method for developing groundwater monitoring wells. Well development is the process of cleaning the face of the borehole and the formation around the outside of the well screen to permit groundwater to flow easily into the monitoring well.

Monitoring wells must be developed for the following reasons:

- To restore the natural permeability of the formation adjacent to the borehole to permit the water to flow into the screen easily.
- To remove the clay, silt, and other fines from the formation so that during subsequent sampling the water will not be turbid or contain suspended matter which can easily interfere with chemical analysis.
- To remove any contamination or formation damage that may have occurred as a result of well drilling.

Well development is necessary for all newly completed wells and may be required for wells which have been left dormant for some time or have accumulated significant quantities of sediment in the well, gravel pack, or surrounding formation.

Well development should remove clay particles deposited on the surface of the formation along with sufficient quantity of water to ensure the removal of fluids introduced into the formation during drilling or prolonged inactivity. The development process should also effectively loosen and remove finer particles from the formation matrix.

During any drilling process the side of the borehole becomes smeared with clays or other fines. This plugging action substantially reduces the permeability and retards the movement of water into the well screen. If these fines are not removed, especially in formations having low permeability, it then becomes difficult and time consuming to remove sufficient water from the well before obtaining a fresh groundwater sample because the water cannot flow easily into the well. Existing wells may also require development due to the buildup of sediments in the well or surrounding formation, or

accumulation of excessive quantities of light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) in the well due to inactivity.

Specific project requirements as described in an approved Work Plan, Sampling Plan, QA/QC plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project geologist/engineer will have the responsibility to oversee and ensure that all monitoring well development is performed in accordance with the project specific sampling program. In addition, the project geologist/engineer must record all pertinent data on the approved forms or in the project field book.

## 3.0 SUPPORTING MATERIALS

The list below identifies the types of equipment which may be used for a range of monitoring well development applications. A project specific equipment list will be selected based upon project objectives, the depth to ground water, purge volumes, and well construction. The types of sampling methods and equipment are as follows:

- Surge block;
- Air lift;
- Bailers and bailer cord;
- Pump (centrifugal, bladder, peristaltic) and discharge line;
- Conductivity/temperature/pH meter(s);
- Water-level measurement equipment;
- Field data sheets and field book;
- Buckets and intermediate containers;
- Paper towels or chemical-free cloths; and
- Decontamination materials.

## 4.0 METHODS AND PROCEDURES

Well development is accomplished by causing the natural formation water inside the well to move vigorously in and out through the screen. The suspended sediment is then removed from the well by bailing or pumping. Several techniques may be employed in developing a well. To be effective, all require reversals or surges in flow to avoid bridging by particles. These surges can be created by using surge blocks, air lifts, bailers, or pumps. The use of water other than the natural formation water is not recommended during well development. If water is added, the amount should be noted on the field forms or in the project field book. Water quality analyses should be conducted so that comparisons can be made with subsequent natural groundwater data.

Before developing the well, water depth, LNAPL or DNAPL depth (if present), and well depth will be measured using an electronic or mechanical device. If a measurable amount of LNAPL or DNAPL is detected, the well shall be bailed or pumped prior to development in an attempt to remove the material. This procedure should reduce the opportunity of LNAPL or DNAPL being forced back into the filter pack and formation during development. Approximately 10 well volumes (calculated from the length of the water column and the well casing diameter) should be removed from the well during development. The discharge from the well should be continuously monitored and development should be continued until a particulate free discharge is apparent and the field parameters (pH, conductivity, and temperature) have stabilized within 10 percent of the previous reading. Field parameters should be recorded on the well development record (Figure 1) after each volume is removed. All materials and equipment used in conjunction with development must be free of any contamination prior to use and all provisions made to prevent the introduction of contaminants during development. Well depths will be measured following development to determine whether sand or silt has accumulated in the well. If material has accumulated, it will be removed with a bailer.

Regardless of the method employed, any discharges from the well must be properly disposed of depending on the nature of the liquid removed from the well. Additionally, all materials and equipment placed into the well in conjunction with development must be free of any contamination prior to use. Decontamination procedures should be consistent with those described in SOP 120.

**Groundwater Well Development Record**

PROJECT _____ WELL NO. _____

DATE _____ TIME _____ DEVELOPED BY _____

WELL CONDITION _____

1. WATER LEVEL MEASUREMENT AND WELL PURGING

   a. Location of measuring point _____

   b. Depth of water table from measuring point _____

   c. Height of measuring point above ground surface _____

   d. Total depth of well below measuring point _____

   e. Length of water column (line 2d-2b) _____

   f. Development method _____

   g. Evacuated volume _____

   Pumping Duration / Vol Rmvd pH Cond. T(C) Color

4. COMMENTS:

   pH meter inoperative

## 4.1 Surge Block

A surge block is a round plunger with pliable edges that will not catch on the well screen. For 2-inch diameter wells the surge block can be constructed of two aluminum plates 1.75 inches in diameter surrounding a thin section of neoprene rubber approximately 2 inches in diameter. The surge block assembly is lowered by hand down the well by connecting sections of one-half inch threaded PVC pipe. Once within the screen interval, the block is rapidly raised and lowered to agitate the water within the well.

If the surge block method is employed, development can be continued using a nitrogen driven bladder pump to evacuate the well. The bladder pump is lowered down the well and is connected to a section of teflon tubing. The nitrogen supply is turned on to activate the pump and discharge liquid from the well.

## 4.2 Air Lift

Compressed air pumped down a pipe inside the well casing can be used to blow water out of the monitoring well. If air is applied to the well intermittently and for short periods then the water is only raised inside the casing rather than blown out and will fall back down the casing causing the desired backwashing action. Finally, blowing the water out will remove the fines brought into the screen by the agitating action.

Considerable care must be exercised to avoid injecting air into the well screen. Such air can become trapped in the formation outside the well screen and alter subsequent chemical analyses of water samples. For this reason, the bottom of the air pipe should never be placed down inside the screen.

Another consideration is the submergence factor. Submergence is the feet of water above the bottom of the air pipe while pumping (blowing water out) divided by the total length of the air pipe. Submergence should be on the order of at least 20 percent.

## 4.3 Bailer

A bailer, sufficiently heavy so that it will sink rapidly through the water, can be raised and lowered through the well screen. The resulting agitation action of the water is similar to that caused by a surge block. The bailer, however, has the added advantage of removing the fines each time it is

brought to the surface and emptied. Bailers can be custom-made for small diameter wells and can be hand-operated in shallow wells.

### 4.4 Pumping

Starting and stopping a pump so that the water is alternately pulled into the well through the screen and backflushed through the screen is an effective development method. Periodically pumping the waste will remove the fines from the well and permit checking the progress to ensure that development is complete.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements include the stabilization of field parameters to within 10 percent of the previous reading. A particulate free discharge is desirable but may not be possible based on the composition of the lithology in which the well is completed.

## 6.0 DOCUMENTATION

Field parameter values shall be entered on the Well Development Form along with the corresponding purge volume. Additional observations, comments, and discussion concerning groundwater well development will be documented in the project field book or the development form. Copies of these documents will be placed in the project files and retained following completion of the project.

## REFERENCES

*Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*, EPA 600/4-89/034, published by National Water Well Association, 1989.

*RCRA Ground Water Monitoring Technical Enforcement Guidance Document*, published by National Water Well Association, 1986.

*A Compendium of Superfund Field Operations*, EPA 540/P-87/001, published by the Office of Emergency and Remedial Response, Office of Waste Programs Enforcement, US EPA, 1987.

# SOP 222

# AQUIFER AND STEP-DRAWDOWN TESTS

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes methods for conducting two types of "pumping tests" on water wells. An aquifer test is a longer-term constant-discharge/drawdown test that is used to evaluate aquifer hydraulic properties, including transmissivity, storativity, and boundary conditions. A step-drawdown test is a shorter term variable-discharge/drawdown test used to evaluate well yield capacity and/or the additional head losses (drawdown) expected in the pumping well (caused by turbulent flow). The step-drawdown test also provides a means to estimate the correct pumping rate for the aquifer test.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project manager will be responsible for designing the test parameters including pumping rate, test length, selecting observation wells to be monitored, frequency of measurements, pumping well piping, and methods of data analysis. The project manager may choose to delegate the work to other members of the project team, but is responsible for overseeing the work and making sure that it is done in accordance with this SOP and project specific sampling plans. It is the responsibility of the contractor (if used) to provide assistance to the field personnel when needed, including placing the discharge pump and piping, and controlling the rate of water discharge.

## 3.0 SUPPORTING MATERIALS

The field project team will provide the following materials:

- Water-level measuring devices and/or pressure transducers and data logger (check all water level measuring devices to ensure that they are calibrated to a common measurement, e.g., a steel tape);
- Water pump with necessary piping and tubing;
- Flow meter;
- Stopwatch or other timing device capable of second accuracy;
- Aquifer test data sheets (Figure 1) or project field book;
- Flashlights/lighting (to measure water levels after dark);
- Tape measures; and
- Well completion logs.

## 4.0 METHODS AND PROCEDURES

This section describes the procedures required for the project field team to conduct either a step-drawdown test or an aquifer test.

### 4.1 General Procedures

The testing duration, and reading frequency and location will be decided by the project manager (or designated representative) prior to testing. The wells and piezometers to be used in the test will be selected or installed prior to the test and must be screened in the zone of interest. The pumping well should be thoroughly developed so that the material around the well screen does not impede water movement and head loss is minimized.

# AQUIFER TEST DATA

Page ____ of

CLIENT _____ SITE _____ Observer(s) _____

WELL NO: _____ Distance from Pumping Well _____ TOC Elevation _____ Well Depth _____

Test No. _____ Type of Test _____

**Time Data**
Pump On (Date): _____ Time _____ (t)
Pump Off (Date): _____ Time _____ (t')
Duration of Aquifer Test:
Pumping _____
Recovery _____

**Water Level Data**
Static Water Level _____
Measuring Point _____
Elevation of measuring pt. _____
Measuring Equipment _____

**Discharge Data**
How Q measured _____
Depth of pump/air line _____
Previous pumping (y / n) _____
Duration _____ End _____

| Date | Clock Time | Pump On/Off | Time since pump started t (min) | Time since pump stopped t' (min) | Depth to Water, ft | Depth to Product, ft | Product Thickness, ft | Depth to Corrected Water Table, ft | Water Level Change s or s', ft | Discharge Measurement | Discharge Rate (gpm) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

The flow meter should be tested prior to use by running a known volume of water through the meter and calibrating it by another method to measure discharge (e.g., bucket and stopwatch). Accuracy of the meter should be within 5 percent (i.e. 2.5 gallons over 50 gallons per minute.)

Prior to testing, several measurements need to be documented on the aquifer test data sheet or in the project field book. These include:

- Calibration of all electronic water-level measuring devices;
- Depth to the bottom of the test well and all observation wells;
- Diameter of test well and all observation wells;
- Surveyed measuring point elevations and horizontal coordinates of pumping and observation wells;
- Linear distance from the observation wells to the test well; and
- Initial water levels in the test and observation wells (water levels should be measured for several days prior to the start of the test, preferably twice per day).

A separate data sheet or page in the field book should be used for each well or piezometer. Time data should be recorded as both clock time and elapsed time (e.g., minutes) since pumping started/stopped. The pumping rate required to stress the aquifer (at least 50 percent of the wells maximum yield) but not pump the well dry, should be calculated based upon an initial estimation of aquifer properties (provided by the project manager (or designated representative)) or by conducting a step-drawdown test.

A step-drawdown test consists of pumping the test well in several stages of increased pumping rate while measuring drawdown in the pumping well during each stage. At least three, and preferably four, stages are conducted with the largest pumping capacity at least 20 percent greater than the design pumping rate anticipated by the project manager (or the designated representative). The water level in the pumping well is measured at brief time intervals increasing to longer intervals, for a period ranging from 1 to 3 hours (see Section 4.2). A longer period (in the first step) should be allowed when the volume of water stored in the well is large relative to the pumping rate. The pumping rate is then increased ("stepped up") and the procedure is repeated. After the last step is completed, pumping is stopped and the recovery of the water level in the well is measured. An 8-

hour test comprised of four 2-hour steps is generally sufficient for a step-drawdown test. All measurements should be recorded on the data sheet or the field book.

The step-drawdown data for each step are plotted on a single semi-log graph. Drawdown is plotted on the arithmetic scale and time is plotted on a logarithmic scale in order to fit a straight line to the data points. The maximum rate of pumping is the highest value for which the straight line relationship between discharge and drawdown applies. An appropriate pumping rate can then be selected using a projection of the straight-line drawdown trend that will stress the aquifer but not pump the well dry. Refer to Labadie and Helweg (1975) for analysis of the step-test data for the purpose of determining well efficiency and a head loss coefficient.

An estimate of the duration of the aquifer test and volume of water to be pumped can then be made based on this calculated rate. The minimum duration of the aquifer test should be about four hours. The best estimates of the aquifer properties and boundary conditions for confined aquifers can be obtained from tests that are conducted for at least 24 hours. A test duration of 72 hours is recommended for unconfined aquifers because of the influence of delayed vertical drainage on the apparent specific yield.

It is necessary to discharge pumped water outside the area affected by pumping to prevent it from re-entering an unconfined aquifer during the test. Water re-entering the aquifer will affect the test results. The project manager (or designated representative) will need to account for head losses in the discharge piping if it is lengthy and carries water to an elevated tank. The procedure to account for head loss is described in *Engineering Fluid Mechanics* (Roberson, 1988). The selection of a test pump can be significantly affected by the discharge condition, i.e., total lift plus head losses due to friction in a small hose or pipe. Be sure that the pump motor horsepower is large enough to provide the test-design discharge rate and that the proper size of generator is on hand with sufficient fuel to last the full duration of the test.

## 4.2 Specific Procedures

These step-by-step procedures should be followed in order to conduct a successful aquifer or step-drawdown test.

- Insert the transducers or water-level probes into the observation piezometers and pumping well, and obtain an initial round of manual water levels. Establish the background trend in non-pumping water levels by measuring levels for several days prior to the test. This effort is extremely important in aquifers with low permeability because routine water-table fluctuations could be greater than drawdown artificially created during the pumping test. Record the data on the aquifer test sheet or field book.

- Lower the pump into the well and position it deep enough in so that the water level will not drop below the pump during the test causing it to stop pumping.

- Set up discharge piping or a hose to transfer the water away from the pumping well at least 50 feet (farther for transmissive aquifers with high infiltration rates) from the pumping well. Set up flow-control valve with initial setting being near closed position. Set up flow-measurement device (in-line meter, weir, bucket and watch, etc.).

- Turn on the pump and water-level recorders to begin the pump test. Make sure a water-level measurement is collected form the pumping and observation wells immediately prior to starting the pump. Write down the exact clock time that the pump was started on the data sheet or field book.

- Adjust the flow-control valve to the proper pre-determined pumping rate. The pumping rate should be monitored with clock time noted throughout the test to ensure a constant discharge is maintained as the pumping water level in the well draws down. This discharge rate should be monitored at least four times per hour at the start of the test. If it remains constant (within 5 percent) for three hours, the number of monitoring intervals can be decreased. The discharge rate should be adjusted, as necessary, to keep it constant by slowly opening the flow-control valve as needed after flow measurements are made.

Drawdown first becomes apparent in the observation wells nearest the pumping well. In these wells, the depth to water should be recorded at 1- or 2-minute intervals for the first several minutes of the test and gradually increased to 10-minute intervals after about one hour. One-half hour recordings are sufficient after 2 hours and hourly recordings are adequate between 5 and 12 hours of pumping time. Beyond 12 hours, the time interval between recordings can be gradually increased to several hours. It is recommended that pumping continue until water level changes with

time are relatively small (approximately three days for unconfined aquifers and approximately one day for confined aquifers).

Since the data will be plotted on a log scale, about ten measurements should be made each log cycle of time (i.e., ten readings in the first 10 minutes, ten in the next 100 minutes, and ten in the next 1000 minutes). This will ensure an adequate number of data points on the graph to provide a curve. Semi-log graphs of time versus drawdown should be prepared by the field project team during the test to determine whether the test is proceeding as expected.

Any unusual event (stopping of pump, onset of weather change, passage of train, tides, or water level fluctuations in nearby surface water) should be noted on the data sheet or the field book. Barometric pressure readings should be corrected for confined aquifer tests to determine barometric efficiencies. Water levels in nearby surface water bodies (e.g. lakes, ponds, rivers, bays) should be measured during the test, especially if a hydraulic connection is suspected between the test aquifer and the surface water body.

After the aquifer test has been conducted for the specified period of time, the pump should be turned off. Whenever possible, water-level recovery measurements in the pumping and observation wells should be taken after pumping has ceased. The frequency of measurements should be identical to the schedule followed during pumping (decreasing frequency with time). These data can be used in the analysis of the pumping data, and can sometimes be more representative of aquifer characteristics.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

When using a transducer/logger system, take periodic manual measurements of the water level as a check on the transducer readings. Compare the analytical results to published values for hydraulic conductivities for similar earth materials. Make sure the pump is on for the entire test and there are no malfunctions. If the pump malfunctions early in the test, let the aquifer recover and restart the test, if possible. If the pump malfunctions later in the test, begin recovery measurements immediately.

## 6.0 DOCUMENTATION

# SOP 222

# AQUIFER AND STEP-DRAWDOWN TESTS

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes methods for conducting two types of "pumping tests" on water wells. An aquifer test is a longer-term constant-discharge/drawdown test that is used to evaluate aquifer hydraulic properties, including transmissivity, storativity, and boundary conditions. A step-drawdown test is a shorter term variable-discharge/drawdown test used to evaluate well yield capacity and/or the additional head losses (drawdown) expected in the pumping well (caused by turbulent flow). The step-drawdown test also provides a means to estimate the correct pumping rate for the aquifer test.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project manager will be responsible for designing the test parameters including pumping rate, test length, selecting observation wells to be monitored, frequency of measurements, pumping well piping, and methods of data analysis. The project manager may choose to delegate the work to other members of the project team, but is responsible for overseeing the work and making sure that it is done in accordance with this SOP and project specific sampling plans. It is the responsibility of the contractor (if used) to provide assistance to the field personnel when needed, including placing the discharge pump and piping, and controlling the rate of water discharge.

## 3.0 SUPPORTING MATERIALS

The field project team will provide the following materials:

- Water-level measuring devices and/or pressure transducers and data logger (check all water level measuring devices to ensure that they are calibrated to a common measurement, e.g., a steel tape);
- Water pump with necessary piping and tubing;
- Flow meter;
- Stopwatch or other timing device capable of second accuracy;
- Aquifer test data sheets (Figure 1) or project field book;
- Flashlights/lighting (to measure water levels after dark);
- Tape measures; and
- Well completion logs.

## 4.0 METHODS AND PROCEDURES

This section describes the procedures required for the project field team to conduct either a step-drawdown test or an aquifer test.

### 4.1 General Procedures

The testing duration, and reading frequency and location will be decided by the project manager (or designated representative) prior to testing. The wells and piezometers to be used in the test will be selected or installed prior to the test and must be screened in the zone of interest. The pumping well should be thoroughly developed so that the material around the well screen does not impede water movement and head loss is minimized.

# AQUIFER TEST DATA

Page ____ of

CLIENT _____ SITE _____ Observer(s) _____

WELL NO: _____ Distance from Pumping Well _____ TOC Elevation _____ Well Depth _____

Test No. _____ Type of Test _____

**Time Data**
Pump On (Date): _____ Time _____ (t)
Pump Off (Date): _____ Time _____ (t')
Duration of Aquifer Test:
Pumping _____
Recovery _____

**Water Level Data**
Static Water Level _____
Measuring Point _____
Elevation of measuring pt. _____
Measuring Equipment _____

**Discharge Data**
How Q measured _____
Depth of pump/air line _____
Previous pumping (y / n) _____
Duration _____ End _____

| Date | Clock Time | Pump On/Off | Time since pump started t (min) | Time since pump stopped t' (min) | Depth to Water, ft | Depth to Product, ft | Product Thickness, ft | Depth to Corrected Water Table, ft | Water Level Change s or s', ft | Discharge Measurement | Discharge Rate (gpm) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

The flow meter should be tested prior to use by running a known volume of water through the meter and calibrating it by another method to measure discharge (e.g., bucket and stopwatch). Accuracy of the meter should be within 5 percent (i.e. 2.5 gallons over 50 gallons per minute.)

Prior to testing, several measurements need to be documented on the aquifer test data sheet or in the project field book. These include:

- Calibration of all electronic water-level measuring devices;
- Depth to the bottom of the test well and all observation wells;
- Diameter of test well and all observation wells;
- Surveyed measuring point elevations and horizontal coordinates of pumping and observation wells;
- Linear distance from the observation wells to the test well; and
- Initial water levels in the test and observation wells (water levels should be measured for several days prior to the start of the test, preferably twice per day).

A separate data sheet or page in the field book should be used for each well or piezometer. Time data should be recorded as both clock time and elapsed time (e.g., minutes) since pumping started/stopped. The pumping rate required to stress the aquifer (at least 50 percent of the wells maximum yield) but not pump the well dry, should be calculated based upon an initial estimation of aquifer properties (provided by the project manager (or designated representative)) or by conducting a step-drawdown test.

A step-drawdown test consists of pumping the test well in several stages of increased pumping rate while measuring drawdown in the pumping well during each stage. At least three, and preferably four, stages are conducted with the largest pumping capacity at least 20 percent greater than the design pumping rate anticipated by the project manager (or the designated representative). The water level in the pumping well is measured at brief time intervals increasing to longer intervals, for a period ranging from 1 to 3 hours (see Section 4.2). A longer period (in the first step) should be allowed when the volume of water stored in the well is large relative to the pumping rate. The pumping rate is then increased ("stepped up") and the procedure is repeated. After the last step is completed, pumping is stopped and the recovery of the water level in the well is measured. An 8-

hour test comprised of four 2-hour steps is generally sufficient for a step-drawdown test. All measurements should be recorded on the data sheet or the field book.

The step-drawdown data for each step are plotted on a single semi-log graph. Drawdown is plotted on the arithmetic scale and time is plotted on a logarithmic scale in order to fit a straight line to the data points. The maximum rate of pumping is the highest value for which the straight line relationship between discharge and drawdown applies. An appropriate pumping rate can then be selected using a projection of the straight-line drawdown trend that will stress the aquifer but not pump the well dry. Refer to Labadie and Helweg (1975) for analysis of the step-test data for the purpose of determining well efficiency and a head loss coefficient.

An estimate of the duration of the aquifer test and volume of water to be pumped can then be made based on this calculated rate. The minimum duration of the aquifer test should be about four hours. The best estimates of the aquifer properties and boundary conditions for confined aquifers can be obtained from tests that are conducted for at least 24 hours. A test duration of 72 hours is recommended for unconfined aquifers because of the influence of delayed vertical drainage on the apparent specific yield.

It is necessary to discharge pumped water outside the area affected by pumping to prevent it from re-entering an unconfined aquifer during the test. Water re-entering the aquifer will affect the test results. The project manager (or designated representative) will need to account for head losses in the discharge piping if it is lengthy and carries water to an elevated tank. The procedure to account for head loss is described in *Engineering Fluid Mechanics* (Roberson, 1988). The selection of a test pump can be significantly affected by the discharge condition, i.e., total lift plus head losses due to friction in a small hose or pipe. Be sure that the pump motor horsepower is large enough to provide the test-design discharge rate and that the proper size of generator is on hand with sufficient fuel to last the full duration of the test.

## 4.2 Specific Procedures

These step-by-step procedures should be followed in order to conduct a successful aquifer or step-drawdown test.

- Insert the transducers or water-level probes into the observation piezometers and pumping well, and obtain an initial round of manual water levels. Establish the background trend in non-pumping water levels by measuring levels for several days prior to the test. This effort is extremely important in aquifers with low permeability because routine water-table fluctuations could be greater than drawdown artificially created during the pumping test. Record the data on the aquifer test sheet or field book.

- Lower the pump into the well and position it deep enough in so that the water level will not drop below the pump during the test causing it to stop pumping.

- Set up discharge piping or a hose to transfer the water away from the pumping well at least 50 feet (farther for transmissive aquifers with high infiltration rates) from the pumping well. Set up flow-control valve with initial setting being near closed position. Set up flow-measurement device (in-line meter, weir, bucket and watch, etc.).

- Turn on the pump and water-level recorders to begin the pump test. Make sure a water-level measurement is collected form the pumping and observation wells immediately prior to starting the pump. Write down the exact clock time that the pump was started on the data sheet or field book.

- Adjust the flow-control valve to the proper pre-determined pumping rate. The pumping rate should be monitored with clock time noted throughout the test to ensure a constant discharge is maintained as the pumping water level in the well draws down. This discharge rate should be monitored at least four times per hour at the start of the test. If it remains constant (within 5 percent) for three hours, the number of monitoring intervals can be decreased. The discharge rate should be adjusted, as necessary, to keep it constant by slowly opening the flow-control valve as needed after flow measurements are made.

Drawdown first becomes apparent in the observation wells nearest the pumping well. In these wells, the depth to water should be recorded at 1- or 2-minute intervals for the first several minutes of the test and gradually increased to 10-minute intervals after about one hour. One-half hour recordings are sufficient after 2 hours and hourly recordings are adequate between 5 and 12 hours of pumping time. Beyond 12 hours, the time interval between recordings can be gradually increased to several hours. It is recommended that pumping continue until water level changes with

time are relatively small (approximately three days for unconfined aquifers and approximately one day for confined aquifers).

Since the data will be plotted on a log scale, about ten measurements should be made each log cycle of time (i.e., ten readings in the first 10 minutes, ten in the next 100 minutes, and ten in the next 1000 minutes). This will ensure an adequate number of data points on the graph to provide a curve. Semi-log graphs of time versus drawdown should be prepared by the field project team during the test to determine whether the test is proceeding as expected.

Any unusual event (stopping of pump, onset of weather change, passage of train, tides, or water level fluctuations in nearby surface water) should be noted on the data sheet or the field book. Barometric pressure readings should be corrected for confined aquifer tests to determine barometric efficiencies. Water levels in nearby surface water bodies (e.g. lakes, ponds, rivers, bays) should be measured during the test, especially if a hydraulic connection is suspected between the test aquifer and the surface water body.

After the aquifer test has been conducted for the specified period of time, the pump should be turned off. Whenever possible, water-level recovery measurements in the pumping and observation wells should be taken after pumping has ceased. The frequency of measurements should be identical to the schedule followed during pumping (decreasing frequency with time). These data can be used in the analysis of the pumping data, and can sometimes be more representative of aquifer characteristics.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

When using a transducer/logger system, take periodic manual measurements of the water level as a check on the transducer readings. Compare the analytical results to published values for hydraulic conductivities for similar earth materials. Make sure the pump is on for the entire test and there are no malfunctions. If the pump malfunctions early in the test, let the aquifer recover and restart the test, if possible. If the pump malfunctions later in the test, begin recovery measurements immediately.

## 6.0 DOCUMENTATION

# STANDARD OPERATING PROCEDURE (SOP) 224
# AQUIFER SLUG TEST

## 1.0 PURPOSE AND APPLICABILITY

Slug tests are a variety of field tests performed on wells completed in either aquifers or aquitards in order to obtain hydraulic conductivity estimates at a number of wells on a site in a reasonable amount of time and at low cost. These tests involve the instantaneous injection or withdrawal of a small volume of water followed by monitoring the time and water-level recovery back to the static pre-test condition. Slug tests are very popular and offer the advantages of not generating excessive amounts of fluids and not requiring expensive equipment. According to Freeze and Cherry (1979) a properly performed and analyzed slug test should give the investigator an order-of-magnitude estimate of the hydraulic conductivity of earth materials in close proximity to the test well. Slug tests can be used as a basis for preliminary design; however, it is recommended that pump tests or pilot tests be conducted to supplement the slug test data.

This SOP describes the techniques used to perform a slug test. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The Project Manager will be responsible for the planning and execution of slug tests. The Project Manager may choose to delegate the work to other members of the project team, but is responsible for overseeing the work and making sure that the it is done in accordance with this SOP and project specific sampling plans.

## 3.0 SUPPORTING MATERIALS

The following is a list of conventional field equipment that is needed to perform a standard ThermoRetec slug test:

- A solid pipe slug, or bailer and cord;
- A pressure transducer and data logger, or manual electric water-level indicator;
- Wrist watch or stop watch to note starting time and elapsed time;

- Decontamination equipment and solutions; and
- Slug test form or field book.

The following considerations should be made based upon site conditions:

- The fluid-level measuring device will be dependent on site conditions. Slug tests can be performed in wells that contain non-aqueous phase liquids (NAPL). The presence of NAPL will require the use of an electric-interface probe capable of measuring depths to the top of each fluid.
- When testing wells completed in highly transmissive aquifers, a transducer and data logger should be used in order to measure rapid changes in the water level after starting the test. Inserting the transducer probe will initiate a change in the water level, which should be allowed to re-equilibrate to static before starting the test. The transducer must have the right resolution for the anticipated maximum change in water level, 0.005 pounds per square inch (psi) and 0.001 feet are generally recommended.
- If the well is expected to respond very slowly to the initial change in water level (e.g., when the saturated formation outside the production zone is composed of poorly permeable silt/clay or shale), a manual system of measurement should be used. In this type of formation there is little cost benefit in using the transducer/data logger system. An electric sounder is recommended; a calibrated steel tape would be acceptable.
- A slug should be selected that is large enough to create the most change in static-water level and short enough to be completely submerged. If the slug is to remain in the well, position it to one side so that it does not interfere with later water-level measurements or the static height of the transducer. If a solid slug is to be removed, allow time after insertion of the slug for the pre-test water level to re-equilibrate to static before starting the test.

All equipment used during the slug test, should be decontaminated following procedures outlined in SOP 120.

## 4.0 METHODS AND PROCEDURES

This sections describes the methods and procedures for conducting a slug test. The project specific sampling plan should be reviewed for any additional or special requirements.

## 4.1 General Information

Slug tests may be performed on wells of any diameter or depth, and on both confined and unconfined aquifers. It is important to make note of the well dimensions and the depth range of the well screen or production zone (screen and filter pack, or open rock hole). It is not necessary that the static-water level prior to testing be either above or below the top of the production zone, although the analysis of the recovery water-level data will depend on these starting conditions. The composition and thickness of the filter pack material should generally be noted because it may affect the hydraulic response observed in the well and will figure into the analysis of the field data. The age of the well may affect results also, so if the year or date the well was completed is not near the year/date of the test, a note of this should be made.

The size and composition of the slug requires some planning. It is practical to use a solid slug made of PVC or steel pipe filled with sand and capped with an I-hook attached to the top plug. The I-hook will act as an attachment for the cord which introduces and retrieves the slug from the well. It is recommended that several sizes and slugs be available in order to accommodate different well and water-level conditions. Three- or five-foot lengths of one-inch diameter pipe are well suited for two-inch diameter wells. To prevent cross contamination, the slug should be decontaminated and the slug cord replaced between wells.

Pouring clean water into a well from the top of casing is not considered standard practice, but can be used in the absence of a solid slug or bailer. If water is used as a slug, it can be removed with a clean bailer. Use of a pump to instantaneously remove the water is not considered standard practice, but could be considered if the well and static-water levels are so deep that use of a slug is impractical. The use of equipment to instantaneously pressurize a sealed well, or to release water from a shut-in artesian well are acceptable, but are also not considered part of the standard practice described here.

## 4.2 Types of Slug Tests

A "rising head" slug test is one in which the initial change serves to lower the water level or hydraulic head in the well. A "falling head" slug test is one in which the initial change serves to raise the water level or hydraulic head. When the initial change in water level occurs entirely within the blank well casing above the well screen or open hole, either test should provide the same analytical results. When the initial change is entirely within the well screen or open hole zone, the two different test methods will produce results that are less likely to coincide due to the fact that rates of water imbibition from the well are different from drainage (flow to the well). The authors

of the papers generally used for analysis of slug tests in wells having screens that straddle the water table discourage the use of their analytical method for falling head tests (Bouwer and Rice, 1976) (Bouwer, 1989).

## 4.3 Pre-Test Information

The following steps are to be followed when performing a slug test on a non-flowing well. These steps pertain to both transducer/data logger tests and manual tests.

1. Observe and enter the following data on the slug test form (Figure 1) or in the project field book (a copy of the well construction log can also be attached, if available):

   - Well total depth and depth interval of the well screen or open rock hole (sound bottom of well if it has not been sounded recently for other purposes);
   - The diameter of the well casing, screen, and original borehole size; and
   - Information about the filter pack, including the depth interval and the size of material used.

   General aquifer conditions such as confined or unconfined, total thickness, and percent of penetration by the test well are optional for the slug test form but will be needed for data analysis.

2. Observe and make note of the static pre-test water levels, date of the test, and clock time of the static-water level. Make a note of the weather conditions at the start of the test. Also note any major changes in the weather that occur in longer term tests since these are an indirect measure of barometric pressure changes, which may affect water levels.

3. Provide information on the slug test form regarding type, dimensions, and volume of the slug to be used in the test. Using a specific volume-per-foot ratio for the given inside diameter of the test well, estimate about how much water-level change will occur when the slug is introduced or removed.

4. Note on the slug test form the type of test (i.e., transducer/data logger or manual).

# SLUG TEST FIELD DATA SHEET

Page _ of

CLIENT _____ SITE _____ Observer(s) _____

WELL NO:_____ Test No. _____ TOC Elevation _____ Well Depth

**Water Level Data**
Static Water Level _____
Measuring Point _____
Elevation of measuring pt_____
suring Equipment _____

Type/ Description of Slug _____
Slug Dimensions: _____ Slug Volume is:_____ Gal _____
Well Inside Diameter _____
Date _____ Weather _____

| Clock Time | Elapsed Time (Min) | Depth to Water (Ft) | Change in Depth to Water Relative to Static Level (Ft) | Comments |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

## 4.4 Slug Testing - Transducer/Data Logger

The following steps are for the use of a transducer and data logger system. Manual slug testing is described in Section 4.5.

1. Insert the transducer probe in the well approximately 0.5 feet off the bottom of the well. Secure the probe cable to the protective well casing and turn on the data logger. Calibrate the data logger reading to an equivalent static-water level depth equal to that measured manually. The data logger can also be set to read zero, in which case negative numbers will relate to a lowering of the static head and positive numbers will relate to a raising of the static head. Program the frequency of measurements and the density of the fluid in the data logger.

2. Start the logging program and take a final depth-to-water measurement just prior to starting the test. Note the measurement and clock time on the slug test form. Start the test by smoothly removing or inserting the slug, so as not to disturb the transducer elevation. Make note of the start time on the slug test form.

3. Check periodically to see if the initial water level or data logger reading is being approached. Stop the test when the pre-test water level has been reached for wells that recover within one day, or after about 80 percent of the initial change has recovered if several days or weeks have elapsed since starting the test.

## 4.5 Slug Testing - Manual

The following steps are for a manual test using an electronic water-level probe. Transducer and data logger slug testing is described in Section 4.4.

1. Take a final depth-to-water measurement just prior to starting the test. Note the measurement and clock time on the slug test form. Start the test by removing or inserting the slug making note of the start time on the slug test form.

2. Observe manual water levels at increasing time intervals and make note of these along with the clock time of each measurement on the slug test form. Make manual observations at least as frequently as follows:

    - Time zero to 5 minutes -- every 30 seconds;
    - 5 to 15 minutes -- every minute;

- 15 to 60 minutes -- every 5 minutes;
- 60 to 120 minutes -- every 15 minutes;
- 120 minutes to 10 hours -- every hour;
- 10 to 48 hours -- every 12 hours; and
- 48 hours to completion -- every 2 days;

Make note of dates of measurements if the recovery time exceeds more than a day.

3. Make elapsed time calculations in the field and observe the general rate of recovery back to the pre-test static water level. Stop the test when the pre-test water level has been reached for wells that recover within one day, or after about 80 percent of the initial change has recovered if several days or weeks have elapsed since starting the test.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

When using a transducer/data logger system, take periodic manual measurements of the water level as a check on the transducer readings. On wells that have screens or open holes below the static-water level, perform both a rising and falling head test, and compare the analytical results of each method. Compare the calculated change in water level from slug volume and the volume/foot well casing ratio as a check on the initial readings made with the transducer system or the manual sounder measurement. These should be within about 5 to 10 percent of each other. During analysis, use the calculated value to represent the initial change in head instead of the first manual measurement taken soon after the initial change in head. Compare the analytical results to published values for hydraulic conductivities for similar earth materials. Note, the Fort Collins office has developed a spreadsheet to assist with calculating the initial desplacement of the slug.

At wells that have free NAPL, the changes in NAPL thickness will need to be adjusted to the equivalent change in water level using the specific gravity of the NAPL prior to analysis. The user should refer to SOP 223 for the free NAPL baildown test.

## 6.0 DOCUMENTATION

The slug test form and or the project field book will be maintained as a part of the slug test results. These documents will provide a summary of the slug test method, site and weather conditions, and the slug test data. These documents will be kept in the project files for reference.

## REFERENCES

Freeze, R.A. and J.A. Cherry, 1979, *Groundwater*, published by Prentice-Hall, Inc., Englewood Cliffs, NJ, 604pp.

Bouwer, H. and R.C. Rice, 1976, *A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells*, US Water Conservation Laboratory, Phoenix, AZ.

Bouwer, Herman, 1989, *The Bouwer and Rice Slug Test - An Update*, US Water Conservation Laboratory, Phoenix, AZ.

# SOP 230

# GROUNDWATER SAMPLING

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the collection of valid and representative samples from groundwater monitoring wells. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The field sampling coordinator will have the responsibility to oversee and ensure that all groundwater sampling is performed in accordance with the project specific sampling program and this SOP. In addition, the field sampling coordinator must ensure that all field workers are fully apprised of this SOP.

## 3.0 SUPPORTING MATERIALS

The list below identifies the types of equipment which may be used for a range of groundwater sampling applications. From this list, project specific equipment will be selected based upon project objectives and site conditions (e.g., the depth to groundwater, purge volumes, analytical parameters, well construction, and physical/chemical properties of the analytes). The types of sampling equipment are as follows:

**Purging/Sample Collection**

- Bailers and bailer cord;
- Centrifugal pump;

- Bladder pump; or
- Peristaltic pump.

The most widely applicable equipment that will contact the water must be made of inert materials, preferably stainless steel or fluorocarbon resin.

**Sample Preparation/Field Measurement**

- pH meter;
- Specific conductance meter;
- Thermometer;
- Filtration apparatus; and
- Water-level measurement equipment.

All equipment will be calibrated before use following the manufacturer's specifications.

**General**

- Distilled water dispenser bottle;
- Methanol or isopropyl dispenser bottle;
- Decontamination equipment;
- Personal protection equipment as specified in the Project Health and Safety Plan;
- Field data sheets and field book;
- Sample containers, labels, and preservation solutions;
- Buckets and drums;

- Coolers and ice; and
- Paper towels or chemical-free cloths.

## 4.0 METHODS AND PROCEDURES

The following sections describe the methods and procedures required to collect representative groundwater samples.

### 4.1 Water-Level Measurement

After unlocking and/or opening a monitoring well, the first task will be to obtain a water-level measurement. A static-water level will be measured in the well prior to the purging and collection of any samples. The water level is needed for estimating the purge volume and may also be used for mapping the potentiometric surface of the groundwater. Water-level measurements will be made using an electronic or mechanical device following the methods described in SOP 231.

The measuring point location for the well should be clearly marked on the outermost casing or identified in previous sample collection records. This point is usually established on the well casing itself, but may be marked on the protective steel casing in some cases. In either case, it is important that the marked point coincide with the same point of measurement used by the surveyor. If not marked from previous investigations, the water level measuring point should be marked on the north side of the well casing and noted in the groundwater sampling form (Figure 1). Whatever measuring point is used, the location should be described on the groundwater sampling form.

To obtain a water level measurement lower a decontaminated mechanical or an electronic sounding unit into the monitoring well until the audible sound of the unit is detected or indicates water contact. At this time the precise measurement should be determined by repeatedly raising

REMEDIATION TECHNOLOGIES, INC.
Groundwater Sampling Form

ThermoRetec
Smart Solutions. Positive Outcomes.

PROJECT _____ WELL NO. _____
PROJECT NO. _____ SAMPLERS _____

1. WELL CONDITION CHECKLIST
   a. Bump posts _____ Pro. casing/lock _____ Surface pad _____
   b. Well visibility (paint) _____
   c. Well label _____

2. WATER LEVEL MEASUREMENT
   DATE _____ TIME _____
   WEATHER CONDITIONS _____
   a. Location of measuring point _____
   b. Depth of water table from measuring point _____
   c. Height of measuring point above ground surface _____
   d. Total depth of well below measuring point _____
   e. Length of water column (line 2d−2b) _____

3. WELL PURGING
   DATE _____ TIME _____
   WEATHER CONDITIONS _____
   a. Purge method _____
   b. Required purge volume at 3 well volumes _____
   Pumping Duration/Vol Rmvd pH Cond. T(C) Appearance
   _____
   _____
   _____
   _____
   _____

4. SAMPLE COLLECTION
   DATE _____ TIME _____
   WEATHER CONDITIONS _____
   a. Collection Method _____
   b. Meter Calibration: Date Model
      pH Meter _____
      Conductivity Meter _____
   c. Sample Information pH _____ Cond. _____ T(C) _____
      Analysis Containers Sample Prep./Preservation
      _____
      _____
      _____
      _____
      _____
   d. Chain of Custody Form _____ COC Tape _____
   e. Shipping Container _____

5. COMMENTS: _____
   _____
   _____
   _____
   _____



FIGURE 1

and lowering the tape or cable to converge on the exact measurement. The water-level measurement should be entered on the groundwater sampling form. The water-level measurement device shall be decontaminated immediately after use following the procedures outlined in SOP 120.

## 4.2 Purging and Sample Collection Procedures

Well purging is the activity of removing some volume of water from a monitoring well in order to induce "fresh" groundwater to flow into the well prior to sampling. Under most well construction and hydrogeologic conditions, this provides water that is more representative of the groundwater in saturated materials adjoining the well.

The volume of water to be removed, referred to as the purge volume, is a function of the water-yielding capacity of the well, the well diameter and depth, and the depth to water made just prior to purging. The well depth should be sounded with the water-level cable or tape just before or after measuring the static depth to water. A well volume is defined as the product of the length of water column and the volume per unit length of well casing, a function of casing inside diameter. The following data can be used in this field calculation:

| Inside Diameter, inches | | Gallons/foot |
|---|---|---|
| 1 1/4 | - | 0.077 |
| 1 1/2 | | 0.10 |
| 2 | | 0.16 |
| 3 | | 0.37 |
| 4 | | 0.65 |
| 6 | | 1.64 |

According to the TEGD (USEPA, 1986), the purge volume should equal at least three well volumes when the earth materials will yield relatively large quantities of water, and between one and two well volumes when the earth materials will only yield small quantities to the well. From

a field operations viewpoint, large quantities (high yield) means that the well can not be pumped or bailed "dry" by removing three well volumes. Small quantities (low yield) are identified when the well can be pumped or bailed "dry".

Based on experience and recent scientific literature, it will be RETEC's policy to minimize the generation of water turbidity when purging. Turbidity is especially of concern when testing the samples for metals or for selected organics that may be sorbed to the sediment. Turbidity will be minimized by :

- using a low-pumping rate submersible pump such as a compressed-gas driven bladder pump; or
- slowly moving the bailer in and out of the water column; avoid dropping the bailer and removing it quickly.

Purging will be performed for all groundwater monitoring wells prior to sample collection.

Three general methods are used for well purging. Well purging may be achieved using bailers, surface pumps, or down-well submersible pumps. In all cases pH and specific conductance will be monitored during purging. Field parameter values will be entered on the groundwater sampling form along with the corresponding purge volume. The following sections explain the procedures to be used to purge and collect samples from monitoring wells.

### 4.2.1 Bailing

Obtain a clean decontaminated bailer and a spool of polypropylene rope or equivalent bailer cord. Using the rope at the end of the spool, tie a bowline knot, or equivalent, through the bailer loop. Test the knot for adequacy by creating tension between the line and the bailer. Tie again if needed.

Lower the bailer to the bottom of the monitoring well and remove an additional five feet of cord from the spool. Cut the cord at the spool and secure the rope to the well head or the wrist of the person who shall perform the bailing.

Raise the bailer by grasping a section of cord using each hand alternately. This bailer lift method is used so that the bailer cord will not come into contact with the ground or other potentially contaminated surfaces.

Samples collected by bailing will be poured directly into sample containers from bailers which are full of fresh groundwater. Samples will be collected in the following order:

- Volatile organic compounds;
- Semivolatile organic compounds;
- Pesticides/Herbicides/PCBs/Dioxins;
- Organic indicator compounds;
- Metals (total and/or dissolved);
- Miscellaneous inorganic compounds;
- Radiometric compounds; and
- Microbial analyses.

During sample collection, bailers will not be allowed to contact the sample containers.

### 4.2.2 Pumping

Groundwater withdrawal using pumps is commonly performed with centrifugal, peristaltic, submersible, or bladder pumps. Peristaltic and centrifugal pumps are limited to conditions where groundwater need only be raised through approximately 20 to 25 feet of vertical distance. Submersible or bladder pumps can be used when groundwater is greater than 25 feet below grade. Specific methods for pumps will be discussed in the project specific sampling plan. Pumping for collection of samples to be analyzed for volatile organics will only be with bladder pumps.

Samples collected by pumping will be transferred directly from the pump discharge tubing into the sample containers. Samples will be collected in the following order:

- Volatile organic compounds;
- Semivolatile organic compounds;
- Pesticides/Herbicides/PCBs/Dioxins;
- Organic indicator compounds;
- Metals (total and/or dissolved);
- Miscellaneous inorganic compounds;
- Radiometric compounds; and
- Microbial analyses.

During sample collection, the discharge tubing will not be allowed to contact the sample containers.

### 4.3 Sample Preparation and Filtration

Specific procedures pertaining to the handling and shipment of samples shall be in accordance with SOP 110. A clean pair of gloves and decontaminated sampling tools will be used when handling the samples during collection to prevent cross contamination.

Prior to transport or shipment, groundwater samples may require preparation and/or preservation. Field preparation may entail filtration, preservation in the form of chemical additives, or temperature control. Specific preservation requirements will be described in the project specific sampling plans.

Groundwater samples collected for dissolved metals analyses will be filtered prior to being placed in sample containers. Groundwater filtration will be performed using a peristaltic pump and a 0.45 micron water filter unless otherwise specified in the project specific sampling plan.

For most dissolved metal analyses, pH adjustment of the sample is also required and shall be performed after filtration.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements include, but are not limited to, blind field duplicates, blind rinsate blanks, and blind field blanks. These samples will be collected on a frequency of one QA/QC sample per 10 field samples or a minimum of one QA/QC sample per day unless otherwise specified in the project specific sampling plan.

## 6.0 DOCUMENTATION

A number of different documents will be completed and maintained as a part of groundwater sample collection. The documents will provide a summary of the sample collection procedures and conditions, shipment method, the analyses requested, and the custody history. The documents may include:

- Field book;
- Groundwater sampling forms;
- Sample labels;
- Chain of custody; and
- Shipping receipts.

All documentation will be stored in the project files.

## REFERENCES

*Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*, EPA 600/4-89/034, published by National Water Well Association, 1989.

*RCRA Ground Water Monitoring Technical Enforcement Guidance Document*, published by National Water Well Association, 1986.

*A Compendium of Superfund Field Operations*, EPA 540/P-87/001, published by the Office of Emergency and Remedial Response, Office of Waste Programs Enforcement, US EPA, 1987.

# GROUNDWATER SAMPLING FORM
# WELL _____

| | |
|---|---|
| Sampled By: | Well Condition: |
| Date: | Weather: |

## PURGING INFORMATION

| | |
|---|---|
| Purge Pump Model: | Water Column: |
| Depth to Intake: | Well Diameter: |
| Total Depth: | Purge Volume: |
| Depth to Water: | |
| Depth to Product: | |

## GROUNDWATER PURGE PARAMETERS

Start Purge Time: Total Volume Purged:

| | Time | Volume Purged | pH | Conductivity | Temp. | Turbidity | DO | Salinity | ORP |
|---|---|---|---|---|---|---|---|---|---|
| Purge 1 | | | | | | | | | |
| Purge 2 | | | | | | | | | |
| Purge 3 | | | | | | | | | |
| Purge 4 | | | | | | | | | |
| Purge 5 | | | | | | | | | |
| Purge 6 | | | | | | | | | |
| Purge 7 | | | | | | | | | |
| Purge 8 | | | | | | | | | |
| Purge 9 | | | | | | | | | |
| Purge 10 | | | | | | | | | |
| Purge 11 | | | | | | | | | |
| Purge 12 | | | | | | | | | |
| Purge 13 | | | | | | | | | |
| Purge 14 | | | | | | | | | |
| Purge 15 | | | | | | | | | |

## SAMPLE COLLECTION AND ANLYTICAL INFORMATION

| | |
|---|---|
| Sample Collection Time: | Laboratory: |
| Shipped by: | COC Seal? yes / no |

## COMMENTS

# STANDARD OPERATING PROCEDURE (SOP) 231
# WATER-LEVEL MEASUREMENTS

## 1.0 PURPOSE AND APPLICABILITY

This SOP is concerned with the measurement of water levels in groundwater monitoring wells. Water-level measurements are fundamental to groundwater and solute transport studies. Water-level data are used to indicate the directions of groundwater flow and areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the groundwater system, to define the hydraulic characteristics of aquifers, and to evaluate stream-aquifer relations. Measurements of the static-water level are also needed to estimate the amount of water to be purged from a well prior to sample collection.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The field sampling coordinator will have the responsibility to oversee and ensure that all procedures are performed in accordance with the project specific sampling program and this SOP.

## 3.0 SUPPORTING MATERIALS

This section identifies the types of equipment which may be used for measurement of groundwater levels. Based on project objectives, observed or probable well contamination, and well construction, a project specific equipment list will be determined from the following equipment:

- Water-level and/or product-level measuring device;
- Distilled water dispenser bottle;
- Methanol or isopropyl dispenser bottle;
- Plastic sheeting;

- Personal protection equipment as specified in the Project Health and Safety Plan;
- Fluid-level monitoring logs and field book; and
- Paper towels or chemical-free cloths.

## 4.0 METHODS AND PROCEDURES

When taking a series of fluid-level measurements at a number of monitoring wells, it is generally good practice to go in order from the least- to most-contaminated well. Additionally, the measurement of all site wells should be done consecutively and before any sampling activities begin. This will ensure the data are representative of aquifer conditions. All pertinent data should be entered in the fluid-level monitoring log sheet (Figure 1) or the project field book.

### 4.1 Well Evaluation

Upon arrival at a monitoring well, the surface seal and well protective casing should be examined for any evidence of frost heaving, cracking, or vandalism. All observations should be recorded in the fluid-level monitoring log or the project field book. The area around the well should be cleared of weeds and other materials prior to measuring the static-water level. A drop cloth or other material (e.g., plastic garbage bag) should be placed on the ground around the well, especially if the ground is disturbed or potentially contaminated. This will save time and work for cleaning equipment or tubing if it falls on the ground during preparation or operation. The well protective casing should then be unlocked and the cap removed.

### 4.2 Safety Considerations

If the well is suspected of being contaminated, or has a history of contamination, the static water-level measurements should be made while wearing appropriate protective gear. The air in the well head should be sampled for organic vapors using either a photoionization analyzer or an organic vapor analyzer. The results shall be recorded in the fluid-level monitoring log or the project field book. This is the first indication of the presence of a non-aqueous phase liquid (NAPL). If the potential for fire or explosion exists, additional personal monitoring shall be conducted.

ThermoRete
Smart Solutions. Positive Outco

# FLUID-LEVEL MONITORING LOG

| | |
|---|---|
| SITE LOCATION: | PROJECT NAME: |
| PERSONNEL: | PROJECT NO. |
| GAUGING INSTRUMENT: | DATE(S) |

| WELL NUMBER | DATE | TIME | TOTAL DEPTH(a) | DEPTH TO WATER(a) | DEPTH TO OIL(a) | OIL THICKNESS | REMARKS |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

(a) measured from surveyed measuring point, unless otherwise noted.

PAGE ___ OF ___



**FIGURE 1**

## 4.3 Measuring Point Location

The measuring point location for the well should be clearly marked on the outermost casing or identified in previous sample collection records. This point is usually established on the well casing itself, but may be marked on the protective steel casing in some cases. In either case, it is important that the marked point coincide with the same point of measurement used by the surveyor. If not marked from previous investigations, the water-level measuring point should be marked on the north side of the well casing and noted in the fluid-level monitoring log or the project field book. Monitoring well measurements for total depth and water level should be consistently measured from one reference point so that these data can be used for assessing trends in the groundwater.

## 4.4 Water-Level Measurement

Water-level measurements shall be made using an electronic or mechanical device. Several methods for water-level measurement are described below. The specific method to be used will be defined in the project specific sampling plan.

### 4.4.1 Graduated Steel Tape

The graduated steel tape method is considered an accurate method for measuring the water level in nonflowing wells. Steel surveying tapes in lengths of 100, 200, 300, 500, and 1,000 feet are commonly used; a black tape is better than a chromium-plated tape. The tapes are mounted on hand-cranked reels up to 500-ft lengths; for greater depth, a motor-driven tape drive is usually required. A slender weight is attached to the ring at the end of the tape to ensure plumbness and to permit some feel for obstructions.

The lower few feet of tape is chalked by pulling the tape across a piece of blue carpenter's chalk. The wet chalk mark identifies the portion of the tape that was submerged. Lower the graduated steel-tape from the measuring point at the top of the well until a short length of the tape is submerged. The weight and tape should be lowered into the water slowly to prevent splashing. Submergence of the weight and tape may temporarily cause the water level to rise in wells or piezometers having very small diameters. This effect can be significant if the well is in materials of very low hydraulic conductivity.

Under dry surface conditions, it may be desirable to pull the tape from the well by hand, being careful not to allow it to become kinked, and reading the water mark before rewinding the tape onto

the reel. In this way, the water mark on the chalked part of the tape is rapidly brought to the surface before the wetted part of the tape dries. In cold regions, rapid withdrawal of the tape from the well is necessary before the wet part freezes and becomes difficult to read. Read the tape at the measuring point, and then read the water mark on the tape. The difference between these two readings is the depth to water below the measuring point. Errors resulting from the effects of thermal expansion of tapes and of stretch due to the suspended weight of the tape and plumb weight can become significant at high temperatures and for measured depths in excess of 1,000 feet.

The observer should make two measurements. If two measurements of static-water level made within a few minutes do not agree within 0.01 or 0.02 foot in observation wells having a depth to water of less than a couple hundred feet, continue to measure until the reason for the lack of agreement is determined or until the results are shown to be reliable. Where water is dripping into the well or covering the well casing wall, it may be impossible to get a good water mark on the chalked tape.

### 4.4.2 Electrical Methods

Many types of electrical instruments are available for water-level measurement; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Electrodes are generally contained in a weighted probe that keeps the tape taut while providing some shielding of the electrodes against false indications as the probe is being lowered into the well. Before lowering the probe in the well, the circuitry can be checked by dipping the probe in water and observing the indicator (a light, sound, and/or meter).

To obtain a water-level measurement, slowly lower the decontaminated probe into the monitoring well until the indicator (light, sound, and/or meter) shows water contact. At this time the precise measurement should be determined by repeatedly raising and lowering the tape or cable to converge on the exact measurement.

In wells having a layer of NAPL floating on the water, the electric tape will not respond to the oil surface and, thus, the fluid level determined will be different than would be determined by a steel tape. The difference depends on how much NAPL is floating on the water. Dual media tapes are recommended in these instance to measure both NAPL and water levels using the same measuring device.

The water-level measurement should be entered in the fluid-level monitoring log or the project field book. The water-level measurement device shall be decontaminated immediately after use following the procedures described in SOP 120.

### 4.4.3 Air Line

The air line method is especially useful in pumped wells where water turbulence may preclude using more precise methods. A small diameter air-type tube of known length is installed from the surface to a depth below the lowest water level expected. Compressed air is used to purge the water from the tube. The pressure, in pounds per square inch (psi), needed to purge the water from the air line multiplied by 2.31 (feet of water for one psi) equals the length in feet of submerged air line. The depth to water below the center of the pressure gage can be easily calculated by subtracting the length of air line below the water surface from the total length of air line (assuming the air line is essentially straight).

Accuracy depends on the precision to which the pressure can be read. The accuracy of an air line or pressure gage measurement depends primarily on the accuracy and condition of the gage. It is normally within one foot of the true level as determined by means of a steel-tape measurement. The air lines themselves, however, have been known to become clogged with mineral deposits or bacterial growth, or to develop leaks and consequently yield false information. A series of air line measurements should be checked periodically by the use of a steel tape or an electric water-level indicator.

The air line and any connections to it must be airtight throughout the entire length. A long-term increase in air line pressure may indicate gradual clogging of the air line. A relatively sudden decrease in air line pressure may indicate a leak or break in the air line. Air line pressures that never go above a constant low value may indicate that the water level has dropped below the outlet orifice of the air line. To minimize the effect of turbulence, the lower end of the air line should be at least five feet above or below the pump intake. Corrections should be made for fluid temperatures much different from 20°C and for vertical differences in air density in the well column for cases where the depth to water is very large.

## 4.5 Procedures for Immiscible Fluids

At those facilities where monitoring to determine the presence or extent of immiscible fluids is required, the sampler will need to use special procedures for the measurement of fluid levels. The

procedures required will depend on whether light NAPL (LNAPL) that form lenses floating on top of the water table or dense NAPL (DNAPL) that sink through the aquifer and form lenses over lower permeability layers are present.

In the case of LNAPL, measurements of immiscible fluid and water level usually cannot be accomplished by using normal techniques. For example, a chalked steel tape measurement will only indicate the depth to the immiscible fluid (not the depth to water) and a conventional electric water-level probe will not generally respond to nonconducting immiscible fluids. Similar problems are found with other techniques.

To circumvent these problems, the use of special techniques and equipment can be specified. These techniques have been specially developed to measure fluid levels in wells containing LNAPL or DNAPL, particularly petroleum products. One method is similar to the chalked steel tape method. The difference is the use of a special paste or gel rather than ordinary carpenters chalk. Such indicator pastes, when applied to the end of the steel tape and submerged in the well, will show the top of the oil as a wet line and the top of the water as a distinct color change. Another method, similar to the electric tape method, uses a dual purpose probe and indicator system. The probe can detect the presence of any fluid (through the wetting effect) and can also detect fluids that conduct electricity. Thus, if a well is contaminated with low density, nonconducting LNAPL such as gasoline, the probe will first detect the surface of the gasoline, but it will not register electrical conduction. However, when the probe is lowered deeper to contact water, electrical conduction will be detected. The detection of a DNAPL would be similar.

## 4.6 Measurement of Total Depth

During water-level measurement, the total depth of the well may also be measured. This measurement gives an indication of possible sediment buildup within the well that may significantly reduce the screened depth. The same methods used for measuring water levels (e.g. steel tape or electrical probes) may be used to measure the total well depth. The most convenient time to measure the total well depth is immediately following measurement of the water level and prior to removing the measurement device completely from the well. The measurement device (steel tape or electrical probe) is lowered down the well until the measurement tape becomes slack indicating the weighted end of the tape or probe has reached the bottom of the well. The total depth of shall be recorded in the field book.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

To ensure that accurate data are collected, repeated measurements of the fluid depths should be made. The readings should be within 0.01 to 0.02 feet of each other. A secondary check, if data are available, is to compare previous readings collected under similar conditions (e.g., summer months, wells pumping, etc.).

## 6.0 DOCUMENTATION

Data will be recorded in the fluid-level monitoring log form, the project field book, or, if groundwater sampling, the groundwater sample collection record. Additional comments, observations, or details will also be noted. These documents will provide a summary of the water-level measurement procedures and conditions, and will be kept the in project files.

# SOP 250

# SURFACE WATER SAMPLING

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the basic techniques and general considerations to be followed for the collection of surface water samples from rivers, lakes, and ponds. The specific details of actual sample collection are highly dependent upon local conditions as well as upon the purpose of the water quality study. Nevertheless, certain aspects of sample collection procedures are independent of project-specific variations. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project manager is responsible for ensuring that a properly designed sampling program is prepared prior to any sample collection. The field sampling coordinator will have the responsibility to oversee and ensure that all surface water sampling is performed in accordance with the project specific sampling program and this SOP. In addition, the field sampling coordinator must ensure that all field workers are fully apprised of this SOP.

## 3.0 SUPPORTING MATERIALS

The following materials must be on hand in sufficient quantity to ensure that proper sampling procedures may be followed.

- Project specific sampling program;
- Personal protection equipment as specified in the Project Health and Safety Plan;
- Sample containers, labels, and preservatives;
- Decontamination equipment and solutions;

- Paper towels or chemical-free cloths;
- Coolers and ice;
- Field equipment as specified in the sampling program, the corresponding manufacturer's manuals, and the appropriate calibration standard;
- Vertical or horizontal type samplers;
- Boat or raft;
- Weighted tape measurer or rigid gage; and
- Field data sheets and field book.

## 4.0 METHODS AND PROCEDURES

The following describes the methods and procedures required to collect representative surface water samples.

### 4.1 Sample Location Selection

The selection of the precise sampling location requires professional judgment and an understanding of the purpose of the study. Sampling locations where mixing is incomplete should be avoided if an average composition is required. Often areas of poor lateral or vertical mixing can be visually identified. For example, color or turbidity differences may be apparent immediately below the confluence of a tributary and the main river or at a wastewater discharge point. Use of a field conductivity meter is recommended for determining the uniformity of the water composition across the width and depth of the water body. Once the sampling point has been selected, it must be fixed by detailed description, maps, or with the aid of stakes, buoys, or other landmarks so that others can identify the sampling location.

## 4.2 Stream Sampling

In shallow streams (those which can be safely traversed on foot) the sample container can be filled directly with the flowing water. In deep rivers, a boat or raft will usually be required to obtain a representative sample. Unless otherwise specified in the project specific sampling plan, samples should be collected at the mid-depth section or deepest flow channel of the stream.

Stream depth and discharge need to be recorded. Stream depth can be determined using a depth sounder or by physical measurement with a heavily weighted flexible measuring tape or a rigid gage. Stream velocity measurements can be collected using a Marsh-McBirney Model 2000 portable flowmeter or similar instruments, and top setting wading rod at the gaging stations. The discharge at the gaging stations can be calculated by determining the mean flow velocity across a stream cross-section and multiplying this by the cross-sectional area as measured with a tape and the wading rod at that point. The top setting wading rod should be used to place the velocity sensor at 60 percent of total water depth as measured from the water surface. This is the same stream gaging method employed by the U.S. Geological Survey (1977). A vertical or horizontal type sampler should be used for collecting samples at a specific depth in the water column.

## 4.3 Lake and Pond Sampling

Water in lakes and ponds is generally poorly mixed and thermal stratification is frequently observed, Single samples can only represent the specific spot from which they were obtained. For many studies, samples collected at the inlet(s) and/or outlet(s) of the lake or pond are of the most interest. In other studies, a grid is established over the lake or pond and samples are collected at grid line intersections. As with deep rivers, a horizontal type sampler should be used for sample collection.

## 4.4 Sample Handling and Preservation

In general, the shorter the time lapse between sample collection and analysis, the more reliable the results will be. Certain water quality parameters, especially pH, temperature, and dissolved oxygen, are so closely related to the environment of the water that meaningful results can only be obtained by in-situ field measurements.

Specific procedures pertaining to the handling and shipment of samples shall be in accordance with SOP 110. A clean pair of gloves and decontaminated sampling tools will be used when handling the samples during collection to prevent cross contamination. A representative sample will be placed in the sampling container. Sample containers shall be labeled with the following information:

- Client or project name, or unique identifier, if confidential;
- Unique sample description (i.e., sampling point number and depth);
- Sample collection date and time;
- Sampler's name or initials; and
- Analyses to be performed.

These data shall be recorded on the surface water sampling form (Figure 1) and/or field book.

Prior to transport or shipment, surface water samples may require preparation and or preservation. Field preparation may entail filtration, or preservation in the form of chemical additives or temperature control. Specific preservation requirements will be described in the project specific sampling plan.

Surface water samples collected for dissolved metals analyses will be filtered prior to being placed in sample containers. Groundwater filtration will be performed using a peristaltic pump and a 0.45 micron water filter unless specified otherwise in the project specific sampling plan. For most dissolved metal analyses, pH adjustment of the sample is also required and shall be performed after filtration.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements include, but are not limited to, blind field duplicates, blind rinsate blanks, and blind field blanks. These samples will be collected on a frequency of one QA/QC

# SURFACE WATER SAMPLING FORM

PROJECT _____ SAMPLE NO. _____

DATE _____ TIME _____ SAMPLED BY _____

WEATHER CONDITIONS _____

SAMPLE LOCATION _____

SAMPLE DEPTH _____

SURFACE WATER FLOW RATE _____

SURFACE WATER TYPE _____

SAMPLE CONDITION (i.e. turbidity, odor, oily) _____

_____

SAMPLE COLLECTION

COLLECTION METHOD _____

COLLECTION TIME _____

SAMPLE INFORMATION pH _____ COND. _____ T(C) _____ D.OXYGEN _____

ANALYSIS CONTAINERS SAMPLE PREP/PRESERVATION

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

CHAIN OF CUSTODY FORM _____ COC TAPE _____

SHIPPING CONTAINER _____

COMMENTS _____

_____

_____

sample per 10 field samples or a minimum of one QA/QC sample per day unless otherwise specified in the project specific sampling plan.

## 6.0 DOCUMENTATION

A number of different documents will be completed and maintained as a part of surface water sampling. The documents will provide a summary of the sample collection procedures and conditions, shipment method, the analyses requested, and the custody history. The documents may include:

- Field log book;
- Surface water sampling forms;
- Sample labels;
- Chain of custody; and
- Shipping receipts.

The field record should be of sufficient detail to allow others to understand how and where samples were taken. All documentation will be retained in the appropriate project files.

## REFERENCES

U.S. Geological Survey, 1977, *National Handbook of Recommended Methods for Water-Data Aquistion*, U.S. Dept. of Interior, Virginia.

# SOP 260

# LAKE AND STREAM SEDIMENT SAMPLING

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the sampling of sediments from stream and lake bottoms. Lake and stream sediment sampling is performed to define the chemical, physical, and/or biological composition of the sediments. Sediment samples may be obtained directly from shallow, slow moving waters using trowels or shovels or from deep water bodies using dredge/clam shell type samplers. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project manager is responsible for ensuring that a properly designed sampling program is prepared prior to any sample collection. The field sampling coordinator will have the responsibility to oversee and ensure that all sediment sampling is performed in accordance with the project specific sampling program and this SOP. In addition, the field sampling coordinator must ensure that all field workers are fully apprised of this SOP.

## 3.0 SUPPORTING MATERIALS

The following materials must be on hand in sufficient quantity to ensure that proper sampling procedures may be followed.

- Project specific sampling program;
- Personal protection equipment as specified in the Project Health and Safety Plan;
- Paper towels or chemical-free cloths;
- Coolers and ice;

- Dredges (e.g. Ponar) and rope;
- Shovels and/or trowels;
- Sample bottles, containers; and labels;
- Sampling implements (e.g. spoons, scoops, etc);
- Decontamination equipment and solutions;
- Field data sheets and field book;
- Waders or boat;
- Measuring tape; and
- Boating safety gear (e.g., life jackets).

## 4.0 METHODS AND PROCEDURES

Select sample locations and method(s) in accordance with the project specific sampling plan. Determine and record the depth of water at each sample location. Collect the sample, using the appropriate sampling equipment and health and safety gear.

Refer to SOP 210 for guidance if using a trowel or shovel. Retrieve the sample slowly and carefully through the water column to minimize sample loss. If using a dredge, first secure the rope to the dredge. Open the dredge and lock it into position. Slowly lower the dredge through the water column to the bottom sediments. Close the jaws of the dredge by jerking the dredge rope once or twice. Pull the dredge back up through the water column at a steady, even pace. Repeat if sediment recovery is inadequate. Several attempts may be necessary to obtain sufficient sample volume. If, after several attempts, sample volume is still inadequate, adjust the sampling location. All equipment will be decontaminated after each use following the procedures outlined in SOP 120.

Specific procedures pertaining to the handling and shipment of samples shall be in accordance with SOP 110. A clean pair of gloves and decontaminated sampling tools will be used when handling the samples during collection to prevent cross contamination. A representative sample will be placed in the sampling container using a clean implement such as a scoop, spoon or tongue depressor. Sample containers shall be labelled with the following information:

- Client or project name, or unique identifier, if confidential;
- Unique sample description (i.e., sampling point number and horizontal/vertical location);
- Sample collection date and time;
- Sampler's name or initials; and
- Analyses to be performed.

These data shall be recorded on the sediment sampling form (Figure 1) and/or field book.

If sampling from a boat, all appropriate boating safety regulations must be understood and followed by the sampling crew.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements include, but are not limited to, blind field duplicates, blind rinsate blanks, and blind field blanks. These samples will be collected on a frequency of one QA/QC sample per 10 field samples or a minimum of one QA/QC sample per day unless otherwise specified in the project specific sampling plan.

## 6.0 DOCUMENTATION

Documentation may consist of all or part of the following:

- Sediment sampling forms;

# SEDIMENT SAMPLING FORM

PROJECT _____ SAMPLE NO. _____

DATE _____ TIME _____ SAMPLED BY _____

WEATHER CONDITIONS _____

SAMPLE LOCATION _____

SAMPLE TYPE GRAB _____ COMPOSITE _____

SAMPLE DEPTH _____

SURFACE WATER FLOW RATE _____

SURFACE WATER TYPE _____

SAMPLE CONDITION (i.e. odor, oily) _____

_____

SAMPLE COLLECTION

COLLECTION METHOD _____

COLLECTION TIME _____

| ANALYSIS | CONTAINERS | SAMPLE PREP/PRESERVATION |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

CHAIN OF CUSTODY FORM _____ COC TAPE _____

SHIPPING CONTAINER _____

COMMENTS _____

_____

_____



FIGURE 1

- Field log book;
- Chain-of-custody forms; and
- Shipping receipts.

The field record should be of sufficient detail to allow others to understand how and where samples were taken. A description of the sediments using the Unified Soil Classification system should be included. All documentation shall be placed in the project files and retained following completion of the project.

# SOP 310

# JAR HEADSPACE SCREENING

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the basic techniques for using a jar headspace analysis to screen for volatile organics from contaminated soils using a portable Photoionization Detector (PID) or Flame Ionization Detector (FID). Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project sampling coordinator is responsible for overseeing work activities to ensure that field screening is performed and documented in accordance with the methods described here and in project specific sampling plan.

## 3.0 SUPPORTING MATERIALS

The following materials must be on hand in sufficient quantity to ensure that proper field analysis procedures may be followed.

- PID/FID instrument;
- 16 oz. soil or "mason"-type glass jars;
- aluminum foil; and
- project field book.

## 4.0 METHODS AND PROCEDURES

Half-fill one clean glass jar with the sample to be screened. Quickly cover each open top with one to two sheets of clean aluminum foil and apply screw caps to tightly seal the jars. Allow headspace development for at least ten minutes. Vigorously shake jars for 15 seconds, both at the beginning and end of the headspace development period. Where ambient temperatures are below 32°F (0°C), headspace development should be within a heated vehicle or building.

Subsequent to headspace development, remove the jar lid and expose the foil seal. Quickly puncture the foil seal with instrument sampling probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates. As an alternative, use a syringe to withdraw a headspace sample then inject the sample into the instrument probe or septum-fitted inlet. This method is acceptable contingent upon verification of methodology accuracy using a test gas standard. Following probe insertion through foil seal and/or sample injection to probe, record highest meter response as the jar headspace concentration. Using foil seal/probe insertion method, maximum response should occur between two and five seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case headspace data should be discounted.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC will include the collection of duplicate samples. Data generated between the duplicates should be consistent to plus or minus twenty percent. Also, the PID/FID instrument shall be calibrated (see SOP 320 for HNu operation/calibration) before beginning screening, and checked or recalibrated no less often than once every ten analyses.

## 6.0 DOCUMENTATION

All data generated (results and duplicate comparisons) will be recorded in the field book. Any deviation from the outlined procedure will also be noted. Field conditions (ambient temperature, wind, etc.) should also be recorded in the field notebook.

# SOP 320

# OPERATION/CALIBRATION HNU PHOTOIONIZATION DETECTOR

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the operation and calibration techniques used for the HNU Photoionization Detector, manufactured by HNU Systems, Inc. This instrument is designed to measure organic vapor levels in the range of zero to 2000 parts per million by volume (ppmv) with a detection limit of 0.2 ppmv. The HNU can be used to monitor air quality as part of a Health and Safety program and to screen samples in the field for organic contamination. The HNU is capable of operating from an internal rechargeable battery for up to eight hours. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project sampling coordinator or health and safety officer will be responsible for the calibration, operation, and maintenance of the instrument and for the documentation which applies to the various procedures performed with the instrument.

## 3.0 SUPPORTING MATERIALS

The following materials are necessary to ensure the proper use of the HNU:

- Traceable span gas cylinder containing a known concentration of Isobutylene or similar gas in air;
- Tubing to direct air flow into and out of the span gas cylinder;

- AC battery charger; and
- Probe extension.

## 4.0 METHODS AND PROCEDURES

Calibration of the instrument should be done in a controlled environment (i.e., in the field office, interior of vehicle, etc.) This is done in order to control variables such as working temperature, vehicle exhausts, etc.

The HNU probe sampler inlet is attached to the readout module by aligning the slot on the 12 pin connector at the end of the probe cable with the tab in the 12 pin receptacle on the read out module. DO NOT FORCE THE CONNECTOR INTO THE RECEPTACLE. Attach the probe extension to probe sampler inlet. The HNU has three controls: A function switch, a "Zero" control knob, and a "Span" control knob. Connect the probe and turn the function switch on to the BATT position. The meter needle should deflet to the green area at the right hand side of the meter scale plate. Listen to the probe to ensure the fan is running (a humming sound). Allow the instrument to warm up for at least two minutes.

Calibration should be done at the beginning and end of each day to ensure accurate readings over the full range of scale that is to be needed. A gas cylinder of a known concentration is to be used as the calibration gas. To obtain the most accurate reading, the calibration gas should have a concentration of approximately the concentration of the gas to be measured. Ideally, the calibration gas should be the same as the vapors to be analyzed.

### 4.1 Zero Setting

Turn the function switch to the STANDBY position. The fan will continue to operate. The lamp will be off. The meter needle will move to the left out of the green area on the meter scale plate. Turn the zero knob until the meter needle reads 0.

### 4.2 Span Setting

Span calibration must be conducted after the zeroing adjustment described above is complete. Span checks should also be made on a daily basis. The cylinder of calibration gas is fitted with a regulator and the gas supply is directed into the probe extension by way of a piece of surgical tubing. Adjust the span so that the instrument reading agrees with the concentration of the calibration gas (e.g., 11.7 eV lamp; Isobutylene 100 ppm; meter needle reading 66 ppmv; span set at 5.0.)

Whenever the span setting is adjusted, the zeroing procedure (Section 4.1) should be repeated, followed by recalibration of span.

If the correct span adjustment cannot be made, remove the probe extension from the probe sampler unit and attach the surgical tubing directly to the probe sample unit. Refer to the Operating Manual should further difficulties be encountered.

### 4.3 Standard Operation

After the instrument is fully calibrated, it is ready to be used. To analyze a sample, the probe extension should be placed in close proximity to the sample, taking care not to contaminate the probe with any materials (e.g., soil, water, etc.). All readings should be documented in the field on the appropriate forms (sample log, field log) and/or in the project field book.

A meter calibration check should be performed by the methods in 4.1 and 4.2 at the end of the day, and any appropriate changes made and documented.

## 5.0 QUALITY ASSURANEC/QUALITY CONTROL

Quick field checks can be conducted using a magic marker. When the instrument probe is placed next to the marker tip or within the marker cap, a deflection of the meter needle should be obtained.

## 6.0 DOCUMENTATION

The HNU calibration should be recorded after each calibration and calibration check. Field calibrations or calibration checks should be recorded in the log book. All documentation shall be retained in the project files.

## REFERENCES

*Operating Manual for HNU*, printed by HNU Systems, Inc.

# STANDARD OPERATING PROCEDURE (SOP) 330
# FIELD INSTRUMENT CALIBRATION, OPERATION AND MAINTENANCE

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the general guidelines for calibrating and maintaining field instruments and monitoring equipment. The calibration and maintenance procedures are documented for each piece of equipment affecting data quality. Calibration and maintenance procedures are developed based on the manufacturer's specification. These procedures include, but are not limited to:

- equipment identification (name) and description;
- equipment specifications;
- calibration and/or maintenance schedule;
- equipment necessary to accomplish calibration (where applicable);
- procedure for calibration and/or maintenance.

As part of normal field operations, some instruments require calibration prior to, during, and/or after field use. Field calibration should be recorded in field books or on field forms as part of the normal field data collection process. If accuracy as reported in the specification cannot be attained for a specific instrument, that instrument is labeled "HOLD" and is unavailable for use until it is repaired and specifications are attained.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

It is the responsibility of the field sampling coordinator to calibrate each instrument used on-site at the appropriate time interval and record the data on the field book and field forms.

## 3.0 SUPPORTING MATERIALS

The field sampling coordinator will provide the following materials, where applicable:

- calibration standards;
- thermometer;
- steel tape; and
- field book and field forms.

## 4.0 METHODS/PROCEDURES

This section describes the methods and procedures to perform calibration and maintenance for:

- Orion 230A pH meter;
- YSI Model 33 S-C-T meter;
- Gastec Precision Gas Detector;
- Solinst Water Level Probe;
- ORS Oil/Water Interface Probe:
- Keck Oil/Water Interface Probe;
- MSA Explosimeter/Combustible Gas Indicator;
- MSA Combustible Gas and Oxygen Alarm; and
- YSI Model 51B Dissolved Oxygen Meter.

### 4.1 Orion 230A Portable pH Meter

### 4.1.1 Introduction

The ORION 230A is a portable battery-operated digital pH meter for field or laboratory use. It is designed for versatile, easy operation, and can be used in or out of the accompanying carrying case. The instrument is lightweight and is designed to fit comfortably in the hand. All controls are on the meter face, which allows one hand calibration.

The instrument measuring range is -1999 to +1999 mV, and pH is displayed to two decimal places. The meter has a large easy to read LCD display. The manufacturer's specifications should be consulted for further details on equipment operation and trouble shooting.

### 4.1.2 Instrument Description

1. Power - Controls power to meter.

2. LCD Display - Automatically displays data in large numerals with negative polarity sign and decimal point. pH values are displayed from 0 to 14 with 0.01 pH unit resolution.

3. Calibration Control - Used to standardize the meter/electrode system in buffers of known pH. "Yes" and "No" buttons assist in calibration procedures and control selection.

4. Timer - Operates timer control.

5. Measure - Begins measurement mode.

6. Electrode Connection - Accepts BNC connector from combination electrodes and pin tip jack available for use with half-cell reference electrodes.

### 4.1.3 pH Measurements

For maximum accuracy, a two buffer calibration will be performed once at the beginning of each day.

1. Choose two buffers to bracket the expected sample pH.

2. Place electrode in first pH buffer and press CAL. Note P1 display.

3. When electrode is stable, the READY prompt will be displayed, with the temperature-corrected value for the buffer. Press YES. Note P2 on display.

4. Promptly remove electrode from the buffer solution, rinse with distilled water, and place in second buffer.

5. Allow reading to stabilize, and press YES. SLP appears in the lower field while percent slope appears.

6. The meter automatically advances to the MEASURE mode. Rinse buffer solution from electrode with distilled water.

7. Place electrode in sample and stir moderately. Allow reading to stabilize.

8. Record pH value displayed.

## 4.2 YSI Model 33 S-C-T Meter

### 4.2.1 Introduction

This procedure presents steps to calibrate and maintain the YSI Model 33 S-C-T meter. The manufacturer's specifications should be consulted for further details on equipment operation and troubleshooting.

### 4.2.2 Calibration

#### Temperature

It is possible for the temperature knob to become loose or slip from its normal position. In an emergency, the dial can be repositioned. It must be emphasized that this is an emergency procedure only and that the instrument should be returned to the factory for proper recalibration.

To recalibrate the temperature setting:

1. Red line instrument and then place probe in sample of known conductivity.

2. Read and record the temperature and conductivity of the solution using appropriate settings. Leave probe in solution.

3. Determine the salinity of the solution by running a line vertically on the graph provided on the back of the meter until it intersects the appropriate °C line. From this intersection, extend a line horizontally to the left edge of the graph. This determines the salinity of the sample.

4. Move the °C knob switch to SALINITY, and turn the control shaft until the meter needle indicates the salinity value determined in Step 3.

5. Switch to TEMPERATURE. If this temperature is the same as Step 2, continue. If not, repeat Steps 1 through 5.

6. Place the knob on the control shaft, without turning the control shaft, with the pointer at the same temperature as the meter reading. Tighten both sets of screws securely. Care must be taken at this step so that the shaft setting is not moved.

7. Return the instrument to the factory at the earliest convenience.

To check the accuracy of the Probe/Instrument temperature readings:

1. Place NBS traceable thermometer in solution with thermometer and probe.

2. Place instrument in temperature mode after zeroing and red lining the instrument.

3. After five minutes, compare temperature of thermometer and instrument. If the instrument varies by +/- 1°C, the instrument should be returned to the factory for calibration and maintenance.

**Probe Cell Calibration**

The YSI #3300 Series Cells are calibrated to absolute accuracy of +/- 1.5 percent based on a standard solution of 0.01 demal KCl. Use a premixed solution, or to prepare this solution:

1. In a one liter flask, dissolve 0.745 grams of pure dry KCl until the solution is one kilogram in weight.

2. Use Table 1 and the temperature of the water to determine the conductivity of the solution just prepared. (Note: Table 1 shows conductivity as if the distilled water was nonconductive.) Since even high purity distilled water is slightly conductive, the measured conductivity will be higher by an amount equal to the water's conductivity.

3. Place probe in solution and measure conductivity. The conductivity of the solution plus the conductivity of the distilled water should not vary from the meter reading by +/- 1.5 percent. If the reading is greater than 1.5 percent, clean the probe and then recheck the conductivity. If after cleaning it is not possible to measure the conductivity of the calibration solution within +/- 1.5 percent, the probe and instrument should be returned to the manufacturer for calibration and maintenance.

### 4.2.3 Maintenance

**Batteries**

The batteries should be replaced either (1) when it is not possible to red line the instrument, (2) after 200 hours of operation, or (3) every six months to reduce the danger of corrosion due to leaky batteries. To replace batteries, remove the six screws from the rear plate. The battery holders are color coded. The positive (+ button) end must go on red. Use two "D" size alkaline flashlight cells (Eveready E95 or equivalent).

TABLE 1 - CELL CALIBRATION DATA

| Temperature (°C) | Conductivity (µmhos/cm) |
|---|---|
| 15 | 1141.5 |
| 16 | 1167.5 |
| 17 | 1193.6 |
| 18 | 1219.9 |
| 19 | 1246.4 |
| 20 | 1273.0 |
| 21 | 1299.7 |
| 22 | 1326.6 |
| 23 | 1353.6 |
| 24 | 1380.8 |
| 25 | 1408.1 |
| 26 | 143615 |
| 27 | 1463,2 |
| 28 | 1490.9 |
| 29 | 1518.7 |
| 30 | 1546.7 |

**Probe**

When the cell test indicates low readings, the probable cause is dirty electrodes. Hard water deposits, oils, and organic matter are the most likely contaminants. For convenient normal cleaning, soak the electrodes for five minutes with a locally available bathroom tile cleaner such as: "Rally, Tile, Porcelain, and Chrome Cleaner"; Johnson Wax "Envy, Instant Cleaner"; or Lysol Brand "Basin, Tub, Tile Cleaner". For storage cleaning, a five minute soak in a solution made of ten parts distilled water, ten parts isopropyl alcohol, and one part HCl can be used. Always rinse the probe in distilled water after cleaning and before storage. CAUTION: Do not touch the electrodes inside the probe. Platinum black is very soft and can be scraped off. If cleaning does not restore probe performance, re-platinizing is required.

It is best to store conductivity cells in deionized water. Cells stored in water require less frequent platinization. Any cell that has been stored dry should be soaked in deionized water for 24 hours before use.

## 4.3 Gastec Precision Gas Detector System

The analyzing tube system (such as Sensidyne or Draeger) is very effective for measuring concentrations of a known contaminant. Detector tubes are available for a variety of gases and concentration ranges. Sufficient background information must be available to help determine the identity of the substances so that the proper tube can be selected.

1. Break tips off a fresh detector tube by breaking each tube end in the tub tip breaker of the pump.

2. Insert tube securely into pump inlet with arrow on tube pointing toward the pump.

3. For twin tubes, connect "C" marked ends with rubber tubing after breaking each end. Insert analyzer tube into the pump with the arrows on the tubes pointing towards the pump.

4. Make certain the pump handle is all the way up. Align the guide marks on the pump body and handle.

5. Pull handle out to desired stroke volume (as indicated by tube instructions). One half pump stroke is 50 cubic centimeters (cc) and one full pump stroke is 100 cc.

6. Read concentrations at the interface of stained to unstained reagent when staining stops. Unlock handle by making 1/4 turn and return it to starting position.

7. In case more pump strokes are indicated in the instruction sheet (included in each box of tubes), take additional samples by repeating pump strokes without removing tube.

The gas detector system should be used as outlined in the project specific sampling plan and as described in the manufacturer's operating and maintenance instructions.

## 4.4 Solinst Water-Level Probe Calibration

The weighted electrode at the end of the Solinst water-level probe may create stress on the measuring tape, causing it to stretch. The Solinst water-level probe must be checked periodically (at least yearly) to determine if any significant stretching of the measuring tape has occurred during use. To determine if any significant stretching of the measuring tape has occurred, follow the procedures outlined below:

1. Obtain an accurate reference tape at least 100 feet in length or the length of the water-level probe if less than 100 feet. A steel tape is preferred.

2. Lay both tapes (the water-level probe and the steel tape) adjacent to each other on the flat surface.

3. Line up the 1-foot mark on both the reference tape and the water level probe and hold them securely in place.

4. Tighten both tapes to eliminate any slack, but do not pull hard on the tapes. This will stretch the tapes unnaturally.

5. Compare the lengths of the two tapes at the longest measurable point, preferably at least 100 feet from the reference point.

6. The correction in length required for the water-level probe is the ratio of the observed probe length to the observed reference tape length:

$$\text{correction} = \frac{\text{Solinst probe length}}{\text{reference tape length}}$$

7. The correction factor and the date of calibration should be written on a tag on the Solinst probe.

8. Any future measurements should be corrected by multiplying by the correction factor. A difference of less than 0.01 foot is insignificant and the correction factor should be 1 in such instances.

## 4.5 ORS Oil/Water Interface Probe

The ORS Oil/Water interface probe is a hand held, battery powered device for measuring depth to water and/or oil in tanks or wells. The instrument is activated by unfolding the crank handle away from the reel housing. The test button on the face plate will make a tone if the power is on. The low battery light will light if the power is low. Pull the protector outward and lower the probe with the thumb brake release. When the probe contacts liquid, an alarm will sound. **Beeping tone** indicates water. **Solid tone** indicates hydrocarbon. The probe should be moved up and down through the interface several times to determine the exact depth to interface.

The equipment is maintenance free. The tape and probe can be cleaned with methanol and deionized water or a soap solution of Alconox. Batteries must be Duracell Type MN1500 (size AA).

The weighted electrode at the end of the probe may create stress on the measuring tape, causing it to stretch. The probe must be checked periodically (at least yearly) to determine if any significant stretching of the measuring tape has occurred during use. To determine if any significant stretching of the measuring tape has occurred, follow the procedures outlined below:

1. Obtain an accurate reference tape at least 100 feet in length or the length of the probe if less than 100 feet. A steel tape is preferred.

2. Lay both tapes (the probe and the steel tape) adjacent to each other on the flat surface.

3. Line up the 1-foot mark on both the reference tape and the probe and hold them securely in place.

4. Tighten both tapes to eliminate any slack, but do not pull hard on the tapes. This will stretch the tapes unnaturally.

5. Compare the lengths of the two tapes at the longest measurable point, preferably at least 100 feet from the reference point.

6. The correction in length required for the probe is the ratio of the observed probe length to the observed reference tape length:

$$\text{correction} = \frac{\text{probe length}}{\text{reference tape length}}$$

7. The correction factor and the date of calibration should be written on a tag on the probe.

8. Any future measurements should be corrected by multiplying by the correction factor. A difference of less than 0.01 foot is insignificant and the correction factor should be 1 in such instances.

## 4.6 Keck KIR-89 Oil/Water Interface Probe

The Keck KIR-89 Oil/Water interface probe is a hand held, battery powered device for measuring depth to water and/or oil in tanks or wells. The instrument is activated by flipping a switch located on the face plate. Pressing the battery test button will cause the buzzer to make a loud signal and the indicator light will be on if the battery is adequate for normal operation.

When the probe contacts liquid, an alarm will sound. **Beeping tone** indicates water. **Solid tone** indicates hydrocarbon. The probe should be moved up and down through the interface several times to determine the exact depth to interface.

The equipment is maintenance free. The tape and probe can be cleaned with methanol and deionized water or a soap solution of Alconox. Batteries must be Duracell Type MN1500 (size AA).

The weighted electrode at the end of the probe may create stress on the measuring tape, causing it to stretch. The probe must be checked periodically (at least yearly) to determine if any significant stretching of the measuring tape has occurred during use. To determine if any significant stretching of the measuring tape has occurred, follow the procedures outlined below:

1. Obtain an accurate reference tape at least 100 feet in length or the length of the water level probe if less than 100 feet. A steel tape is preferred.

2. Lay both tapes (the probe and the steel tape) adjacent to each other on the flat surface.

3. Line up the 1-foot mark on both the reference tape and the water level probe and hold them securely in place.

4. Tighten both tapes to eliminate any slack, but do not pull hard on the tapes. This will stretch the tapes unnaturally.

5. Compare the lengths of the two tapes at the longest measurable point, preferably at least 100 feet from the reference point.

6. The correction in length required for the water level probe is the ratio of the observed probe length to the observed reference tape length:

$$\text{correction} = \frac{\text{probe length}}{\text{reference tape length}}$$

7. The correction factor and the date of calibration should be written on a tag on the probe.

8. Any future measurements should be corrected by multiplying by the correction factor. A difference of less than 0.01 foot is insignificant and the correction factor should be 1 in such instances.

Any calibration should be done following the manufacturer's instructions

## 4.7 Explosimeter/Combustible Gas Indicator

The MSA Explosimeter/Combustible Gas Indicator (Model 2a) is used to test concentrations of flammable gases and vapors in an atmosphere. Tests are made by drawing a sample of the atmosphere over a heated catalytic filament which forms part of an electrical circuit. Combustible gases are burned on the filament, raising its temperature, electrical resistance, and operating the concentration scale. The detector is not intended for oxygen rich atmosphere. The instrument operational envelope is variable, and dependent on the contaminant and atmospheric conditions. The instrument instruction manual should be carefully read and operational procedures followed. The instrument sampling line should not come in contact with any liquid.

### 4.7.1 Operating Instructions

The MSA Explosimeter is operated by a single control rheostat. The equipment should be prepared for operation in an area known to be free of combustible gasses by the following procedures.

1. Lift the end of the rheostat knob on-off bar, and turn the rheostat knob one quarter turn clockwise. (Rotate to counterclockwise and note locking bar down to turn instrument off).

2. Flush fresh air through the instrument. Five squeezes of the aspirator bulb are sufficient. An additional two squeezes should by used for each 10 feet of sampling line.

3. Adjust rheostat knob until meter rests at zero. The explosimeter is now ready for operation. Place the sampling line in position for the sample.

4. Readjust the meter pointer to zero if necessary by turning rheostat knob.

5. Aspirate sample through instrument until highest reading is obtained. Approximately five squeezes of the bulb are sufficient to give maximum deflection. Two additional squeezes of the bulb are necessary for each ten feet of sampling line. This reading indicates the concentration of combustible gases or vapors in the sample.

The gradation on the lower scale indicates percent of the lower explosive limit (LEL), or how closely the atmosphere approaches the minimum concentration required for explosion. If the meter pointer moves rapidly across the scale and returns to a lower position or zero, this may indicate a concentration of gases above the upper explosive limit. Verification should be accomplished by flushing the line with fresh air. If the meter pointer moves right, then left of the scale, it indicates the sample is above the upper explosive limit. When in use, the meter should be zeroed at three minute intervals for the first ten minutes, and ten minute intervals thereafter to maintain accuracy.

### 4.7.2 Maintenance

The six D-size carbon zinc batteries should be replaced when the meter pointer remains below zero and cannot be raised to zero when the rheostat is in its extreme clockwise position. The dry cells are replaced by removing the bottom of the instrument case (via two slotted screws). The cells must be installed with the tops (positive) toward the top of the battery compartment. Cells should be replaced in groups.

The detector filament will serve for several thousand tests. It should be changed if the pointer moves to the extreme right side of the scale and cannot be zeroed. A spare is located inside the case below the instrument panel. Changing procedures follow:

1. Remove the top of the case, and the screws holding two green wires to the terminals.

2. Unscrew the detector unit from the combustion chamber. Screw the replacement unit in tightly.

3. When the green wires are replaced, note that the screws holding them are firmly set and that the two terminal lugs at the ends of the wires do not touch each other.

Other parts are designed to last during normal operation. Other mechanical maintenance operations should be referenced from the instruction manual.

### 4.7.3 Calibration

Calibration should be done periodically to check the instrument operation. A calibration system is available that uses methane calibration gas to verify the LEL. Calibration instructions follow.

1. Attach the flow control to the calibration gas tank.

2. Connect the hose to the flow control and to the instrument inlet fitting.

3. Open the flow control valve.

4. Record the meter reading after it stabilizes. (It is not necessary to operate the aspirator bulb).

5. Check the meter reading against the following ranges for the Model 2A:

| 2.0% Methane | 2.5% Methane |
|---|---|
| 42 to 60 % | 54 to 76% |

6. If the instrument does not read within the acceptable range, replace the detector filament and repeat calibration.

7. Close the flow control valve. Remove the hose from the flow control and the inlet fitting on the instrument. Remove the flow control from the calibration gas tank.

## 4.8 Combustible Gas and Oxygen Alarm

The MSA Model 261 Combustible gas and oxygen meter is a hand-carried, battery operated instrument designed to sample atmosphere for combustible gases or vapors, sample atmospheres for oxygen content, and warn the user when predetermined concentrations of either gas are reached. It is portable and operates eight to ten hours with a fully charged battery.

### 4.8.1 Operating Instructions

The meter should be calibrated and zeroed in an uncontaminated atmosphere by the following procedure:

1. Open the instrument lid and turn the center ON-OFF knob to the HORN OFF position. Both meter pointers will move and one or both Alarms may light.

2. The % LEL meter pointer should be set at zero by adjusting the ZERO LEL control. This adjustment must be made within 30 seconds after the instrument is turned on to prevent activation of the LockAlarm circuit.

3. If the % Oxygen meter pointer stabilizes at a value other than 20.8%, the pointer should be set to 20.8% by using the CALIBRATE $O_2$ control.

4. Press the ALARM RESET button; the alarms should reset and the green pilot light should flash.

5. Place a finger over the sample inlet fitting. Observe the flow indicator float drop out of sight, indicating no flow.

6. Press the check button and observe the % LEL meter. The pointer should read 80% LEL or higher. If the meter reads less, the battery pack must be recharged.

7. Turn the ON-OFF to ON. The pilot lamp should light continuously.

8. Accessory equipment should be attached, and flow checked as described. The instrument is ready for use.

9. Place the end of the sampling line to the point where the sample is to be taken. The instrument samples only the atmosphere at the inlet of the sample line or probe.

### 4.8.2 Calibration

Calibration of the oxygen sensor is dependent on the partial pressure of oxygen, and should be checked and calibrated at the elevation and temperature where the instrument is used. The instrument should be checked and zeroed as previously described before calibration. The following procedures should be followed for calibration of the instrument.

1. Attach the flow control to the recommended gas tank, and the adaptor-hose to the flow control. Open the flow control valve.

2. Connect the adapter-hose fitting to the inlet of the instrument. The LEL meter pointer should be stable and within the range specified on the sheet accompanying the calibration equipment.

3. If the meter pointer is not in the correct range, stop the flow and remove the right hand side (speaker) panel. Turn ON the flow control and adjust the (S) control with a small screwdriver to obtain the reading specified on the calibration sheet.

4. Remove the calibration equipment.

### 4.8.3 Maintenance

Equipment should be maintained as described in the Instruction Manual accompanying the Model 261 Combustible Gas and Oxygen Alarm. The battery pack is the primary maintenance item. The charger plug should be inserted into the charge jack. The POWER ON lamp indicates the charger is receiving power from the 120 or 240 VAC line.

The FAST CHARGE lamp indicates the higher charge rate. If the FAST CHARGE lamp is not on, it indicates the battery is at least 95% charged and the charger has changed to the trickle charge rate.

Battery Pack replacement, Sensor and Circuit Board adjustments and replacements are not typical maintenance items. The Instruction Manual should be consulted to attempt these procedures.

## 4.9 Dissolved Oxygen Meter

The YSI Model 51 B Dissolved Oxygen Meter is intended for dissolved oxygen and temperature measurement in water and wastewater applications. Dissolved oxygen is indicated in milligrams per liter (mg/L) on a 0 - 15 mg/L scale. Temperature is indicated in degrees Celsius (°C) on a -5 to +45 degree scale. The dissolved oxygen range is automatically temperature compensated for permeability of the pore membrane, and manually by direct dial for changes in water temperature. Typical response time is between 10 and 30 seconds.

The instrument should be prepared for use in the operating position, as follows.

1. With switch set to "OFF", adjust the meter pointer to zero with the screw in the center of the meter panel. Do not force this adjustment.

2. Switch to zero and adjust the FULL SCALE knob until the meter needle aligns with the 15 mark on the mg/L scale.

3. Switch to full scale and adjust the FULL SCALE knob until the meter needle aligns with the 15 mark on the mg/L scale.

4. Attach the prepared probe to the probe connector of the instrument and adjust the retaining ring finger tight.

5. Before calibrating, allow 15 minutes for optimum probe stabilization and polarization. Allow 15 minutes for repolarization whenever the instrument has been off, or the probe has been disconnected.

Calibration is accomplished by exposing the probe to a known oxygen concentration, and should be done daily. Calibration can be disturbed by physical shock, touching the membrane, fouling of the membrane, or drying out of the electrolyte. Air-Saturated Water Calibration is performed as follows.

1. Air saturate a volume of water (300 to 500 mL) by aerating or stirring for at least 15 minutes at a relatively constant temperature.

2. Place the probe in the sample and stir.

3. With the function switch at CALIB $O_2$, adjust the CALIB knob so the needle indicates the local altitude. Leave the Probe in the sample for 2 minutes to verify stability.

Dissolved oxygen measurement should be conducted as follows:

1. Stirring should be accomplished by raising and lowering the probe about 1 foot per second.

2. Allow sufficient time for the probe to stabilize to sample temperature and dissolved oxygen.

3. Switch to TEMP and read the temperature from the lower meter scale. Set the $O_2$ SOLUBILITY FACTOR dial to the observed temperature, taking care to use the appropriate salinity index.

4. Switch to READ $O_2$ and read the dissolved oxygen value in mg/L directly from the meter.

Less oxygen can be dissolved in salt water than in fresh water. The user must determine the salinity and choose the correct position along the index scale when dialing in the temperature. The scale represents 5,000 mg/L increments. The line leading to the correct temperature should intersect the left edge of the bar at the proper salinity concentration. Refer to the Instruction manual for further in depth explanation.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC will include the use of calibration standards, if applicable, and following all of the manufacturer's instructions. If accuracy cannot be attained for a specific instrument, that instrument is labeled "HOLD" and is unavailable for use until it is repaired and specifications are attained.

## 6.0 DOCUMENTATION

All of the information collected will be recorded on the project field book and field forms. All field books and field forms will be kept in the project files.

# SOP 410

# QUALITY ASSURANCE/QUALITY CONTROL DATA VALIDATION

## 1.0 PURPOSE AND APPLICABILITY

This SOP describes the method to be used for evaluating analytical laboratory data collected during field investigations. This evaluation is performed in order to establish the validity of the data generated. The laboratory analytical data will be evaluated for precision, accuracy, and completeness. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

## 2.0 RESPONSIBILITIES

The project manager will be responsible for ensuring that procedures set forth in the sampling program documents are followed in the field and in the analytical laboratory. Where procedures differ, the most stringent project-specific document(s) will apply.

The Project Quality Assurance/Quality Control (QA/QC) Officer will be responsible for validating the analytical data for precision, accuracy, and completeness. The QA/QC Officer will work in conjunction with the project manager and Laboratory Coordinator to produce the final report.

## 3.0 SUPPORTING MATERIALS

Section 3.0 is not applicable.

## 4.0 METHODS AND PROCEDURES

This section presents the method and procedure for implementation of the RETEC Quality Assurance/Quality Control process for data evaluation. Analytical data will be reviewed for precision, accuracy, and completeness. The following sections provide a detailed discussion of the steps necessary to meet these criteria. The following criteria are recommended and should be evaluated on a project-specific basis.

A preliminary evaluation of the analytical data will include:

- review of the Work Plan or Quality Assurance Project Plan (QAPP);
- a review of the laboratory project narrative;
- a review of holding times, detection limits, methods of analysis; and
- a check of data flags, reporting units, and sample matrices.

Any deviations from the requirements of the QAPP will be identified in the data evaluation report and the Project Manager will be notified. Additionally, the laboratory will be contacted, if necessary, and appropriate corrective actions will be implemented.

### 4.1 Evaluation of Precision

Precision is the measure of variability of individual sample measurements. Precision is determined through the analysis of replicate samples, field blanks, trip blanks, and equipment rinseate blanks. A replicate sample represents two or more separate samples collected at the same location. A replicate sample is often referred to as a duplicate. Additionally, replicates are often submitted to the laboratory as blind samples. Field blanks consist of deionized water poured into sample bottles in the field. These blanks are used to determine whether airborne contamination is present at the site. Trip blanks are laboratory generated analyte-free water samples for volatiles analysis which travel to and from the site with the sample coolers. These blanks are used to document contamination attributed to bottle preparation and/or shipping and handling procedures. Equipment rinseate blanks consist of reagent water exposed directly to sampling equipment. The equipment rinseate blank is useful in documenting adequate decontamination of sampling equipment.

### 4.1.1 Duplicates

Duplicates, when collected, will be evaluated at the frequency of ten percent (10%) of samples collected for each matrix. Evaluation of replicates for precision will be done using the Relative Percent Difference (RPD). The RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The RETEC advisory limit for RPDs is 50% for soil samples and 30% for groundwater. When the RPD exceeds the advisory limit, consideration will be given to the possibility of matrix effect. If however professional judgement indicates a potential laboratory error, the positive results will be "J" flagged.

### 4.1.2 Field Blanks

Collection of a field blank is recommended for one in every 20 samples, or one sample per batch if less than 20 samples are collected. However, on a project-specific basis, analysis of field blanks may not be appropriate.

### 4.1.3 Trip Blanks and Rinseate Blanks

Preparation of a trip blank is recommended at one blank for each cooler if volatile analysis has been requested. Equipment rinseate blanks should be collected during each day of sampling or at a 10% frequency.

## 4.2 Evaluation of Accuracy

The accuracy of data is a measure of the system bias. The level of accuracy is determined through examination of a blank spike (BS), laboratory matrix spike/spike duplicate analyses (MS/MSD), surrogate recoveries for organic analyses, and method blanks. A blank spike is a laboratory QC sample which is introduced with the sample batch to monitor the performance of the system. The BS is used to document laboratory performance and is also referred to as a lab control sample (LCS), ongoing precision recovery (OPR), or lab spike (LS). The MS/MSD is an environmental field sample which is spiked with method or client specific analytes. The MS/MSD indicates how well the lab can reproduce the analytical results on field samples. The MS/MSD can indicate matrix effects. Surrogates are compounds that are structurally similar to the compounds requested for analysis, but are not found in nature (i.e., deuterated compounds). They are analyzed

to demonstrate the percent recovery of the method by the laboratory and are applicable only for organic analysis. Method blanks or reagent blanks are analyte-free blank samples which monitor contamination introduced by the laboratory during sample preparation or analysis.

Blank spikes are recommended for one in every twenty sample analyses. A MS/MSD set is recommended for one in every twenty samples. Surrogates are compounds spiked into every sample submitted to the laboratory for organic analysis and have method specific recovery limits. A method blank will be prepared for one in every 20 samples per matrix. Method blanks are used to check on process contamination, carry over, and purity of reagents used by the laboratory.

When a BS is out of control limits, the laboratory should first reanalyze the sample. If it is still out of control limits, the laboratory should reextract all samples in the set. If neither of the above have been done by the laboratory, all of the data should be qualified with either a "J", to indicate the values are estimates, or a "R", to indicate the results are unusable. The severity of flagging will be based on the professional judgement of the data reviewer and the end use of the data.

MS/MSD percent recoveries and RPDs are compared to published QC limits. If the MS/MSD recoveries and/or RPDs are outside QC limits, but the BS recovery is acceptable, the samples likely have matrix interference problems. If the precision is acceptable between the MS and the MSD, the reliability of the data is good. If the recovery in the MS or MSD is less than 10%, the corresponding unspiked sample should be qualified with a "J" for positive hits and a "R" for nondetects. Note that this action is taken on the sample alone, not the entire batch of samples.

When surrogate recoveries are outside QC limits, the procedures described below will be followed.

- If any one Base/Neutral (B/N) and/or one Acid surrogate is out of QC limits, and the surrogate recoveries are all greater than 10%, then the positive results should be estimated as "J" and the nondetected results should be estimated as "UJ".
- If any two Base/Neutral (B/N) or two Acid surrogates (or more) are out of QC limits, or any surrogate recovery is less than 10%, then the sample should be reanalyzed.
- If any volatile surrogate is out of QC limits, the sample should be reanalyzed.
- If the laboratory reanalyzes and the surrogates are still outside QC limits, both results should be reported and the outlying recoveries attributed to matrix interference.
- If the laboratory does not reanalyze or reextract and reanalyze, then the positive results should be flagged with a "J" and the nondetected results flagged with an "R".
- If the surrogates are outside QC limits for any blank, the validity of the data should be considered questionable.

### 4.3 Evaluation of Completeness

Completeness is a measure of the amount of data actually collected, analyzed, and validated compared to the amount specified in the sampling plan. The overall measure of completeness is the ratio of samples planned to valid analyses received. The data quality objective for the data is to achieve 90-100% accuracy and completeness of data collected, unless otherwise stated in the QAPP.

## 5.0 QUALITY ASSURANCE/QUALITY CONTROL

RETEC will review data validation procedures on a yearly basis and update QA/QC procedures annually, if necessary.

## 6.0 DOCUMENTATION

During the data review/data validation process, problems with analytical procedures, analytical results outside QC limits, or other unusual conditions will be documented. In many cases this information will be contained in the laboratory project narrative accompanying the analytical data. Where additional explanations from the laboratory are required, the information will be documented by the laboratory and provided to RETEC. The QA/QC Officer will summarize the information for inclusion into the QA/QC summary. Documentation of data review/data validation will vary depending upon the level of review required by the individual project.

## REFERENCES

*Analyses, EPA (1990)*

*CLP Organic Data Review, EPA (1992)*

*EPA Contract Laboratory Program (CLP) Guidelines :*

*Statement of Work : Organics 2/88*
*Statement of Work : Organics 3/90*
*Statement of Work : Inorganics 9/91*
*Statement of Work : Dioxins 8/87*

*Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, EPA Region I (1988)*

*Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, EPA Region I (1989)*

*Modified Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, EPA Region III (1992)*

*Modified Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, EPA Region III (1993)*

*RCRA Laboratory Audit Inspection Guidance Document, EPA (1988)*

*Superfund Analytical Methods for Low Level Water Organic*

*Three Levels of Data Review, EPA (1989)*

*Test Methods for Evaluating Solid Waste, SW-846, Third Edition (1993)*

# Appendix B

# Health and Safety Plan

# Site-Specific Health & Safety Plan for

# Closed Industrial Waste Unit at the Austin Community Landfill

Prepared by:

ThermoRetec Consulting Corporation
1301 W. 25th Street Suite 406
Austin, Texas 78705

ThermoRetec Project No.: 3-4198-300

Prepared for:

Waste Management of Texas
9900 Giles Lane
~~9708 Giles Lane~~
Austin, TX 78754

| Onsite Emergency Phone Numbers | |
|---|---|
| Fire: | 911 |
| Police: | 911 |
| Ambulance: | 911 |
| For more emergency numbers and directions to the hospital, turn to page 7-1. | |

August 2, 1999
~~April 1999~~

# Site-Specific Health & Safety Plan for

# Closed Industrial Waste Unit at the Austin Community Landfill

Prepared by:

ThermoRetec Consulting Corporation
1301 W. 25th Street Suite 406
Austin, Texas 78705

ThermoRetec Project No.: 3-4198-300

Prepared for:

Waste Management of Texas
9900 Giles Lane
~~9708 Giles Lane~~
Austin, TX 78754

Prepared by:

_____
Robert Crone, Geologist

Approved by:

_____ _____
Regional Health & Safety Officer Date

August 2, 1999
~~April 1999~~

F:\PROJECT\4000-199\4198\WP\300\hasprevised.wpd

# Table of Contents


Executive Summary ..... ES-1

1 Introduction ..... 1-1
- 1.1 Site Safety Plan Acknowledgment and Acceptance ..... 1-1
- 1.2 Site Health and Safety Meetings ..... 1-1
- 1.3 Training Requirements ..... 1-2
- 1.4 Medical Monitoring Requirements ..... 1-2
- 1.5 Fit Testing Requirements ..... 1-2
- 1.6 Responsibilities ..... 1-3
- 1.7 Access to Employee Exposure and Medical Records ..... 1-3
- 1.8 Hazard Communication ..... 1-3

2 Health & Safety Risk Analysis ..... 2-1
- 2.1 Hazards When Working Around Heavy Equipment ..... 2-1
- 2.2 General Site Hazards ..... 2-1
  - 2.2.1 Lighting ..... 2-1
  - 2.2.2 Electrical Power ..... 2-1
  - 2.2.3 Lockout/Tagout ..... 2-2
  - 2.2.4 Fall Protection ..... 2-2
  - 2.2.5 Drum Handling ..... 2-2
  - 2.2.6 Cold Stress ..... 2-2
  - 2.2.7 Heat Stress ..... 2-2
  - 2.2.8 Eye Wash Protection ..... 2-2
  - 2.2.9 Hearing Protection ..... 2-3
  - 2.2.10 Fire Protection/Fire Prevention ..... 2-3
  - 2.2.11 Utilities ..... 2-3
  - 2.2.12 Confined Space Entry ..... 2-3
  - 2.2.13 Excavation/Trenching ..... 2-3
  - 2.2.14 Overhead Power Lines ..... 2-3
  - 2.2.15 Hot Work ..... 2-4
- 2.3 Chemical Hazards ..... 2-4

3 Personal Protective Equipment ..... 3-1
- 3.1 Level A ..... 3-1
- 3.2 Level B ..... 3-2
- 3.3 Level C ..... 3-3
- 3.4 Level D ..... 3-4

4 Air Monitoring and Action Levels ..... 4-1
- 4.1 Routine Air Monitoring Requirements ..... 4-1
- 4.2 Additional Air Monitoring ..... 4-2

# Table of Contents


5 Site Control . . . . . 5-1
5.1 Work Zones . . . . . 5-1
5.2 General Field Safety and Standard Operating Procedures . . . . . 5-3

6 Decontamination . . . . . 6-1
6.1 Personnel Decontamination . . . . . 6-1
6.2 Sampling Equipment . . . . . 6-1
6.3 Equipment Decontamination . . . . . 6-2
6.4 Disposal of Contaminated Materials . . . . . 6-2
6.5 Emergency Decontamination . . . . . 6-2
6.6 Sanitizing of Personal Protective Equipment . . . . . 6-2

7 Emergency Response/Contingency Plan . . . . . 7-1
7.1 Emergency Contacts/Telephone Numbers . . . . . 7-1
7.2 Personnel Responsibilities During Emergencies . . . . . 7-3
7.3 Medical Emergencies . . . . . 7-4
7.4 Fire or Explosion . . . . . 7-5
7.5 Spill or Leaks . . . . . 7-5
7.6 Evacuation Routes and Resources . . . . . 7-5
7.7 Near Accident . . . . . 7-6

8 Drum Handling/Sampling . . . . . 8-1

9 Excavation and Trenching . . . . . 9-1

10 Confined Space Entry . . . . . 10-1

11 Lockout/Tagout . . . . . 11-1
11.1 Tags . . . . . 11-1
11.2 Locks . . . . . 11-2
11.3 Procedures . . . . . 11-2

12 Fall Protection . . . . . 12-1

13 Hearing Protection . . . . . 13-1
13.1 Noise Measurement . . . . . 13-1
13.2 Types of Hearing Protection . . . . . 13-3
13.2.1 Ear Plugs . . . . . 13-3
13.2.2 Canal Caps . . . . . 13-4
13.2.3 Ear Muffs . . . . . 13-4

# Table of Contents


13.2.4 Multiple Hearing Protectors . . . . . 13-4
13.3 Selection of Protection . . . . . 13-4

14 Drilling Safety . . . . . 14-1

15 Vehicle Safety . . . . . 15-1
15.1 Motor Vehicles . . . . . 15-1
15.2 Required Safety Devices . . . . . 15-1
15.3 Miscellaneous Requirements . . . . . 15-2
15.4 Special Requirements for Dump Trucks . . . . . 15-2
15.5 Pre-Safety Check . . . . . 15-2
15.6 Mechanized Equipment . . . . . 15-3
15.6.1 General Requirements . . . . . 15-3
15.6.1.1 General Safety Requirements . . . . . 15-3
15.6.1.2 Material Handling Equipment . . . . . 15-3
15.6.1.2.1 Earth Moving Equipment . . . . . 15-4
15.6.1.2.2 Excavating Equipment . . . . . 15-4
15.6.1.2.3 Lifting and Hauling Equipment . . . . . 15-5
15.7 Site Clearing . . . . . 15-6

16 Sampling . . . . . 16-1
16.1 Classes of Samples . . . . . 16-1
16.2 Collection Methods . . . . . 16-1
16.3 Types of Samples . . . . . 16-2
16.4 Equipment . . . . . 16-3
16.4.1 Selection of Samplers/Containers . . . . . 16-3
16.4.2 Sampling Technique . . . . . 16-3
16.4.3 Documentation . . . . . 16-4
16.4.4 Samplers . . . . . 16-6
16.4.4.1 Liquids . . . . . 16-6
16.4.4.2 Solids . . . . . 16-12
16.5 Containers Closures/Closure Liners . . . . . 16-15
16.5.1 Containers . . . . . 16-15
16.5.2 Closures/Closure Liners . . . . . 16-16
16.6 Preservation and Storage of Samples . . . . . 16-16
16.7 Log Book . . . . . 16-17
16.8 Photographs . . . . . 16-17
16.9 Sample Labels . . . . . 16-18
16.10 Chain-of-Custody Procedures . . . . . 16-18

# Appendices

Appendix A Site Safety Plan Amendments
Appendix B Site Safety Plan Acknowledgment Form
Appendix C Visitor Sign-In Form
Appendix D Safety Meeting Form
Appendix E Notification of Access To Employee Exposure and Medical Records
Appendix F Cold Stress
Appendix G Heat Stress
Appendix H Material Safety and Data Sheets
Appendix I Air Quality Monitoring
Appendix J Equipment Calibration Log
Appendix K Record of Hazardous Waste Activity
Appendix L Injury/Exposure Report
Appendix M Near-Accident Report
Appendix N Hot Work Permit
Appendix O Drill Rig Inspection Log

# List of Tables


Health & Safety Plan Amendment Record ..... vii
Table 1-1 General Information ..... 1-5
Table 1-2 Background ..... 1-6
Table 2-1 Chemical Hazards ..... 2-4
Table 3-1 Level A PPE to Be Utilized ..... 3-2
Table 3-2 Level B PPE to Be Utilized ..... 3-3
Table 3-3 Level C PPE to Be Utilized ..... 3-4
Table 3-4 Level D PPE (Minimum Work Uniform Permitted) ..... 3-5
Table 3-5 Activity vs. Level of Protection ..... 3-5
Table 4-1 Instruments ..... 4-3
Table 6-1 Decontamination Procedures ..... 6-3
Table 7-1 Emergency Contacts/Telephone Numbers ..... 7-1
Table 7-2 Individuals Currently Certified in First Aid/CPR ..... 7-2
Table 7-3 Emergency Equipment Available Onsite ..... 7-2
Table 10-1 ThermoRetec Confined Space Entry Permit ..... 10-4
Table 12-1 Fall Protection ..... 12-1
Table 13-1 Allowable Noise Exposures ..... 13-1
Table 16-1 Samplers for Liquids/Solid Hazardous Materials ..... 16-4
Table 16-2 Samplers for Hazardous Materials ..... 16-10

# List of Figures

Figure 5-1 Site Map . . . . . 5-2
Figure 7-1 Route to Hospital . . . . . 7-7

## Health & Safety Plan Amendment Record

| | |
|---|---|
| **Client:** | Waste Management, Inc. |
| **Project No.:** | 3-4198 |
| **Project Manager:** | Steve Dischler ~~Andy Nietupski~~ |
| **Site Geol./Mgr:** | Mark Riggle |

| Amendment No. | Date | Description |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**NOTE: See Safety Plan Amendments (Appendix A) for Complete Description.**

# Executive Summary

This document describes the health and safety protocols developed for the investigation of the Closed Industrial Waste Unit at the Austin Community Landfill located in Austin, Texas. This plan was developed to protect onsite personnel, visitors, and the public from known or suspected health and safety hazards. The procedures and guidelines contained herein are based on the most up-to-date information available at the time of the drafting of this document. Specific sections of this plan will be changed or revised when additional information is received or when conditions at the site change. Any changes or revisions to this plan will be by a written amendment which will become a permanent part of this plan. Where appropriate, specific Occupational Safety and Health Administration (OSHA) standards or other standards will be cited.

The project manager, site engineer, site health and safety officer, or other designated representative shall be responsible for informing visitors to work areas and all individuals assigned to work on the site of the contents of this plan and ensuring that each person signs the Site Safety Plan Acknowledgment Form. By signing the Safety Plan Acknowledgment Form, individuals are recognizing the site Health and Safety hazards, known or suspected, and the protocols required to minimize exposure to such hazards.

All personnel assigned to the site must have successfully completed 40 hours of training for hazardous waste site work in accordance with OSHA 29 CFR 1910.120(e)(3) and be current with their 8-hour refresher training in accordance with OSHA 29 CFR 1910.120(e)(8). Personnel managing or supervising work onsite will also have successfully completed 8 hours Manager/Supervisor Training, meeting the requirements of 29 CFR 1910.120(e)(4). Documentation of OSHA training is required prior to personnel being permitted to work onsite.

The health and safety risk analysis in this document identifies the hazards associated with specific site operations and presents an analysis of documented or potential chemical hazards that exist at the site. Every effort must be made to reduce or eliminate these hazards. Those which cannot be eliminated must be guarded against by use of engineering controls and/or personal protective equipment.

Site controls will be established to reduce migration of contaminants into clean areas, and to prevent access or exposure to hazardous materials by unauthorized personnel. Work zones will include: the support zone, the decontamination zone, and the exclusion zone. The support zone is an uncontaminated zone outside the

decontamination and exclusion zones. This area is used for staging of materials, parking of vehicles, sanitation facilities, and the receipt of deliveries. There will be only one controlled entry/exit point from the support zone to the decontamination zone. The decontamination zone will provide a location for removal and decontamination of personal protective equipment. All personnel and equipment should exit the exclusion zone through the decontamination zone. The exclusion zone will be the work area inside of the decontamination zone. Appropriate warning signs to identify the exclusion zone will be posted. Any material that is generated by decontamination procedures will be stored in steel drums in a designated area in the exclusion zone pending disposal approvals and disposition.

According to 29 CFR 1910.120(h), air monitoring shall be performed to identify and quantify airborne levels of hazardous substances, if any, to determine the appropriate level of employee protection required for personnel working onsite. Air monitoring will be conducted using instruments capable of detecting and measuring concentrations of combustible gases, oxygen, and organic vapors. Routine air monitoring will be conducted; upon initial entry of a work area; when the possibility of a dangerous condition of flammable atmosphere has developed; as an ongoing check of the levels of contaminants in the breathing zone; when a different operation is initiated or work is initiated on a different portion of the site; or when contaminants other than those previously identified are encountered. Additional air monitoring will be conducted to protect the public from potential fugitive emissions for investigation activities. The additional air monitoring will be performed downwind of work activities using the same equipment as the routine air monitoring. The downwind air monitoring will be performed when work is initiated at each drilling location, when elevated levels of volatile organic compounds or combustible gases are detected in the work zone, and as an ongoing check through the workday.

The Emergency Response/Contingency Plan was developed so that site personnel will be prepared in the event of an emergency. Emergencies can take many forms: illnesses/injuries, chemical exposure, fires, explosions, spills, leaks, releases, or sudden changes in weather. The emergency response/contingency plan includes: emergency contacts and telephone numbers, including fire department, police, ambulance, hospital, poison control center, utility companies, National Response Center, the Center for Disease Control, ATF (explosion information), Chemtrec, state environmental agency (TNRCC), U.S. EPA Region VI, ThermoRetec corporate Health and Safety Officer, and the ThermoRetec medical consultant. The plan details personnel responsibilities during emergencies, medical emergencies, fire or explosion, spills or leaks, and evacuation routes including driving directions, and a map showing the route to the nearest hospital.

# 1 Introduction

This document describes the Health and Safety protocols developed for the Closed Industrial Waste Unit at the Austin Community Landfill (ACL), located in Austin, Texas. This plan was developed to protect onsite personnel, visitors, and the public from known or suspected health and safety hazards. The procedures and guidelines contained herein are based on the most up-to-date information available at the time of the drafting of this document. Specific sections of this plan will be changed or revised when additional information is received or when conditions at the site change. Any changes or revisions to this plan will be by a written amendment which will become a permanent part of this plan and placed in Appendix A. Where appropriate, specific Occupational Safety and Health Administration (OSHA) standards or other standards will be cited.

## 1.1 Site Safety Plan Acknowledgment and Acceptance

The project manager, site engineer, site health and safety officer, or other designated representative shall be responsible for informing all individuals assigned to work on the site, or visit the site beyond the clean/support zone, of the contents of this plan and ensuring that each person signs the Site Safety Plan Acknowledgment Form in Appendix B. By signing the Safety Plan Acknowledgment Form, individuals are recognizing the site Health and Safety hazards, known or suspected, and the protocols required to minimize exposure to such hazards.

Additionally, all personnel visiting the site must sign the visitors log in Appendix C indicating date and time of visit.

## 1.2 Site Health and Safety Meetings

An initial "*Kick-Off*" Health and Safety meeting shall be held on the first day of mobilization to the site and prior to the commencement of any work activities. Mandatory attendance is required for all personnel initially assigned to the site. At the conclusion of the Kick-Off meeting, personnel are to sign the Safety Plan Acknowledgment Form in Appendix B, indicating their attendance and understanding of the health and safety protocols. As additional personnel are assigned to the site, it is the responsibility of the project manager/site engineer to ensure that the personnel are briefed on health and safety protocols and that they also sign the Safety Plan Acknowledgment Form.

Additional health and safety meetings will be held on a regularly scheduled basis throughout the duration of the project. In no case shall more than one week lapse

between health and safety meetings. These meetings shall be conducted to inform all personnel of changing site conditions, to ensure that personal protective equipment (PPE) is sufficiently stocked, being used properly and to address worker health and safety concerns. The site engineer or health and safety officer will complete the site safety meeting form in Appendix D indicating the date, time, topics discussed, and personnel in attendance of all health and safety meetings.

## 1.3 Training Requirements

All personnel assigned to the site must have successfully completed 40 hours of training for hazardous waste site work in accordance with OSHA 29 CFR 1910.120(e)(3) and be current with their 8-hour refresher training in accordance with OSHA 29 CFR 1910.120(e)(8).

Personnel managing or supervising work onsite will also have successfully completed 8 hours Manager/Supervisor Training, meeting the requirements of 29 CFR 1910.120(e)(4). Documentation of OSHA training is required prior to personnel being permitted to work onsite.

## 1.4 Medical Monitoring Requirements

All personnel assigned to the site must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Personnel must have successfully passed an occupational physical during the past 12 months and be medically cleared to work on a hazardous waste site and capable of wearing appropriate PPE and respiratory protection as may be required.

## 1.5 Fit Testing Requirements

All personnel assigned to the site who must wear a respirator must be familiar with the requirements in RETEC's respiratory protection program and the OSHA respiratory standard (29 CFR 1910.134). All personnel who are required to wear respiratory protection must have successfully passed a respirator fit test within the past 12 months. Documentation of a successful respirator fit test for the appropriate type of respirator needed for work on this specific site (half-face or full-face APR or supplied air) will be required. The project manager, project site engineer, or site health and safety officer is to ensure that the respirator being worn by personnel is the same size, make, and model as that specified on any respirator fit test records from the past 12-month period.

## 1.6 Responsibilities

The project manager, or site engineer, is responsible for overall project administration and for coordinating health and safety protocols and procedures for all personnel onsite at all times. All applicable U.S. EPA and OSHA Health and Safety requirements shall be maintained throughout the course of the project. This health and safety plan covers all personnel onsite; however, each sub-contractor is also responsible for the health and safety of its employees. If there is a dispute with regards to health and safety, the following procedures shall be followed:

(1) Project manager or site engineer shall attempt to resolve the issue with a complete written follow-up to RETEC's Corporate Health and Safety Officer, or

(2) If the issue cannot be resolved, the project manager shall consult the Corporate Health and Safety Officer immediately, and the specific task or operation in dispute shall be discontinued until the issue is resolved.

Any person who observes health and safety problems or infractions should immediately report the problem or infraction to the appropriate personnel.

## 1.7 Access to Employee Exposure and Medical Records

OSHA provides employees and their designated representatives a right of access to relevant exposure and medical records (29 CFR 1910.20). The "*notification*" of access to employee exposure and medical records (Appendix E) is to be posted in a prominent location at all ThermoRetec field operations.

## 1.8 Hazard Communication

ThermoRetec will advise everyone assigned to this site of the hazards associated with working onsite and the means to be utilized to mitigate hazards and prevent exposures.

This information will be specified in the site-specific health and safety plan and presented to personnel prior to initiation of any field activities. Personnel will acknowledge receipt of this information by signing the acknowledgment and acceptance form in Appendix B.

The following information regarding hazardous materials will be presented per RETEC's Hazard Communication Program:

- Material Safety Data Sheets (MSDS)
- Chemical/Physical hazards
- PPE
- Labeling

## Table 1-1 General Information

| | | | |
|---|---|---|---|
| **Client:** | Waste Management, Inc. | **Proj. No.:** | 3-4198 |
| **Site Name:** | Industrial Waste Materials Management Site | | |
| **Site Location:** | Austin, Texas | | |
| **Description of Field Activities:** | Install onsite investigation wells, perform a pump test on one of these wells and a slug test on all of the onsite wells. Drill deep soil borings adjacent to the site. Collect soil samples from deep boring. Collect water and soil samples from all investigation wells and borings. Collect surface water samples. | | |
| **Dates of Field Activities:** | April 1999 through April 2000 | | |
| **Project Manager:** | Steve Dischler ~~Jamie Greacen~~ | | |
| **Site Geologist/ Manager:** | Mark R. Riggle | **Office:** | Austin |
| **Designated Site H&S Officer:** | Robert Crone | | |

**ThermoRetec Personnel Assigned to Site**

| Name | Office | OSHA Training Date | | | Physical Date | Respirator Fit Test Date | | SCBA |
|---|---|---|---|---|---|---|---|---|
| | | 40 Hr | Supervisor Trng. | 8 Hr | | APR HF | APR FF | |
| Mark R. Riggle | Austin | 3/6/92 | 3/4/92 | 11/98 | 10/98 | NA | 12/98 | NA |
| Wally Zverina | Austin | 12/8/89 | 4/19/94 | 1/99 | 4/98 | 9/98 | 11/98 | 11/98 |
| Paul Michalski | Austin | 7/16/98 | NA | 11/98 | 7/98 | NA | 7/98 | 11/98 |
| Dieter Geithner | Austin | 10/85 | NA | 11/98 | 11/98 | 5/98 | 11/98 | 11/98 |
| Robert Crone | Austin | 1/14/99 | NA | NA | 1/99 | 2/99 | 2/99 | NA |

**Subcontractor Personnel Assigned to Site**

| Name | Subcontractor | OSHA Training Date | | | Physical Date | Respirator Fit Test Date | | SCBA |
|---|---|---|---|---|---|---|---|---|
| | | 40 hr | Supervisor Trng. | 8 hr | | APR HF | APR FF | |
| Names to be determined | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

## Table 1-2 Background

| **Overall Hazard Is:** | | | |
|---|---|---|---|
| **High:** | **Low:** | **Moderate:** X | **Unknown:** |
| **Facility Description:** Site is a former industrial landfill. | | | |
| **Status:** Inactive | | | |
| **Unusual Features (containers, dikes, buildings, power lines, terrain, etc.):** Install onsite investigation wells, perform a pump test on one of these wells and a slug test on all of the onsite wells. Drill deep soil borings adjacent to the site. Collect soil samples from deep borings. Collect water and soil samples from all investigative wells and borings. Collect surface water samples. | | | |
| **Site History (worker injury, complaints, regulatory agency action):** | | | |
| **Waste Types:** | | | |
| **Liquid:** X | **Solid:** X | **Sludge:** X | **Gas:** X |
| **Characteristics:** | | | |
| **Corrosive:** | **Ignitable:** X | **Volatile:** | **Toxic:** X |
| **Reactive:** | **Unknown:** | **Radioactive:** | |
| **Other (Name):** | | | |
| **Hazards Posed by Site Activities:** Low to moderate level hazard associated with contaminated soil and groundwater. Moderate level hazard associated with ignitable gases from drilling soil borings and monitoring well installations within the landfill. | | | |
| **Unusual Hazards:** | | | |

# 2 Health & Safety Risk Analysis

This analysis identifies the general hazards associated with specific site operations and presents an analysis of documented or potential chemical hazards that exist at the site. Every effort must be made to reduce or eliminate these hazards. Those which cannot be eliminated must be guarded against by use of engineering controls and/or personal protective equipment (PPE).

## 2.1 Hazards When Working Around Heavy Equipment

- All equipment must have back-up alarms.
- Personnel must make eye contact with the operator before approaching the equipment.
- Operators must be aware of personnel in the area and use proper hand signals before maneuvering.
- Operators must wear hard hats when operating machines unless equipment has an enclosed cab or cage cover.
- Operators must wear hard hats when going to and from their equipment.
- Operators must be cautious when maneuvering equipment near overhead power lines.

## 2.2 General Site Hazards

### 2.2.1 Lighting

Work areas must have adequate lighting for employees to see to work and identify hazards (5-foot candles minimum, comparable to a single 75- to 100-watt bulb). Personnel should carry flashlights in all dark areas for use in the event of a power failure. Applicable OSHA standards for lighting (29 CFR 1910.120(m)) shall apply.

### 2.2.2 Electrical Power

All electrical power must have a ground fault circuit interrupter as part of the circuit. All equipment must be suitable and approved for the class of hazardous

atmosphere in which it is being used. Applicable OSHA standards for electric power (29 CFR 1910 Subpart S) shall apply.

### 2.2.3 Lockout/Tagout

Operations where the unexpected energization or start-up of equipment or release of stored energy could cause injury to personnel will be protected by the implementation of a lockout/tagout program meeting the requirements of 29 CFR 1910.147. See Section 11 of this Plan for more details.

### 2.2.4 Fall Protection

Work site slip, trip and fall accidents can result in serious injuries or fatalities. Procedures to help prevent these types of accidents will be implemented. Elevated work where a fall potential exists will be performed using appropriate ladders and/or fall protection (i.e., body harness or lifeline). Applicable OSHA standards for fall protection (29 CFR 1910.21 through 29 CFR 1910.32) shall apply. See Section 12 of this Plan for more details.

### 2.2.5 Drum Handling

The movement and opening of drums will be done in accordance with 29 CFR 1910.120(j). See Section 8 of this Plan for more details.

### 2.2.6 Cold Stress

When the temperature falls below 40°F, cold stress protocols shall be followed. Employees must be supplied with adequate clothing to maintain core temperature. Cold stress is discussed in detail in Appendix F.

### 2.2.7 Heat Stress

When the temperature exceeds 70°F, and personnel are wearing personal protective clothing, a heat stress monitoring program shall be implemented. Employees shall have frequent break periods and access to drinking water. Heat stress is discussed in detail in Appendix G.

### 2.2.8 Eye Wash Protection

All operations involving the potential for eye injury, splash, etc., must have approved eye wash units locally available as per 29 CFR 1910.151(c).

## 2.2.9 Hearing Protection

When the noise level of any operation exceeds the 8-hour Time Weight Average (TWA) of 85 decibels, a hearing protection program meeting the requirements of 29 CFR 1910.95 will be implemented.

## 2.2.10 Fire Protection/Fire Prevention

Operations involving the potential for fire hazards shall be conducted in a manner as to minimize the risk. Non-sparking tools and fire extinguishers shall be used or available as required. Sources of ignition shall be removed. When necessary, explosion-proof instruments and/or bonding and grounding will be used to prevent fire or explosion.

## 2.2.11 Utilities

Overhead and underground utility hazards shall be identified and/or inspected prior to conducting operations involving potential contact.

## 2.2.12 Confined Space Entry

If any operation is conducted in an area classified as a permit confined space by OSHA, a "*Confined Space Entry Permit*" will be completed and all applicable procedures meeting the requirements of 29 CFR 1910.146 will be implemented. See Section 10 of this Plan for more details.

## 2.2.13 Excavation/Trenching

Any excavation/trench greater than four feet depth in which personnel must enter will be designed, and constructed per all applicable requirements of 29 CFR 1926, Subpart P. See Section 9 of this Plan for more details.

## 2.2.14 Overhead Power Lines

Anytime work is performed in the vicinity of high tension wires, a person who is a good judge of distances, will be assigned to help operators maneuver equipment in and around the wires.

The following distances will always be maintained around high tension wires:

| Minimum Distance | Voltage |
|---|---|
| 10 ft | 751v to 75 Kv |
| 15 ft | 75 Kv to 250 Kv |
| 20 ft | 250 Kv to 550 Kv |

### 2.2.15 Hot Work

Prior to initiation of any hot work procedures a "*Hot Work*" permit (Appendix N) must be approved by a client representative and the site safety officer.

## 2.3 Chemical Hazards

Previous sampling and analytical data or previous site history and investigation have indicated that the following chemical hazards, either documented or suspected, exist at the site. Detailed hazard information for these chemicals is available through MSDS in Appendix H.

### Table 2-1 Chemical Hazards

| Contaminant | ppm or mg/m³ | Skin Absor Haz. | PEL[a] | TLV[b] | REL[c] | STEL[d] | IDLH[e] | Odor Thres-hold | IP[f] |
|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | ppm | no | NA | 1 | CA | NA | CA | 190 | 10.00 |
| Methylene Chloride[h] | ppm | no | 25 | 50 | 0.010 CA | NA | 2300CA | 160 | 11.32 |
| Carbon Tetrachloride[h] | ppm | no | 10; 25C | 5 | CA | 10 | 200 CA | 140 | 11.47 |
| Vinyl Chloride[h] | ppm | no | 1; 5C | 1 | CA | 5 | CA | 10-20 | 9.99 |
| Trichloroethene[h] | ppm | no | 100; 200C | 50 | 25 | 100 | 1000 CA | 82 | 9.45 |
| Tetrachloroethene[h] | ppm | no | 100; 200C | 25 | CA | 100 | 150 CA | 47 | 9.32 |
| Chlorobenzene | ppm | no | 75 | 10 | NA | NA | 1000 | 1.3 | 9.07 |
| Toluene | ppm | yes | 200 | 50 | 100 | 150 | 500 | 0.160 | 8.82 |
| Acetone | ppm | no | 1000 | 500 | 250 | NA | 2500 | 3.6 | 9.59 |
| n-Heptane | ppm | no | 500 | 400 | 85 | NA | 750 | 230 | 9.90 |
| Xylene | ppm | no | 100 | 100 | 100 | 150 | 900 | 20 | 8.56 |
| Sulfuric Acid | mg/m³ | no | 1 | 1 | 1 | 3 | 15 | 0.15 | NA |
| Nitric Acid | ppm | no | 2 | 2 | 2 | 4 | 25 | NA | 11.95 |
| Benzene[h] | ppm | yes | 1 | 1 | 0.1 | 1 | 500 | 4.68 | 9.24 |
| Hydrogen Cyanide | ppm | no | 10 | 10 | 10 | 20 | 50 | 1 | 13.60 |
| Acetone | ppm | no | 1000 | 500 | 250 | 750 | 2500 | 3.6-653 | 9.69 |
| Styrene | ppm | no | 100 | 20 | 50 | 40 | 700 | 0.017-1.9 | 8.4 |
| Isopropyl Alcohol | ppm | no | 400 | 200 | 400 | 500 | 2000 | 43 | 10.10 |
| Methyl Isobutyl Ketone | ppm | no | 200 | 200 | 200 | 300 | 3000 | 2.85 | 9.54 |
| Methyl Ethyl Ketone | ppm | no | 100 | 50 | 50 | 75 | 500 | 0.1-7.8 | 9.3 |
| Cellosolve | ppm | yes | 200 | 5 | 0.5 | NA | 500 | 2.7 | NA |
| Caustic Soda | mg/m³ | no | 2 | NA | 2C | 2C | 10 | NA | NA |
| Phosgene | ppm | no | 0.1 | 0.1 | 0.1 | NA | 2 | 0.12-5.7 | 11.55 |
| Isocyanates with free Phosgene (flammable liquid) | ppm | no | 0.1 | 0.1 | 0.1 | NA | 2 | 0.12-5.7 | 11.55 |
| Aniline Wastes (poison) | ppm | yes | 5 | 2 | CA | NA | 100 CA | 0.58-10 | 7.70 |
| Phenol Wastes | ppm | yes | 5 | 5 | 5 | NA | 250 | 0.06 | 8.50 |

**Note:**

[a] OSHA Permissible Exposure Limit (PEL)

[b] American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV)

[c] National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) **USE LOWEST FIGURE OF THE THREE LIMITS.**

[d] Short-Term Exposure Limit

[e] Immediately Dangerous to Life & Health

[f] Ionization Potential

[g] C = Ceiling Limit

[h] CA = Carcinogenic

NA = Not available

# 3 Personal Protective Equipment

The following is a brief description of the personal protective equipment (PPE) which may be required during various phases of the project. The U.S. EPA terminology for protective equipment will be used: Levels A, B, C, and D.

Respiratory protective equipment shall be NIOSH approved and use shall conform to OSHA 29 CFR 1910.134.

## 3.1 Level A

Level A protection shall be used when:

- The hazardous substance requires the highest level of protection for skin, eyes, and the respiratory system.
- Substances with a high degree of hazard to the skin are known or suspected.
- Chemical concentrations are known to be above the Immediate Danger to Life and Health (IDLH) levels.
- Biological hazards requiring Level A are known or suspected.

### Table 3-1 Level A PPE to Be Utilized (Check Appropriate PPE)

| | |
|---|---|
| | Positive-pressure (pressure demand), self-contained, or in-line breathing apparatus (OSHA/NIOSH approved) |
| | Fully Encapsulating Chemical-Resistant Suit (Selected for resistance to chemicals at the site.)<br>**Fabric Type:** |
| | Disposable chemical-resistant inner gloves |
| | Disposable chemical-resistant outer gloves<br>**Material Type:** |
| | Chemical-resistant boots with steel toe and shank (depending on suit boot construction, worn over or under suite boot)<br>**Material Type:** |
| | Two-way radio communication (intrinsically safe) |
| | Knife strapped to body for emergency egress from suit |
| | Hearing Protectors (REQUIRED if site noise levels are greater than 85 dB based on an 8-hour TWA.) |
| | Hard hat (under suit) |
| | Coveralls and/or long cotton underwear |
| | Escape/egress mask/bottles |
| | **Modifications:** |

**Note:**
Maximum distance personnel are allowed to travel from air source on an in-line system is 300 feet.

## 3.2 Level B

Level B protection shall be used when:

- The substance(s) has been identified and requires a high level of respiratory protection but a lesser degree of skin protection.
- Concentrations in the air are IDLH or above the maximum use limit of Air Purifying Respirator (APR) with full face mask.
- Oxygen deficient or potentially oxygen deficient atmospheres (<19.5%) are possible.
- Confined space entry requires Level B PPE.

## Table 3-2 Level B PPE to Be Utilized (Check Appropriate PPE)

| | |
|---|---|
| | Positive pressure (pressure demand), self-contained or in-line breathing apparatus (OSHA/NIOSH approved) |
| | Chemical-resistant clothing (overalls, and long-sleeved jacket, coveralls, hooded, two-piece, chemical splash suit, or disposable chemical-resistant coveralls (i.e., Saranex) **Fabric Type:** |
| | Disposable inner gloves (surgical) |
| | Disposable chemical-resistant outer gloves **Material Type:** |
| | Chemical-resistant boots with steel toe and shank **Material Type:** |
| | Sleeves to be duct-taped over gloves and pants to be duct-taped over boots. Duct tape to be used over zippers and any other area where the potential for exposure exists |
| | Two-way radio communication (intrinsically safe) |
| | Hearing Protectors (REQUIRED if site noise levels are greater than 85 dB based on an 8-hour TWA.) |
| | Hard hat |
| | Coveralls under splash suit |
| | Long cotton underwear |
| | Escape/egress mask/bottles |
| | **Modifications:** |

**Note:**
Maximum distance personnel are allowed to travel from air source on an in-line system is 300 feet.

# 3.3 Level C

Level C protection shall be used when:

- Substance(s) require the same level of skin protection as Level B, but a lesser level of respiratory protection.
- The types of air contaminants have been identified, concentrations measured, and respirator decision logic indicates that APRs are sufficient to remove the contaminants.
- The substance has adequate warning properties and all criteria for the selection of APR has been met.

**Table 3-3 Level C PPE to Be Utilized (Check Appropriate PPE)**

| | |
|---|---|
| X | Half-face APR (MSHA/NIOSH approved) or |
| X | Full-face APR (MSHA/NIOSH approved) or |
| | **Type of Cartridges to Be Used:** |
| | |
| X | Organic Vapor/acid gas/HEPA Filter |
| X | Chemical-resistant clothing: circle appropriate garments: (one-piece coverall; hooded, two-piece, chemical splash suit, chemical-resistant hood and apron, disposable chemical-resistant coveralls (i.e., Tyvek)<br>**Fabric Type:** Saranex |
| X | Disposable inner gloves (surgical) |
| X | Disposable, chemical-resistant outer gloves<br>**Material Type:** Neoprene |
| X | Chemical-resistant boots with steel toe and shank or disposable boot covers; booties<br>**Material Type:** Neoprene |
| X | Sleeves to be duct-taped over gloves and pants to be duct-taped over boots |
| X | Safety goggles/glasses |
| | Hard hat with face shield |
| X | Hearing Protectors (REQUIRED if site noise levels are greater than 85 dB based on an 8 hr. TWA.) |
| | Two-way radio communication (intrinsically safe) |
| X | Hard hat |
| | Long cotton underwear |
| | **Modifications:**<br>Modified Level C - As above with no respiratory protection |

## 3.4 Level D

Level D protection will be used when:

- The atmosphere contains no known hazard.
- Work functions preclude splashes, immersions, or the potential for unexpected inhalation of or contact with hazardous concentrations of chemicals.
- Atmospheric concentrations of contaminants are less than the TLV.

## Table 3-4 Level D PPE (Minimum Work Uniform Permitted)

**(Check Appropriate PPE)**

| | |
|---|---|
| X | Standard work uniform/coveralls |
| X | Work boots with steel toe and shank |
| X | Work gloves |
| X | Safety goggles/glasses or |
| X | Hearing Protectors (REQUIRED if site noise levels are greater than 85 dB based on an 8-hour TWA.) |
| | Hard hat with face shield |
| X | Hard hat |
| | Two-way radio communication (intrinsically safe) |
| | Long cotton underwear |
| | **Modifications:** |

## Table 3-5 Activity vs. Level of Protection

| Activity | Level of PPE | Special Requirements |
|---|---|---|
| Field activities to include: Install onsite investigation wells, perform a pump test on one of these wells and a slug test on all of the onsite wells. Drill deep soil borings adjacent to the site. Collect soil samples from deep boring. Collect water and soil samples from all investigative wells and borings. Collect surface water samples. | Modified C | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# 4 Air Monitoring and Action Levels

According to 29 CFR 1910.120(h), air monitoring shall be used to identify and quantify airborne levels of hazardous substances and health hazards in order to determine the appropriate level of employee protection required for personnel working onsite.

## 4.1 Routine Air Monitoring Requirements

Air monitoring shall be conducted at the following times or as specified by the site engineer:

- Upon initial entry to rule out IDLH conditions
- When the possibility of an IDLH condition or flammable atmosphere has developed
- As an on-going check of the levels of contaminants in the breathing zone
- When work is initiated on a different portion of the site
- When contaminants other than those previously identified are encountered
- When a different operation is initiated
- When work involves the handling of leaking drums or containers or, when working in areas with obvious liquid contamination
- During confined space entry

Air monitoring will consist, at a minimum, of the criteria listed on Table 4-1. All air monitoring and instrumentation calibration data will be recorded on the Air Quality Monitoring Record in Appendix I. All Equipment Calibration data is to be recorded on the "*Equipment Calibration Log*" in Appendix J. This data will be made available for review by all interested persons. Air monitoring instruments will be calibrated and maintained in accordance with the manufacturer's specifications.

## 4.2 Additional Air Monitoring

In order to evaluate any fugitive emissions resulting from drilling activities, additional air monitoring will be performed downwind of the exclusion zone surrounding work activities. Monitoring will be performed using the same equipment as that used to monitor conditions in the work zone as described in Section 4.1. The air monitoring will be performed when work is initiated at each drilling location, when elevated levels of VOCs or combustible gases are observed in the work zone, and as an ongoing check throughout the work day. Air monitoring will be performed downwind of the exclusion zone surrounding the drilling sites and recorded in the Air Quality Monitoring Record in Appendix I.

## Table 4-1 Instruments (Check Appropriate Instrumentation)

| ✔ | **Combustible Gas Indicator (CGI)** |
|---|---|
| **Use:** | Detection of Explosive/Flammable Atmospheres |
| **Action Level:** | <10% LEL — Continue Work<br>10 to 25% LEL — Continue Work with Caution<br>>25% LEL — EXPLOSION HAZARD — **Evacuate Site Immediately** |
| **Frequency:** | |
| ✔ | **Oxygen Meter** |
| **Use:** | Detect Percent Oxygen Content in Air |
| **Action Level:** | <19.5% Oxygen — Monitor Wering SCBA<br>19.5 to 22% Oxygen — Continue Work<br>>22 Oxygen — FIRE HAZARD — **Evacuate Site Immediately** |
| **Frequency:** | |
| ✔ | **Radiation Meter** |
| **Use:** | Detect Radiation |
| **Action Level:** | Background to 2m REM/hr — Continue Work<br>2m REM/hr to 10m REM/hr — **Evacuate Site and Notify Corporate H&S Officer** |
| **Frequency:** | |
| ✔ | **HNu (specify model):** |
| | **Please Check Bulb Size:** |

| | 9.5 eV | | 10.2 eV | ✔ | 11.7 eV |
|---|---|---|---|---|---|

| | |
|---|---|
| **Tip Model:** | |
| **OVA Model:** | |
| **Use:** | Detection of Organic Gases and Vapors |
| **Action Level:** | >1ppm above background sustained for five minutes in the breathing zone, stop work until readings fall below 1ppm. |
| **Frequency:** | |

## Table 4-1 Instruments (Check Appropriate Instrumentation)

| | Specify Other Instrument: |
|---|---|
| **Use:** | |
| **Action Level:** | |
| **Frequency:** | |
| **Use:** | **Specify Other Instrument:** |
| **Action Level:** | |
| **Frequency:** | |

**Note:**
The designated site Health and Safety Officer is to complete the "*Record of Hazardous Waste Field Activity*" Form (Appendix K) and return it to the Corporate Health and Safety Officer on a regularly scheduled basis, but in no case shall more than one month lapse between submittals.

# 5 Site Control

## 5.1 Work Zones

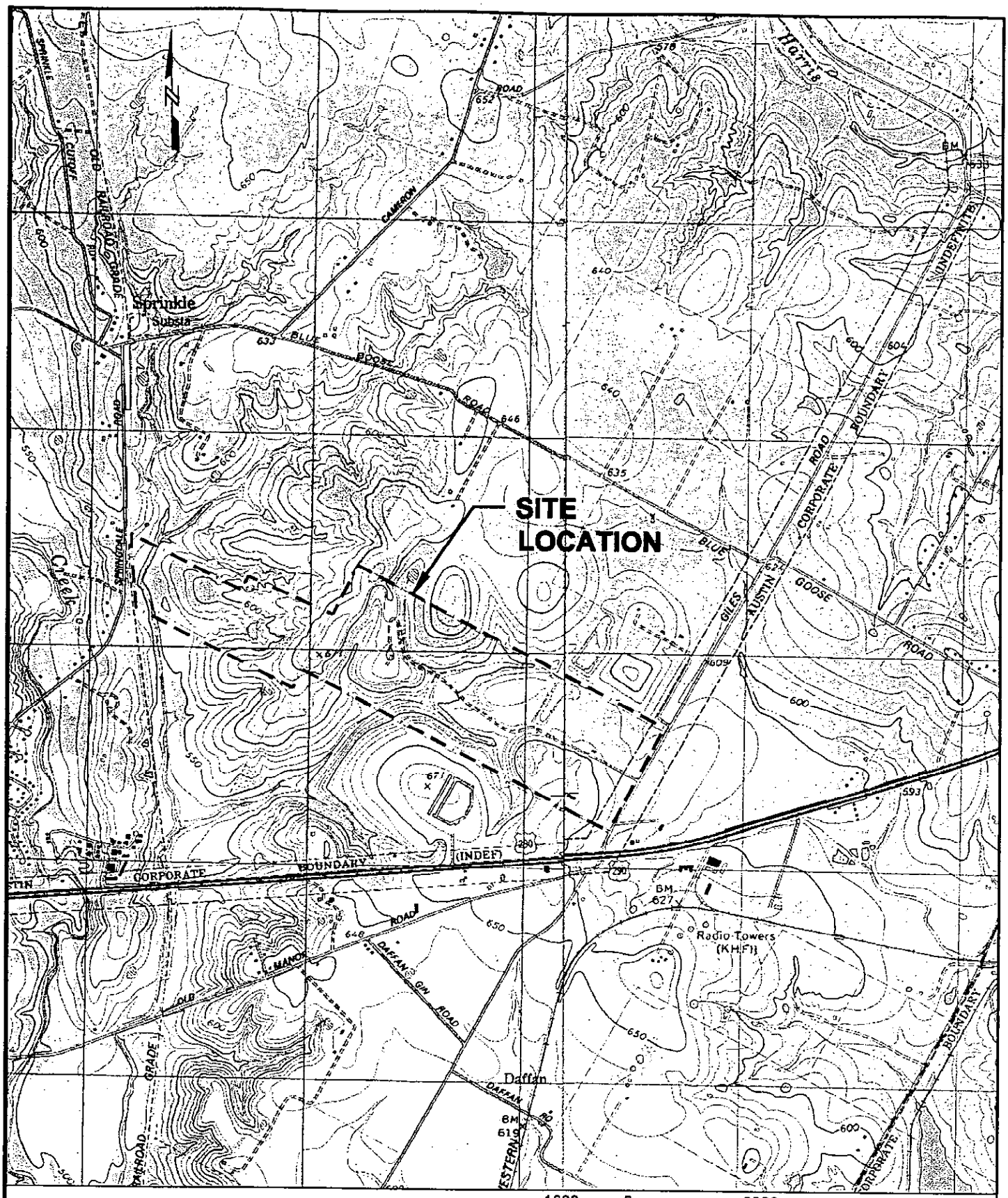
The primary purpose for site controls is to establish the hazardous area perimeter, to reduce migration of contaminants into clean areas, and to prevent access or exposure to hazardous materials by unauthorized personnel. At the end of each work day, the site should be secured or guarded to prevent unauthorized entry. Site work zones will include:

- **Clean Zone/Support Zone.** This uncontaminated zone will be the area outside the exclusion and decontamination zone and within the geographic perimeters of the site. This area is used for staging of materials, parking of vehicles, office and laboratory facilities, sanitation facilities, and receipt of deliveries. Personnel entering this zone may include delivery personnel, visitors, security guards, etc., who will not necessarily be permitted in the exclusion zone. All personnel arriving in the support zone will report to the command post and sign a site entry/exit log. There will be only one controlled entry/exit point from the clean zone to the decontamination zone.

- **Decontamination Zone.** The decontamination zone will provide a location for removal of contaminated personal protective equipment (PPE) and final decontamination of PPE. All personnel and equipment should exit via the decon area. A separate decontamination area will be established for heavy equipment.

- **Exclusion Zone/Hot Zone.** The exclusion zone will be the "*hot zone*" or contaminated area inside the site perimeter. Entry to and exit from this zone will be made through a designated point. Appropriate warning signs to identify the exclusion zone should be posted (i.e., "**DANGER — AUTHORIZED PERSONNEL ONLY**", "**PROTECTIVE EQUIPMENT BEYOND THIS POINT**", etc.). Exit from the exclusion zone must be accompanied by personnel and equipment decontamination.

A site map depicting the proposed monitoring well location is shown on the next page. A map indicating the various work zones as discussed above is not required.




| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ThermoRetec | WASTE MANAGEMENT OF TEXAS, INC.<br>AUSTIN COMMUNITY LANDFILL<br>3-4198-300 | | | | | | DATE 4/14/99 | SITE LOCATION MAP<br>USGS 7.5 MIN. QUADS.<br>"AUSTIN EAST 1988 AND MANOR 1988, TEXAS" |
| | NO | DRWN | DATE | REVISION | CHKD | DATE | APPVD | DATE |
| | 1 | | | | | | | |
| | 0 | GWC | 4/14/99 | ORIGINAL ISSUE | B.C. | 4/14/99 | B.C. | 4/14/99 |
| | | | | | | | FILE | USGS |
| | | | | | | | DRAWING NO. | FIGURE 5-1 |
| | | | | | | | REVISION | |

## 5.2 General Field Safety and Standard Operating Procedures

- The "*Buddy System*" will be used at all times by all field personnel in the exclusion zone. Especially if personnel are required to wear Level C or higher PPE. No one is to perform field work alone. Maintain visual, voice, or radio communication at all times.

- Whenever possible, avoid contact with contaminated (or potentially contaminated) surfaces. Walk around (not through) puddles and discolored surfaces. Do not kneel or set equipment on the ground. Stay away from waste drums unless it is necessary to sample or handle the drums. Protect equipment from contamination by bagging.

- Eating, drinking and/or smoking is only permitted in designated areas in the support zone.

- Hands and face must be thoroughly washed upon leaving the decon area.

- Beards or other facial hair that interferes with respirator fit will preclude admission to the exclusion zone.

- All equipment must be decontaminated or properly discarded upon exit from the exclusion zone as determined by the project manager.

- All personnel exiting the exclusion zone must go through the decontamination procedures as described in this Health & Safety Plan.

- PPE as described in this Health & Safety Plan will be required for all field personnel working on site.

- No contact lenses are permitted to be worn onsite.

# 6 Decontamination

In general, everything that enters the exclusion zone must either be decontaminated or properly discarded upon exit from the exclusion zone. All personnel, including any state or local officials, must enter and exit the exclusion zone through the decon area. Prior to demobilization, contaminated equipment will be decontaminated and inspected by the project manager/site engineer before it is moved into the clean zone. Any material that is generated by decontamination procedures will be stored in a designated area in the exclusion zone pending disposal approvals and disposition.

The type of decontamination solution to be used is dependent on the type of chemical hazards. The decontamination solution for this project is alconox and water. Decontamination solutions will be changed as required and collected and stored onsite until disposal approvals are secured and the arrangements for their final disposition are finalized.

## 6.1 Personnel Decontamination

Personnel may become contaminated in a number of ways including:

- Contacting vapors, gases, mists, or particulates in the air
- Being splashed by materials while sampling open containers
- Walking through puddles of liquids or on contaminated soil
- Using contaminated instruments or equipment

Even with safeguards, contamination may occur. Harmful materials can be transferred into the clean area, exposing unprotected personnel. In removing contaminated clothing, personnel may contact contaminants on clothing or inhale them. To prevent such occurrences, decontamination procedures must be developed and established before anyone enters the site and must continue throughout site operation.

Personnel decontamination procedures will be based on the contaminants of concern and the level of protection being worn by site personnel.

## 6.2 Sampling Equipment

Sampling devices, when used onsite, require special cleaning procedures which are delineated in the chart in Section 6.7.

## 6.3 Equipment Decontamination

Heavy equipment will be decontaminated by moving the equipment to the designated decon area and brushing off the heavy contamination with a broom, etc. The equipment will then be steam cleaned with the decon waters collected for proper disposition. Following the decontamination and prior to exiting the decontamination zone, the project manager/site engineer will inspect the equipment, and if it is properly decontaminated, make note of the date, time, method, and name of decon personnel in the field notebook. The equipment will then be tagged by the project manager/site engineer using a tag containing the same information as that entered into the field log.

## 6.4 Disposal of Contaminated Materials

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be properly packaged and stored onsite until disposal arrangements are finalized. Clothing not completely decontaminated onsite should be secured in plastic bags before being removed from the site.

The proper disposal methods for the site are outlined in Table 6-1.

## 6.5 Emergency Decontamination

Personnel with medical problems or injuries may also require decontamination. There is the possibility that the decontamination may aggravate or cause more serious health effects. If prompt lifesaving, first aid, and medical treatment is required, decontamination procedures will be omitted. In either case, a member of the site management team will accompany contaminated personnel to the medical facility to advise on matters involving decontamination.

Emergency decontamination procedures for this site are discussed in the chart in Section 6.7.

## 6.6 Sanitizing of Personal Protective Equipment

Respirators, reusable protective clothing, and other personal articles not only must be decontaminated before being reused, but also sanitized. The insides of masks and clothing becomes soiled due to exhalation, body oils, and perspiration. Manufacturer's instructions should be used to sanitize the respirator masks. If practical, reusable protective clothing should be machine-washed after a thorough decontamination; otherwise it must be cleaned by hand.

## Table 6-1 Decontamination Procedures

| | |
|---|---|
| | **LEVEL A:** Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, tape removal, boot cover removal, outer glove removal, suit/hard hat removal, SCBA removal, inner glove wash, inner glove removal, field wash, re-dress. Modifications: |
| | **LEVEL B:** Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, tape removal, boot cover removal, outer glove removal, suit/safety boot wash, suit/SCBA/boot/glove rinse, (tank change), safety boot removal, splash suit removal, SCBA removal, inner glove wash, inner glove rinse, face piece removal, inner glove removal, inner clothing removal, field wash, re-dress. |
| X | **LEVEL C:** Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, boot cover removal, outer glove removal, suit/safety boot wash, suit safety boot rinse, (canister or mask change), safety boot removal, splash suit removal, inner glove wash, face piece removal, inner glove removal, inner clothing removal, field wash, re-dress. |
| X | **LEVEL D:** Segregated equipment drop, boot and glove wash, boot and glove rinse. **Modifications:** |
| X | **Sampling Equipment Decontamination:** Utilize standard decontamination procedures per RETEC's Standard Operation Procedures No. 120. |
| X | **Heavy Equipment Decontamination:** Utilize standard decontamination procedures per RETEC's Standard Operation Procedures No. 120. |
| X | **Decontamination Disposal Procedures:** Decon water will be placed into 55-gallon drums for disposal. All solids generated as a result of decontamination procedures will be drummed pending disposal. |
| | **Emergency Decontamination Equipment/Procedures:** |

# 7 Emergency Response/Contingency Plan

It is essential that site personnel be prepared in the event of an emergency. Emergencies can take many forms: illnesses/injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in weather. Table 7-1 outlines the general procedures for emergencies.

## 7.1 Emergency Contacts/Telephone Numbers

### Table 7-1 Emergency Contacts/Telephone Numbers

| | | | | |
|---|---|---|---|---|
| **Fire:** | 911 | | | |
| **Police:** | 911 | | | |
| **Ambulance:** | 911 | | | |
| Capable of Transporting Contaminated Personnel? | **Yes:** | X | **No:** | |
| **Hospital:** Brackenridge Hospital | (512) 324-7000 | | | |
| Address: | 601 E. 15th St., Austin, TX | | | |
| Chemical Trauma Capabilities? | **Yes:** | X | **No:** | |
| Decontamination Capabilities? | **Yes:** | X | **No:** | |
| Directions From Site to Hospital: | Southwest on Giles Rd. to US 290 West. Right on 290 West to I-35 South. Left on I-35 South to 15th St. Hospital is on the southwest corner of I-35 frontage road and 15th St. | | | |
| **Note:** See attached map for route to hospital.<br>The route to the hospital was verified by: Bob Crone<br>Distance from the site to the hospital is: Approx. 10 miles<br>The approximate driving time is: 25 minutes. | | | | |
| **Poison Control Center:** | 1-800-764-7661 | | | |
| **Electric Company:** City of Austin | (512) 322-9100 | | | |
| **Gas Company:** None | | | | |
| **Water Company:** City of Austin | (512) 912-6000 | | | |
| **Airport:** Austin-Bergstrom International Airport | (512) 369-6600 | | | |
| **National Response Center:** | (800) 424-8802 | | | |
| **Center for Disease Control:** | (404) 639-3311 (24-hour) | | | |
| **ATF (explosion information)** | (202) 927-8310 | | | |

| | | |
|---|---|---|
| **Chemtrec:** | (800) 424-9300 | |
| **State Environmental Agency:** TNRCC | | (512)234-1000 |
| **U.S. EPA Region Name:** Region VI | **Region Number:** | (214)665-2222 |
| **ThermoRetec Corporate Office:** | Ms. Dawn Dearborn | (978) 371-1422 |
| **ThermoRetec Personnel Office (local):** | Mr. Marwan Salameh | (512) 477-8661 |
| **ThermoRetec Corporate Health & Safety Officer:** | Mr. William A. Odenthal | (412) 826-3340 |
| **ThermoRetec Medical Consultant (Corporate)** | Health Resources | (781) 935-8581 |
| **ThermoRetec Personnel Medical Consultant (Local)** | Concentra Medical | (512) 467-7232 |
| **ThermoRetec Project Manager:** | Mr. Steve Dischler ~~Mr. Andrew Nietupski~~ | (512) 477-8661 |
| **Client Contact:** | Mr. Steve Dischler ~~Mr. Andrew Nietupski~~ | (512) 477-8661 |

## Table 7-2 Individuals Currently Certified in First Aid/CPR

| Name | First Aid Date | CPR Date |
|---|---|---|
| Paul Michalski | 2/6/99 | 2/6/99 |
| Dieter Geithner | 2/6/99 | 2/6/99 |
| Robert Crone | 2/6/99 | 2/6/99 |
| | | |
| | | |
| | | |
| | | |

## Table 7-3 Emergency Equipment Available Onsite (Check All That Apply)

| | |
|---|---|
| **Communication Equipment** | |
| | Public Telephones |
| | Private Telephones |
| X | Cellular Telephones |
| | Two-way Radio (Walkie-Talkie) |
| | Emergency Alarms/Horns |
| **Medical Equipment** | |
| X | First Aid Kits |
| | Stretcher |

| | |
|---|---|
| X | Eye Wash Station |
| | Safety Shower |
| | Blankets |
| | Other (please list): |
| | |
| | |
| **Fire Fighting Equipment** | |
| X | Fire Extinguisher Types: ABC (to be provided by subcontractor) |
| | Other: |
| **Spill/Leak Equipment** | |
| | Absorbent Boom Pads |
| | Dry Absorbent |
| **Additional Safety Equipment:** | |

## 7.2 Personnel Responsibilities During Emergencies

The project manager/site engineer, as the site administrator for the project, has primary responsibility for responding to and correcting emergency situations. The onsite project manager/site engineer will:

- Take appropriate measures to protect personnel including withdrawal from the exclusion zone, total evacuation and securing of the site, or upgrading/downgrading the level of protective clothing and respiratory protection.

- Take appropriate measures to protect the public and the environment including isolating and securing the site, preventing run-off to surface waters, and ending and/or controlling the emergency to the extent possible.

- Ensure that the appropriate federal, state, and local agencies are informed, and emergency response plans are coordinated. In the event of a fire or explosion, the local fire department should be summoned immediately. In the event of an air release of toxic materials, the local authorities should be informed in order to assess the need for

evacuation. In the event of a spill, sanitary districts and drinking water systems may need to be alerted.

- Ensure that appropriate decon treatment for exposed or injured personnel is obtained.
- Determine the cause of the incident and make recommendations to prevent recurrence.
- Ensure that all required reports have been prepared.
- If an injury has occurred, depending on the type and severity, notify RETEC's medical consultant and/or occupational physician.
- Notify RETEC's Corporate Health & Safety Officer and Human Resources Department.
- Notify the injured person's regional office.
- Prepare an Injury/Exposure Report (Appendix L) and submit the report to RETEC's Corporate Health & Safety Officer and Human Resource Department within 24 hours.
- If the incident results in one or more fatalities or hospitalization of three or more personnel, notify the local OSHA office within 8 hours.

## 7.3 Medical Emergencies

Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and, if possible, first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must be reported to the project manager/site engineer.

Any person transporting an injured/exposed person to a hospital for treatment should take directions to the hospital with them, and information on the chemicals involved. Any vehicle used to transport contaminated personnel will be cleaned or decontaminated as necessary.

## 7.4 Fire or Explosion

In the event of a fire or explosion, the local fire department should be summoned immediately. Upon their arrival the project manager/site engineer will advise the fire commander of the location and nature of the fire and the location and identification of all hazardous materials onsite.

If it is safe to do so, site personnel may use fire fighting equipment available on site or remove or isolate flammable or other hazardous materials which may contribute to the fire.

## 7.5 Spill or Leaks

In the event of a spill or leak, site personnel will locate the source of the spillage and stop the flow, if it can be done safely, and begin containment and recovery of the spilled material.

## 7.6 Evacuation Routes and Resources

Evacuation routes will be established by work area locations for the site. Evacuation should be conducted immediately, without regard for equipment, under conditions of extreme emergency. See site map (Figure 5-1) for evacuation routes.

- Evacuation notification will be a continuous blast on an air horn, vehicle horn, or by verbal communication via radio.
- Keep upwind of smoke, vapors, or spill location.
- Exit through the decontamination corridor, if possible.
- If evacuation is not via the decontamination corridor, site personnel should remove contaminated clothing once they are in a location of safety and leave the clothing near the exclusion zone or in a safe place.
- The project manager/site engineer will conduct a head count to ensure all personnel have been evacuated safely.
- In the event that a site evacuation is necessary, all personnel are to:
  - Escape the emergency situation
  - Decontaminate to the maximum extent practical
  - Meet at RETEC's command post or some other pre-arranged location

## 7.7 Near Accident

If anyone onsite witnesses a near-accident they must complete the Near-Accident Report (Appendix M) and submit it to the Corporate Health & Safety Officer within 72 hours. Near accidents are incidents that, depending on the circumstances, could have resulted in death, personal injury and/or property/equipment damage.

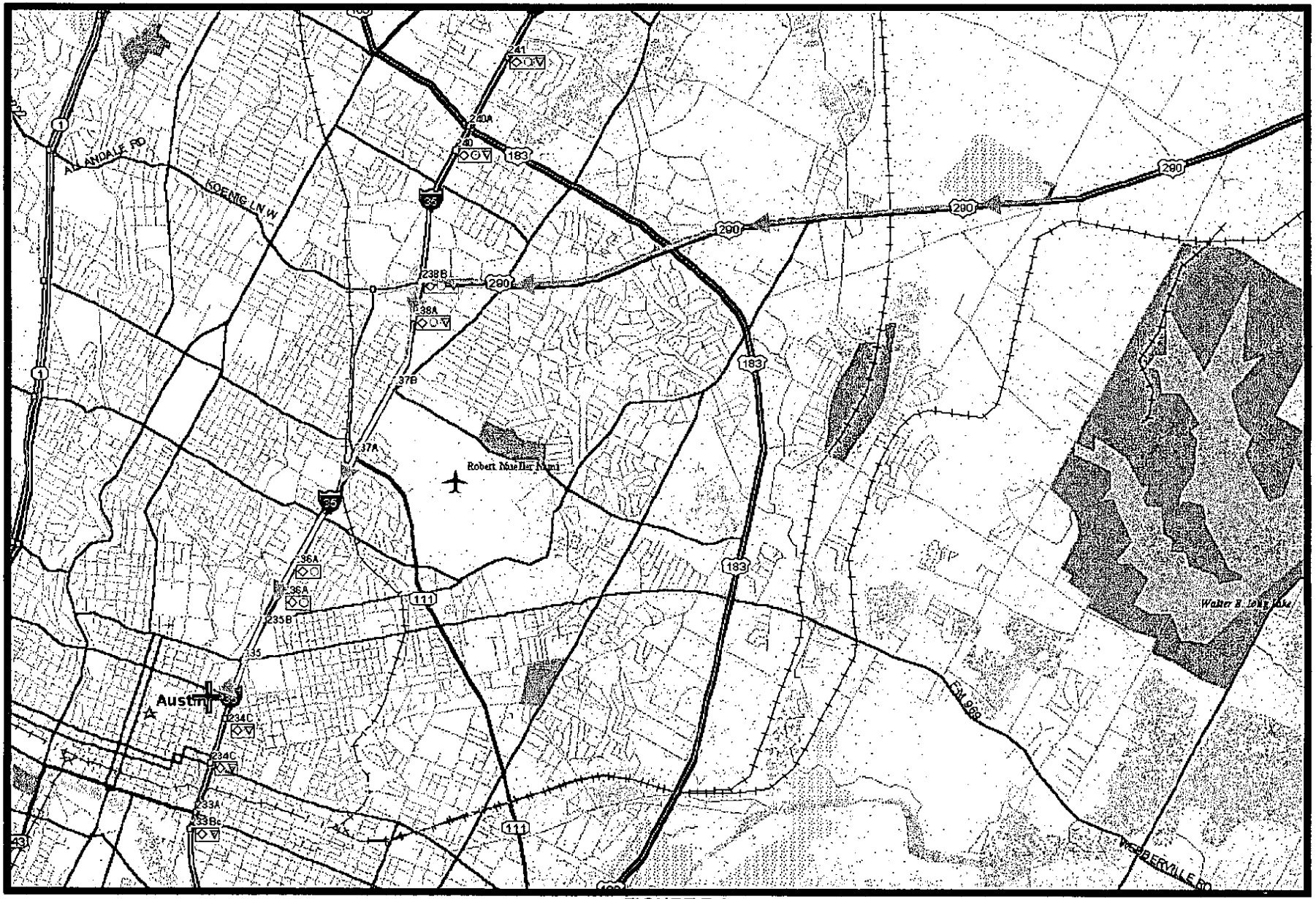



**FIGURE 7-1**
**ROUTE TO HOSPITAL**

# 8 Drum Handling/Sampling

Will this project require the handling or sampling of drummed materials?

| No: | | Yes: | X |
|---|---|---|---|

If the answer to this question is **NO** proceed to the next section. If the answer is **YES**, read this section and follow all procedures for safe drum handling and sampling.

Accidents may occur during handling of drums and other hazardous waste containers. Hazards include detonation, fires, explosions, vapor generation, and physical injury resulting from moving heavy containers by hand and working around stacked drums, heavy equipment, and deteriorated drums. OSHA regulations (29 CFR Parts 1910 and 1926) include general requirements and standards for storing, containing, and handling chemicals and containers, and for maintaining equipment used for handling materials. EPA regulations 40 CFR Part 265 stipulates requirements for types of containers, maintenance of containers and containment structures, and design and maintenance of storage areas. DOT regulations (49 CFR Parts 171 through 178) also stipulate requirements for containers and procedures for shipment of hazardous waste.

- Have a dry chemical fire extinguisher on hand to control small fires.
- Check for labels, markings, etc. and note conditions of containers. Are the drums bulging, deteriorated, or leaking?
- Before moving any drum or container, determine the most appropriate sequence in which the various containers should be moved.
- Exercise extreme caution in handling drums that are not intact or tightly sealed.
- Use the following types of equipment to move drums and/or containers: (1) drum grappler attached to a hydraulic excavator, (2) small front-end loader with a bucket sling, (3) rough terrain fork lift, or (4) drum cart.
- Train personnel in proper lifting and moving techniques to prevent back injuries.

- Have over packs ready before any attempt is made to move drums.

- Pressurized drums are extremely hazardous. If possible, do not move drums that may be under internal pressure as evidenced by bulging or swelling.

- If a pressurized drum has to be moved, handle the drum with a grappler unit constructed for explosive containment, if possible. Either move the drum only as far as necessary to allow seating on firm ground, or carefully over pack the drum.

- If a drum containing liquid cannot be moved without rupture, immediately transfer its contents to a sound drum using a pump designed for transferring the liquid.

- Unless drum contents are known, exercise extreme caution when opening drums.

- If an explosive situation exists, use non-sparking tools such as a bronze wrench.

- If a drum shows signs of swelling or bulging, relieve excess pressure prior to opening, and if possible, open using such remote devices as pneumatically operated impact wrenches, hydraulically or pneumatically operated drum piercers, or a backhoe equipped with bronze spikes for penetrating drum tops.

- **DO NOT** use picks, chisels, or firearms to open drums.

- If pressure must be released manually, place a barrier such as explosion-resistant plastic sheeting between the worker and bung to deflect any gas, liquid, or solid that may be expelled as the bung is loosened.

- Reseal open bungs and drill holes with new bungs or plugs to avoid explosions and/or vapor generation. If an open drum cannot be resealed, place the drum into an over pack. Plug any opening in pressurizing drums with pressure venting caps set for 5 psi.

- When manually sampling a drum, keep sampling personnel at a safe distance while drums are being opened. Sample only after opening operations are complete.

- Do not lean over other drums to reach the drum being sampled.

- Cover drum tops with plastic sheeting or other suitable non-chlorinated material to avoid excessive contact with drum tops.
- Never stand on drum tops.
- Obtain samples with either glass rods or vacuum pumps.

# 9 Excavation and Trenching

Will this project require any excavations or trenches greater than 4 ft. in depth?

| | | | |
|---|---|---|---|
| **No:** | X | **Yes:** | |

If excavations or trenches are required and are greater than 4 ft. in depth will personnel be required to enter the excavations and/or trenches?

| | | | |
|---|---|---|---|
| **No:** | X | **Yes:** | |

If the answer to the last questions is **NO** proceed to the next section. If the answer is **YES** OSHA's Final Rule for Excavations (29 CFR 1926 Subpart P) must be implemented, and personnel must comply with all excavation guidelines.

- Remove all surface encumbrances.
- Locate all underground installations prior to opening excavation.
- Supply means of egress so that no more than 25 feet of lateral travel is required by personnel in the excavation.
- Supply warning vests for personnel exposed to vehicular traffic.
- Utilize barricades, hand signals, or stop logs for equipment operating next to excavations and slope grade away from excavation.
- Check for hazardous atmospheres (Oxygen Deficient, Flammable, Toxic Gases).
- Protect excavation and personnel from water accumulation.
- Check stability of adjacent structures.
- Protect personnel from loose rock or soil.
- Inspect excavations and record information from the inspection in the field log book.

- Provide for fall protection (refer to Section 12 of this Plan).
- Classify soil.
- Describe in detail any protective system used for personnel protection (slopping & benching of sides, support systems or shield systems).

| **Trench Dimensions** | | | | | |
|---|---|---|---|---|---|
| | Length | | Width | | Depth |

| **Soil Classification** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Stable Rock | | A | | B | X | C |
| **Note: If soil class is unknown, assume Class C for trench/shoring design.** | | | | | | | |

| **Support System** | | |
|---|---|---|
| | Slopping or benching sides | |
| | Slope to be used based on soil class and trench dimensions | |
| | Shield system | |
| | Support system | |
| | | Upright Dimensions |
| | | Whale Dimension |
| | | Cross-Bracing Dimension |

| **Sketch of Protective System To Be Utilized** |
|---|
| |

# 10 Confined Space Entry

Confined spaces pose unique problems due to their unique contents and/or configuration. Some confined spaces, for example, pose entrapment hazards for entrants, while others restrict air circulation so that hazardous atmospheres may accumulate quickly. Confinement itself can increase the risk of injury or death by making personnel work closer to hazards than they would otherwise. OSHA considers an area to be a "Permit Required Confined Space" if it is an enclosed space which:

- Is large enough and so configured that an employee can bodily enter and perform assigned work
- Has limited or restricted means for entry and exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits and diked areas)
- Is not designed for continuous employee occupancy
- Has one or more of the following characteristics:
  - Contains or has a potential to contain a hazardous atmosphere
  - Contains a material with the potential for engulfment of an entrant
  - Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls, or a floor which slopes downward and tapers to a smaller cross-section
  - Contains any other recognized serious safety or health hazard

Does this project require personnel to enter a Permit Required Confined Space as defined above?

| | | | |
|---|---|---|---|
| **No:** | X | **Yes:** | |

If the answer is **NO**, proceed to the next section. If the answer is **YES**, OSHA regulations for Confined Space Entry (29 CFR 1910.146) must be implemented and personnel must comply with all Confined Space Entry procedures.

- Complete and submit a *Confined Space Entry Permit* to the Corporate Health and Safety Officer for approval.

- Certify that all personnel have completed the OSHA 40-hour course in Health and Safety and are current with their 8-hour refresher training.

- Certify that all personnel are enrolled in a medical surveillance program and are physically capable of performing a confined space entry.

- Certify that all personnel have successfully passed a respirator fit-test within the past year.

- Identify entrants and ensure they are properly trained and understand their duties.

- Identify attendants and ensure they are properly trained and understand their duties.

- Identify a rescue team or make arrangements with an outside agency for rescue assistance. If site personnel are assigned to a rescue team, ensure that the personnel are properly trained and are familiar with the operation, capabilities and maintenance of rescue equipment.

- Ensure that at least one member of the rescue team is current in his/her First Aid and CPR certification.

- Determine that the entry permit contains the required information before authorizing entry.

- Determine that the necessary procedures, practices, and equipment for safe entry are in effect before allowing entry.

- Determine, at appropriate intervals, that entry operations remain consistent with the terms of the entry permit, and that acceptable entry conditions are present.

- Cancel the entry authorization and terminate entry whenever acceptable conditions are not present.

- Take the necessary measures for concluding an entry operation, such as closing off a permit space and canceling the permit, once the work authorized by the permit has been completed.

- Take the appropriate measures to remove unauthorized personnel who are in or near permit spaces.

## Table 10-1 ThermoRetec Confined Space Entry Permit

| | | |
|---|---|---|
| **Client:** | **Proj. No.:** | |
| **Location:** | **Date:** | |
| **Project Manager:** | **Site Engineer:** | |
| **Site H&S Officer:** | | |
| **Location and Description of Confined Space:** | | |
| **Purpose of Entry:** | | |
| **Date of Entry:** | **Termination Date:** | |
| **Description of Hazards of the Permit Space:** | | |

**Authorized Entrants** (List Date)

| Name | Affiliation | OSHA Training Date | | | Physical Date | Respirator Fit Test Date | | SCBA |
|---|---|---|---|---|---|---|---|---|
| | | 40 Hr | Super-visor Trng. | 8 Hr | | APR HF | APR FF | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

**Authorized Attendants** (List Date)

| Name | Affiliation | OSHA Training Date | | | Physical Date | Respirator Fit Test Date | | SCBA |
|---|---|---|---|---|---|---|---|---|
| | | 40 hr | Super-visor Trng. | 8 hr | | APR HF | APR FF | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

**Rescue Team Personnel/Outside Agency**

| Name | Affiliation | OSHA Training Date | | | Physical Date | Respirator Fit Test Date | | |
|---|---|---|---|---|---|---|---|---|
| | | 40 Hr | Super-visor Trng. | 8 Hr | | APR | | SCBA |
| | | | | | | HF | FF | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

| Special Requirements | Yes | No |
|---|---|---|
| Lockout/tagout | | |
| Lines Broken-capped or Blanked | | |
| Purge-flush or Vent | | |
| Ventilation | | |
| Secure Area | | |
| SCBA or APRs | | |
| Escape Harness | | |
| Tripod Emergency Escape Harness | | |
| Lifelines | | |
| Fire Extinguishers | | |
| Lighting | | |
| Resuscitator-Inhalator | | |
| PPE | | |
| • Level A, B, C or D | | |
| • Modifications | | |
| • Communication System | | |
| • **Type:** | | |

| Tests to Be Taken | P.E.L. | Yes | No | Frequency (Times/day) |
|---|---|---|---|---|
| % Oxygen | +19.5 to 21% | | | |
| % LEL | 0 to 10% | | | |
| Benzene | 1 ppm | | | |
| Carbon Monoxide | 50 ppm | | | |
| Aromatic Hydrocarbon | 10 ppm | | | |
| | | | | |
| | | | | |
| **Note:** If any reading exceeds the PEL designated appropriated actions must be implemented before allowing anyone to enter the confined space. | | | | |
| Name of Person Conducting Monitoring: | | | | |

**Note:** Continuous/periodic tests shall be established prior to initiation of site activities. Any questions pertaining to testing, contact RETEC's Corporate H&S Officer at (412) 826-3340.

| Instruments Used | Type | Yes | No | Calibration Date/Gas |
|---|---|---|---|---|
| HNu | PID | | | |
| Photovac TIP | PID | | | |
| OVA | FID | | | |
| LEL | Explosimeter | | | |
| Oxygen Meter | % Oxygen | | | |
| Sampling Tubes | Dräger | | | NA |
| | | | | |
| | | | | |

| **Immediately Prior to Entry Conduct These Test Three Times at Five-Minute Intervals** | | | |
|---|---|---|---|
| | **Test 1 Time _____** | **Test 2 Time _____** | **Test 3 Time _____** |
| Oxygen Content | | | |
| Flammability | | | |
| Toxic Gases | | | |

| **Describe in Detail Any Ventilation Systems to Be Utilized:** |
|---|
| |
| |
| |
| |

| **Onsite Individual Responsible for Authorizing Entry:** | |
|---|---|
| NAME (Please Type): | |
| Signature: | |

| **Confined Space Entry Permit Approval:** | |
|---|---|
| NAME (Please Type): | William A. Odenthal — Corporate Health & Safety Officer |
| Signature: | |
| Date of Approval: | |
| Duration of Permit Validity: | |

# 11 Lockout/Tagout

Does this project involve the operation of machines and/or equipment in which the unexpected energization or start up of the machinery or equipment, or release of stored energy, could cause injury to personnel?

| | | | |
|---|---|---|---|
| **No:** | X | **Yes:** | |

If the answer is **NO**, proceed to the next section. If the answer is **YES**, OSHA regulations for Lockout/Tagout (29 CFR 1910.147) must be implemented and personnel must comply with all Lockout/Tagout procedures.

To assure personnel are protected from equipment accidentally operating during maintenance and servicing, OSHA requires the utilization of lockout/tagout procedures. These procedures apply to maintenance and/or servicing of equipment and not to normal operations.

These procedures apply to operations when guards are removed or bypassed, other safety devices are bypassed, or any part of the body is in a danger zone for the servicing and/or maintenance of the equipment. The procedures do not apply to cord-plug-connected equipment which is under the control of the operator.

Some of the common energy sources which require lockout/tagout procedures include, but are not limited to:

- Electrical
- Hydraulic
- Pneumatic
- Chemical
- Thermal

## 11.1 Tags

Tags are only warning devices and do not provide physical restraint. Tags **MUST NOT** be removed without authorization of the person responsible for its attachment and must never be bypassed or ignored. Tags must be legible, understandable, and used as part of the overall lockout/tagout program. Tagout devices shall warn against hazardous conditions and shall include verbage such as:

- DO NOT START
- DO NOT OPEN
- DO NOT CLOSE
- DO NOT ENERGIZE
- DO NOT OPERATE

## 11.2 Locks

Locks are used as a positive means to hold energy isolating devices in the *"safe"* or *"off"* position. Locks prevent removal without excessive force or unusual techniques such as the use of bolt cutters etc.

The lockout/tagout procedure requires the utilization of a lockout device on all energy isolating devices which can be locked out, unless it can be demonstrated that a tagout device provides the equivalent amount of protection. If tagouts are authorized, they must be placed in the same location where the lock would be placed. All lockout/tagout devices shall be singularly identified, used only for controlling energy, durable, standardized, and identifiable.

## 11.3 Procedures

- **Prepare.** Notify affected personnel that work requiring lockout/tagout will be performed.

- **Shutdown.** Turn off or shut down the equipment by following an orderly shutdown procedure.

- **Isolation.** Locate and isolate the equipment energy isolating devices. Isolate equipment from both primary and secondary power sources.

- **Lockout/Tagout.** Lockout/tagout each energy isolating device in a *"safe"* or *"off"* position. If the tagout device is utilized, affix it at the same point where the lock would be used or as close as possible to that location.

- **Stored Energy.** Assure all potentially hazardous or residual energy is relieved or otherwise made safe. Make sure the stored energy will not reaccumulate by locking a vent valve in the open position.

- **Verify.** Verify proper isolation and/or de-energization by testing the start button to ensure that the equipment will not operate. Make sure you push the **STOP** button after activating the start button.

- **Perform Work.** After lockout/tagout procedures have been implemented, execute the maintenance and/or servicing work.

- **Release.** Ensure that all non-essential items (tools, etc.) have been removed and the equipment is operationally intact. Ensure that personnel are safely positioned and affected personnel have been notified.

- **Removal.** Lockout/tagout devices must be removed only by the authorized employee who applied the devices.

- **Notification.** Notify affected personnel that the maintenance and/or servicing is complete, the lockout/tagout devices have been removed, and the equipment is released for operation.

Testing or positioning may be required for some equipment. Before removing lockout/tagout devices, clear the machine, remove personnel, remove devices, energize, and proceed with testing. After testing, de-energize and reapply the lockout/tagout procedures.

Outside personnel, such as contractors, and ThermoRetec personnel shall inform each other of their lockout/tagout procedures to assure all lockout/tagout procedures are complied with.

Some jobs may require lockout/tagout of numerous energy isolation devices. A group lockout/tagout is then used which provides equal protection. Group lockout/tagout must be under the primary responsibility of an authorized employee. Each group member must apply his/her own personal lockout/tagout device.

During shift changes, special procedures must be utilized to assure the continuity of lockout/tagout protection. There must be an orderly transfer between off-going and on-coming personnel.

# 12 Fall Protection

Does this project involve the use of any floors, platforms, and/or runways 4 ft. or more above adjacent flooring or ground level, or the use of ladders, scaffolding, or power platforms?

| | | | |
|---|---|---|---|
| **No:** | X | **Yes:** | |

If the answer is **NO**, proceed to the next section. If the answer is **YES**, OSHA regulations for Fall Protection (29 CFR 1910.21 through 29 CFR 1910.32) must be implemented and appropriate fall protection devices must be utilized.

Complete the questionnaire on the next page and ensure that all rules and regulations of this section are implemented for this project.

## Table 12-1 Fall Protection

| **Describe the Areas and Operations Onsite Where Fall Protection Will Be Required:** | |
|---|---|
| **Describe the Types of Fall Protection to Be Implemented:** | |
| **Check Type of Fall Protection Equipment to Be Utilized Onsite:** | |
| | Body Belt |
| | Chest Harness |
| | Full Body Harness |
| | Positioning Belt |
| | Rope Grab |
| | Vertical Life Line |
| | Horizontal Life Line (Static Line) |
| | Self-retracting Lifeline |
| | Lanyard |
| | Shock Absorbing Lanyard |

| | |
|---|---|
| | Locking Snap Hook |
| | Snap Hook |
| | Safety Net |
| | Non-Skid Surfaces |
| | Platforms, Walkways, or Temporary Flooring with Standard Guard Railing And Toeboard |
| | Stairs with Standard Railing |
| | Appropriate Designed Ladders |

Rules and regulations include but are not limited to the following:

**A. Floor Openings, Open Sides, etc.**

- Every stairway and ladder way floor opening must be guarded by a standard railing with standard toeboard on all exposed sides except the entrance. The entranceway to ladder way openings will be guarded to prevent a person walking directly into the opening. For infrequently used stairways, the guards may consist of a hinged cover and removable standard railing.

- Every hatchway and chute floor opening must be guarded by a hinged floor opening cover equipped with standard railings which leave only one exposed side, or a removable railing with toeboard on not more than two sides and fixed standard railing with toeboards on all other exposed sides.

- Every floor hole into which persons can accidentally walk must be guarded by either a standard railing with standard toeboard on all exposed sides, or a floor hole cover which should be hinged in place. While the cover is not in place, the floor hole must be attended or must be protected by a removable standard railing.

- Every open-sided floor, platform, or runway 4 feet or more above adjacent floor or ground level must be guarded by a standard railing with toeboard on all open sides, except where there is an open entrance to a ramp, stairway, or fixed ladder. Runways not less than 18 inches wide used exclusively for special purposes may have the railing on one side omitted where operating conditions necessitate.

- Regardless of height all open-sided floors, walkways, platforms, or runways above or adjacent to dangerous equipment must be guarded with standard railing and toeboard.

### B. Stairs, Fixed Industrial

- Every flight of stairs having four or more risers must be provided with a standard railing on all open sides. Handrails must be provided on at least one side of closed stairways, preferably on the right side descending.

- Stairs must be constructed so that rise height and tread width is uniform throughout.

- Fixed stairways must have a minimum width of 22 inches.

- Fixed stairs must be provided for access from one structure level to another where operations necessitate regular travel between levels, and for access to operating platforms at any equipment which requires attention routinely during operations. Fixed stairs must also be provided where access to elevations is daily or at each shift where such work may expose employees to harmful substances, or for which purposes the carrying of tools or equipment by hand is normally required.

- Spiral stairways must not be permitted except for special limited usage and secondary access situations where it is not practical to provide a conventional stairway.

### C. Safety Nets

- Safety nets must be provided when workplaces are more than 25 feet above the surface where the use of ladders, scaffolds, catch platforms, temporary floors, and safety lines or safety belts is impractical.

- Where nets are required, operations must not be undertaken until the net is in place and has been tested.

As a general condition, a standard toeboard and guardrail are required whenever people walk near or beneath the open sides of a platform or under similar structures or where things could fall from the structures or could fall from the structures into machinery below.

A standard guardrailing consists of a top rail and posts. The normal distance from the upper surface of the top rail to the floor, platform, runway, or ramp should be 42 inches. There must be an intermediate rail spaced approximately halfway between the top rail and the floor. All handrails and railings should be provided

with a clearance of not less than 3 inches between the handrail or railing and any other object.

A standard guardrailing can be of any configuration and construction that meets the basic dimension requirement (42 inches high with midrail), and can withstand 200 pounds applied in any direction at any point on the top rail. For wood railings, the rails and posts must be at least 2 x 4-inch stock with posts spaced not more than 6 feet apart. For pipe railings, the rails and posts must be at least 1½ inches outside diameter (OD) pipe with posts spaced not more than 8 feet apart. For structural steel rails, posts and rails must be of 2 x 2 x 3/8 inch angles or other metal shapes of equivalent strength, with posts not more than 8 feet apart.

The standard toeboard must be approximately 4- inches in height from the floor to the top edge, with no more than a 1/4-inch gap between the toeboard and the floor. The toeboard may be constructed of any solid or perforated substantial material, as long as the openings are smaller than 1-inch.

OSHA considers a platform to be any elevated surface designed or used primarily as a walking or working surface, and any other elevated surface on which employees are required or allowed to walk or work while performing assigned tasks on a predictable or regular basis. Employee activities are considered predictable and regular when the activity is performed at least one day every two weeks or a total of four man hours or more during any sequential four-week period.

If fall protection is required on a project, the following checklist should be used to check for walking and working surface problems:

- Are all places of operations kept clean and orderly?
- Are floors, aisles, and passageways kept clean and dry, and are spills cleaned up immediately?
- Are floor holes, such as drains, covered?
- Are permanent aisles appropriately marked?
- Are wet and/or greasy areas covered with non-slip materials?
- Are floor mats (rubber and wood) in good repair?
- Are signs showing floor-load capacities present?

- Are platform, storage lofts, balconies, etc. which are more than four feet above the floor protected with standard guardrails?
- Are floor holes, through which a person could fall or accidentally walk into and trip, guarded by standard guardrails and toeboards?
- Have defective ladders (e.g., with broken rungs or split side rails) been tagged as "Dangerous, Do Not Use" and removed from service for repair or destruction?
- Are stepladders equipped with a metal spreader or locking device?
- Is the use of the top of an ordinary stepladder as a step prohibited?
- Do portable ladders have non-slip bases?
- Is the distance between the centerline of rungs on a fixed ladder and the nearest permanent object in back of the ladder at least 7-inches?
- Do all fixed ladders have a preferred pitch of 75 to 90° with the horizontal?
- Do stairs have at least 7 feet overhead clearance?
- Do stairs angle no more than 50° and no less than 30° off the horizontal?

# 13 Hearing Protection

Noise is an unwanted and unpleasant sound. If the noise level gets high enough it can cause problems such as:

- making you tired from the strain of listening or talking over loud sounds;
- missing important safety or work instructions;
- reduce efficiency due to the physical and/or mental stress as a result of the loud noises; or
- partial or full hearing loss.

## 13.1 Noise Measurement

Noise is measured in two ways---loudness and pitch or frequency. Loudness is measured in decibels (dB) with special noise or sound meters. You run the risk of hearing loss if you are exposed to an average of more than 90 dB over an 8-hour work day (See Table 16-1 for Allowable Noise Exposures). Pitch or frequency is measured in hertz (Hz). High frequency shrill noises like whistles are more likely to harm your hearing than low-frequency noises from rumbling machines. Noise that is both loud and high-pitched has the worst effect on hearing, actually breaking down parts of the ear.

**Table 13-1 Allowable Noise Exposures**

| A-WEIGHT SOUND LEVEL, L (DECIBEL) | REFERENCE DURATION, T (HOUR) |
|---|---|
| 80 | 32 |
| 81 | 27.9 |
| 82 | 24.3 |
| 83 | 21.1 |
| 84 | 16.4 |
| 85 | 16 |
| 86 | 13.9 |
| 87 | 12.1 |
| 88 | 10.6 |

| A-WEIGHT SOUND LEVEL, L (DECIBEL) | REFERENCE DURATION, T (HOUR) |
|---|---|
| 89 | 9.2 |
| 90 | 8 |
| 91 | 7.0 |
| 92 | 6.1 |
| 93 | 5.3 |
| 94 | 4.6 |
| 95 | 4 |
| 96 | 3.5 |
| 97 | 3.0 |
| 98 | 2.6 |
| 99 | 2.3 |
| 100 | 2 |
| 101 | 1.7 |
| 102 | 1.5 |
| 103 | 1.3 |
| 104 | 1.1 |
| 105 | 1 |
| 106 | 0.87 |
| 107 | 0.76 |
| 108 | 0.66 |
| 109 | 0.57 |
| 110 | 0.5 |
| 111 | 0.44 |
| 112 | 0.38 |
| 113 | 0.33 |
| 114 | 0.29 |
| 115 | 0.25 |
| 116 | 0.22 |
| 117 | 0.19 |

| A-WEIGHT SOUND LEVEL, L (DECIBEL) | REFERENCE DURATION, T (HOUR) |
|---|---|
| 118 | 0.16 |
| 119 | 0.14 |
| 120 | 0.125 |
| 121 | 0.11 |
| 122 | 0.095 |
| 123 | 0.082 |
| 124 | 0.072 |
| 125 | 0.063 |
| 126 | 0.054 |
| 127 | 0.047 |
| 128 | 0.041 |
| 129 | 0.036 |
| 130 | 0.031 |

Some signs that noise could be hurting your hearing are:

- noise or ringing in your ears,
- trouble hearing people speaking,
- difficulty hearing certain high or soft sounds, like the ticking of a watch, and
- having to raise the volume on the TV or radio.

# 13.2 Types of Hearing Protection

## 13.2.1 Ear Plugs

Ear plugs seal the ear canal and prevent noise from reaching delicate parts of the ear. Some plugs come in standard sizes, others are individually moldable, while others are custom fitted to the exact shape of your ear. Ear plugs are small, portable, and comfortable in hot weather. The disadvantages of ear plugs are that they can be hard to fit, they can introduce dirt into the ear canal, and protection can vary among individuals.

**Keep All Ear Plugs Clean And Always Wash Hands Before Inserting Ear Plug Into The Ear.**

### 13.2.2 Canal Caps

Canal caps are a soft pad on a headband. The caps seal the entrance to the ear canal without actually entering it. A snug fit is essential. Canal caps are comfortable, cool, and lightweight. A potential problem is that they don't always effectively seal the ear canal. It should be noted that a number of facilities do not allow the use of canal caps.

### 13.2.3 Ear Muffs

Ear muffs have three basic parts a headband, ear cups, and ear cushions. To be effective, the ear cups must fit snugly. Ear muffs, if fitted properly, usually provide the greatest protection, and one size usually fits everyone. Disadvantages are their bulk and discomfort in hot weather.

### 13.2.4 Multiple Hearing Protectors

OSHA says that hearing protectors must reduce noise to 90 dB. In order to accomplish this reduction, it may possibly require that an individual wear two types of hearing protectors simultaneously.

## 13.3 Selection of Protection

The most convenient method by which to gauge the adequacy of a hearing protector's attenuation is by checking its noise reduction rating (NRR). The NRR was developed by the EPA. According to the EPA regulation the NRR must be printed on the hearing protector package. The NRR is then correlated with an individual's noise environment to assess the adequacy of the attention characteristics of a particular hearing devise. The NRR basically indicates how much protection a type of hearing protection will provide.

Sound is measured with a sound level meter which measures sound pressure variations in the air. The instrument does this on one of three weighing networks "A", "B" or "C". The A network was designed to approximate the equal loudness curves at low sound pressure levels. The B-network was designed for medium levels and the C-network was designed for high sound presser levels.

The weighing networks are the sound level meter's means of responding to some frequencies more than other. The very low frequencies are discriminated against (attenuated) quite severely by the A-network, moderately filtered by the B-network, and hardly attenuated at all by the C-network.

The A-weighted sound level measurement has become popular in assessment of the overall noise hazard since the level is thought to provide a rating of industrial

broad band noises that indicates the injurious effects such noise has on the human ear. Basically the A-network reads the noise level the way the human ear processes sound.

Unfortunately the NRR assigned to various hearing protection devices was assigned using the C-network and for this reason it is necessary to subtract 7 from the NRR to realize the effective NRR. For example, if a set of ear plugs has an NRR of 29 the effective noise reduction that can be expected if worn and fitted properly, is 29-7 or 22 decibels. To find the effective NRR of any hearing protection you must subtract 7 from the NRR stated on the particular device.

It is also important to note that if the actual noise levels are >100 dBA you must determine the effective NRR by subtracting 7 from the NRR and then divide by two. For example in an area where noise levels are >100 dBA the effective NRR of a hearing protection devise with a NRR of 29 would be (29-7)/2 or 11 dBA.

# 14 Drilling Safety

Will this project require the use of a drill rig for well installation and/or subsurface sampling?

| | | | |
|---|---|---|---|
| **No:** | | **Yes:** | X |

If the answer to this question is **NO** proceed to the next section. If the answer is **YES**, read this section and follow all procedures for safe work practices around a drill rig.

**Note: Site Engineer or Site Safety and Health Officer (SSHO) must complete the Drill Rig Inspection Log in Appendix L prior to the initiation of any drilling operations.**

Accidents may occur during drilling activities. Hazards include heavy machinery, heavy falling objects, slip/trip fall, and potential flying debris. It is the site Engineer/SSHO responsibility to ensure drilling activities are conducted safely. During the site safety meeting, the site Engineer/SSHO should check that all members of the drill crew meet the following training requirements:

- 40 Hour OSHA Training
- 8 Hour Annual Refresher Training
- Drill Rig/Training/Safe Operating Practices
- First Aid/CPR
- Emergency Procedures
- Emergency Phone Numbers Posted
- Site Orientation
- Health and Safety Plan Review

Every drill crew should have designated safety supervisor who has authority to enforce safety on the drilling site.

Prior to the commencement of any drilling activities the Site Engineer/SSHO must ensure the following:

**PPE**

- All drilling crew members are wearing appropriate PPE, including at a minimum hard hat, safety shoes/boots, appropriate gloves, safety glasses, and any other PPE that may be required on a particular site.

- Clothing of drilling crew is close fitting without loose ends, straps, draw strings, belts and other unfastened parts.

### Housekeeping

- Suitable storage for tools, materials and supplies.
- Pipes, drill rods, casings, augers, and other drilling tools are properly placed in racks or sills to prevent rolling and/or sliding.
- Penetration or other driving hammers are placed at a safe location on the ground and secure from moving.
- Work area, platforms, walkways, scaffolding and other access ways are free of materials, debris, obstructions, and substances.
- All controls and control linkages, warning and operation lights and lenses are free of oil and grease and/or ice.
- Gasoline is stored only in non-sparking red containers with a flame arrester in the fill spout and the word "gasoline" easily visible.

### Maintenance

- The drill rig engine is shut down to make repairs or adjustments. Follow lockout/tagout procedures.
- Wheels are blocked and leveling jacks are lowered and hand breaks set before working under a drill rig.
- All pressure on hydraulics, fluid and air systems, as appropriate is released prior to performing maintenance.
- Personnel do not touch engine or exhaust systems immediately after a drilling operation.
- Personnel never climb the mast for maintenance or repairs.
- Personnel never weld or cut near fuel tank.
- Drill rig is kept well maintained with appropriate quantities and qualities of lubricants, hydraulic oils, etc.

- Filter plugs, guards, high pressure hose clamps, and chains and cables are replaced that have been removed for maintenance.

### Hand Tools

- All hand tools are kept in good condition.
- All damaged tools are either repaired or replaced immediately.
- Personnel must use the right tool for the right job.

### Clear Work Area

- The site is adequately cleared and leveled prior to drilling to accommodate drill rig and supplies.

### Drilling Operations

- Drill rig it not to be driven from hole to hole with derrick in raised position.
- Personnel must check for overhead obstruction before raising the derrick.
- Drill rig is leveled and stabilized with leveling jacks and/or sold cribbing before derrick is raised.
- Derrick is locked before initiating operations.
- Personnel only operate drill rig from position of controls.
- Exhaust fumes are conducted out of area if drilling in a confined or enclosed area.
- Personnel clean mud and grease from boots before stepping onto drill rig platform and they use hand holds and railings.
- Personnel do not touch any metal parts with exposed flesh during freezing weather.
- All unattended boreholes are adequately covered.
- All operations are terminated during electrical storms.

- Personnel working on an elevated derrick platform must wear appropriate fall protection and attach the lifeline to the derrick just above the derrick platform to a sold structural derrick.

- All tools are attached to derrick with safety lines.

- While working on a derrick platform never guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or traveling block.

- Loose tools are never left on derrick platform.

- Personnel must use appropriate lifting techniques to prevent bodily injury.

### Overhead and Buried Utilities

- All overhead and buried utilities are identified and located and noted on all boring location plans and boring assignment sheets.

### Suppling Power to Job Site

- All wiring and fixtures used to provided electricity for drilling operations are installed by a qualified person in accordance with the National Electric Code (NFPA 70-1984) with consideration with the American Petroleum Institutes recommended practices for electrical installation for production facilities (API-RP-500 B).

### Contact with Electricity

- If a drilling rig or a drill rig carrier makes contact with overhead or underground electrical wiring that the operator and the person in the seat of the vehicle remain seated and not leave the vehicle and not touch any part of the vehicle or drill rig.

- If personnel must evacuate the drill rig they must jump clear, as far as possible, and land with both feet together and then hop from the scene.

### Safety Operating Practices

- There exist a system of responsibility between the operator and the tool handler when connecting and disconnecting auger sections.

- Handler stands away from rotating auger when connecting and disconnecting auger sections.
- A pin is inserted and tapped in place, using a hammer or similar device, when securing the augur to a power coupling.
- A tool hoist is used when lowering second section of auger into place.
- Both operators stand clear of auger as it is being lifted into place.
- Long handled shovels are used to move dirt away from auger.

No attempt shall be made to exceed manufactures ratings of speed, force, torque, pressure, flow, etc. The drill rig and tools are to be used only for the purposes for which they are intended and designed.

# 15 Vehicle Safety

This part of the Corporate Health and Safety Manual provides safety requirements for the use of motor vehicles and various types of machinery and equipment used in construction including earth moving equipment, excavating equipment, pile driving equipment, and equipment use for site clearing. This applies to equipment that is motorized or self propelled. Motor vehicles include any vehicles that operate within an off highway job site that is not open to public traffic.

## 15.1 Motor Vehicles

Motor vehicles covered by this section are vehicles that operate within an off highway job site that is not open to public traffic. Vehicles that are used both on and off the highway are covered by this section. Material handling equipment including the following equipment is excluded:

- Scrapers
- Loaders
- Crawler or Wheel Tractors
- Bulldozers
- Off highway trucks
- Graders
- Agricultural and Industrial Tractors
- Excavating Equipment
- Lift Trucks and Stackers

## 15.2 Required Safety Devices

Motor vehicles under this section must have the following safety devices in operable condition.

- Brakes
- Lights
- Audible Warning Devices
- Windshields and Power Wipers
- Cab Shields
- Seatbelts
- Fenders

## 15.3 Miscellaneous Requirements

Tools that are transported in the same compartment as employees must be secured to prevent movement. Also, any vehicle used to transport employees must have an adequate number of seats and the seats must be firmly secured.

## 15.4 Special Requirements for Dump Trucks

There are several additional safety standards for vehicles with dump bodies and devices. These standards are designed to prevent the accidental lowering or starting of these devices. Trucks with dump bodies must have a support mechanism that is permanently attached and can be locked in position. Operating levers that control hoisting or dumping devices on haulage bodies must have a latch or other devices that prevents accidental starting or tripping of the mechanism. Also, trip handles for tailgates must be arranged so that operator will be in the clear when dumping.

## 15.5 Pre-Safety Check

You must check, at the beginning of each shift, the following parts, equipment and accessories of vehicles that are being used in order to determine that they are in safe operating condition and free of apparent damage that could cause failure while in use. Any defect must be corrected before the vehicle is placed in service.

- Service breaks, including trailer break connections
- Parking system (Hand Brakes)
- Emergency Brakes
- Tires
- Horn
- Steering Mechanism
- Coupling Devices
- Seatbelts
- Operating Controls
- Safety Devices
- Lights
- Reflectors
- Windshield Wipers
- Defrosters
- Fire Extinguishers

# 15.6 Mechanized Equipment

## 15.6.1 General Requirements

The following general safety standards apply to all mechanized equipment used in construction. This regulation is directed at equipment that is motorized or self-propelled. There are additional requirements for specific types of equipment including earth moving equipment, excavating equipment and pile driving equipment. These requirements are discussed below.

### 15.6.1.1 General Safety Requirements

Equipment used in construction under this section must have the following safety devices and the following safety procedures must be followed:

- Lights or reflectors, or barricades with lights or reflectors are required for equipment that is left unattended at night, is adjacent to a highway, or is located in a construction area where work is in progress.

- A safety tire rack, cage or equivalent protection is required when inflating, mounting or dismounting tires installed on split rims, or rims equipped with locking rims or similar devices.

- Before employees may work under or between equipment that is suspended or held aloft by slings, jacks, or hoists, it must be blocked or cribbed to prevent falling or shifting. Bulldozers and scraper blades, end loader buckets, dump bodies and any other similar equipment must also be blocked or fully lowered when not in use or when it is being repaired. Additionally, the controls should be in neutral, the motors stopped, and the brakes set, unless the work being performed requires otherwise. The parking brake must be on when the equipment is parked. If the equipment is parked on an incline, then wheels must also be chalked. The standard that the wheels be chalked applies only to mechanically self-propelled equipment.

- Cab glass must be safety glass, or its equivalent which produces no visible distortion.

### 15.6.1.2 Material Handling Equipment

Material handling equipment includes earth moving equipment, excavating equipment and lifting and hauling equipment.

#### 15.6.1.2.1 Earth Moving Equipment

Earth moving equipment includes but is not limited to scrapers, loaders, crawlers or wheel tractors, bulldozers, off highway trucks, graders and agriculture and industrial tractors. The following standards apply to earth moving equipment:

- Seatbelts meeting the requirements of the Society of Automotive Engineers are required for all earth moving equipment except those designed for stand up operation only, or for equipment that does not have a roll over protective structure or adequate canopy protection.

- There must be a service brake system that could stop and hold equipment fully loaded, as specified by the Society of Automotive Engineers. Self-propelled rubber-tired off highway equipment manufactured after January 1, 1972 must have brake systems that meet the standards set forth by the Society of Automotive Engineers recommended practices.

- Fenders, meeting the standards of the Society of Automotive Engineers, are required on all wheels of pneumatic tired earth haulage equipment whose maximum speeds exceed 15 mph. Pneumatic tired earth haulage equipment for purposes of this fender requirement includes trucks, scrapers, tractors and trailing units.

- Rollers, compactors, front-end loaders, bulldozers and other bidirectional machines must have a horn that can be operated on an as needed basis when the machine is moving in either direction. The horn must be distinguishable from the surrounding noise level and must be in operating order. Any earth moving equipment that is used in reverse, and has an obstructed rear view, must have a reverse signal alarm that is distinguishable from the surrounding noise level or an employee signaling that it is safe to go in reverse.

- Front-end loaders with scissor points that are of a hazard to the operator when in use must be guarded. This equipment can only be moved on access roadways and grades that are constructed and maintained to safely accommodate the movement of these vehicles and equipment. In addition, emergency access ramps and berms must be constructed to restrain and control runaway vehicles.

#### 15.6.1.2.2 Excavating Equipment

Crawler or wheel tractors and agricultural and industrial tractors must have seatbelts for the operators on the operators seat. Seatbelts are required even though the tractors are equipped with attachments such as backhoes or beakers that are used for excavating or other work.

#### 15.6.1.2.3 Lifting and Hauling Equipment

Lifting and hauling equipment, for the purpose of this section, includes lifting and hauling equipment, such as industrial trucks. All industrial trucks must meet the applicable requirements of design, construction, stability, inspection, testing and maintenance operations as provided in the American National Standards Institute Safety Standards for Powered Industrial Trucks. In addition to the general safety requirements applicable to all equipment, industrial trucks with lifting and hauling equipment must also meet the following requirements:

- **Rate Capacity Posting**. Rate capacity must be posted on the vehicle so that it is clearly visible to the operator. All rated capacities must also be posted on equipment that have removable counter weights that are provided by the manufacturer. The manufacturer's written approval is required for any modifications or additions that affect the capacity or safe operation of the equipment. However, the original safety factor may not be reduced. If any modification or changes are made, the changes must be reflected in a capacity, operation, and maintenance instruction plates, tags, or decals. The rate capacity can not be exceeded. Where a load is lifted together by two or more trucks working in unison, then the total load is proportioned and the total load carried by any one truck can not exceed that truck capacity.

- **Steering Knob**. Only steering or spinner knobs that prevent road reactions from causing the steering wheel to spine can be attached to the steering wheel. The steering knob must be mounted within the periphery of the wheel.

- **Overhead Guard**. High lift rider industrial trucks must be equipped with overhead guards. These guards must meet the requirements of the American National Standards Institutes, Safety Standards for Powered Industrial Trucks.

- **Riding On Trucks**. Where riding of trucks is authorized, you must provide a safe place to ride. Unauthorized personnel can not ride on powered industrial trucks.

- **Lifting Carriages or Forks for Lifting Personnel**. In addition to the general safety standards for lifting and hauling equipment, the following additional requirements apply to trucks equipped with vertical only, or vertical and horizontal controls elevatable with the lifting carriages or forks for lifting personnel.

- A safety platform firmly secured to the lifting carriage and/or fork must be used.

- Personnel on the platform must be able to turn off power to the truck.

- Personnel must provide protection from falling objects as operating conditions make it a necessity.

## 15.7 Site Clearing

- Employees engaged in site clearing must be protected from irritants and toxic plants, and be instructed in available first aid treatment.

- Equipment used in site clearing must be equipped with roll over guards that meet the safety requirements for roll over guards. Rider operator equipment must also be equipped with an overhead and rear canopy guards meeting the following requirements:

  - The overhead covering on the canopy structure must be at least 1/8" steel plate or 1/4" woven wire with openings no greater than 1", and

  - Openings in the rear of the canopy structure must be covered with at least 1/4" woven wire mesh with openings no greater than 1".

# 16 Sampling

Sampling is the physical collection of a representative portion of a universe (or environment). A representative sample must be collected and handled in such a fashion as to preserve its original physical form and chemical composition, as well as to prevent contamination or changes in concentration of the materials to be analyzed. It is imperative to ensure sample integrity and maintain quality assurance standards for a sample to be "typical" of the larger body of the material of concern.

Samples are taken to accomplish different objectives. In many cases they are taken to determine compliance with existing regulations or to obtain data to classify, treat, recover, recycle, or determine compatibility characteristics of the material in question. It is important to determine the specific purpose of the collecting of the sample since this will dictate many of the subsequent choices of methodology, sampling sites, types and numbers of samples required, proper sample containers, etc.

## 16.1 Classes of Samples

There are two classes of samples:

- **Environmental** - samples considered to contain no contaminants or low concentration of contaminants.

- **Hazardous** - samples considered to contain high concentration of contaminants.

Any sample thought to contain enough hazardous materials to pose a safety threat should be designated as hazardous and handled to ensure personnel safety. Hazardous samples when shipped must meet all Department of Transportation (DOT) regulations.

## 16.2 Collection Methods

Representative samples of hazardous materials can be collected one of two ways:

- **Grab** - a discrete sample that is collected at one specific time. Usually, this is considered representative of one specific site at one specific time. However, if the source is fairly consistent over a period of time and/or

geographic area, then the sample can be considered representative of that time or area.

- **Composite** - a nondiscrete sample composed of more than one specific sample collected at various sampling sites or times and/or mixed and treated as one. Composite samples may give an average concentration or composition and may be an alternative to analyzing numerous grab samples and then calculating a statistical average. If the constituents or concentrations can change significantly due to collection, transport or storage, composites cannot be used.

When collecting hazardous samples it is advisable to collect only grab samples. Composting samples pose a safety risk if it involves samples of unknown hazardous content.

## 16.3 Types of Samples

Sampling sites are influenced by the objectives of the study. Exact locations should be chosen considering factors that can influence the concentrations of the materials of concern. Judgement sampling should be used first. Judgement sampling relies on experience and available information to determine the spots which will provide the most representative sample. Random sampling depends on the theory of random chance probabilities in order to choose the most representative sample. This process is utilized when numerous sampling locations are available but there is no satisfactory reason for choosing one over another. Random sampling will usually be used only at dump sites involving drums of unknown content.

When gathering evidence for possible legal actions, multiple samples must be collected to maintain an adequate quality assurance program:

- **Duplicate Samples** - duplicate or multiple samples are essentially identical and must be collected at the same time, at exactly the same location, with the same apparatus and into identical containers prepared the same way, and filled to the same volume.

- **Split Samples** - portions of a sample or a duplicate sample can be analyzed by another accepted analytical technique or another qualified laboratory in order to verify the original results.

- **Spiked Samples** - known amount of the contaminant is added to a sample at concentrations where the test method is accurate. Hazardous samples should be spiked only in the laboratory.

- **Reproducibility Check** - a duplicate sample is analyzed using the same procedure and instrument employed in the original analysis. This verifies reproducibility of data over a period of time.

- **Sample Blank** - a sample of distilled deionized, contaminant free water that is collected, containerized, treated (if used), and handled in the same manner as the samples. This can be an indicator of sample contamination throughout the entire process.

## 16.4 Equipment

Equipment use to collect hazardous samples should be:

- disposable or easily decontaminated.,
- inexpensive, especially for disposable items,
- easy to operate,
- nonreactive, so that it does not contaminate the samples, and
- safe to use.

### 16.4.1 Selection of Samplers/Containers

Hazardous wastes are usually complex mixtures of semi-solid, liquids or solids. The liquid and semisolid mixtures vary greatly in viscosity, corrosivity, volatility, explosiveness, and flammability. The solid wastes can range from powders to granulates to big lumps.

The wastes are contained in drums, barrels, sacks, bins, tanker trucks, vacuum trucks, ponds, and other containers. No single type of sampler can collect representative samples of all types of waste, so a number are commonly employed.

Sample containers will also vary according to the materials being sampled. If little or nothing is known about the sample, use glass bottles with Teflon lined caps.

### 16.4.2 Sampling Technique

Another important factor is use of the same technique for sampling. The same member of the work party should collect all the samples of a particular type (member A collects all drum samples, member B collects all soil samples, member C collects all stream samples, etc.). These practices ensure that data obtained from sample analysis are representative of the waste sampled and not a result of erratic sampling techniques. (See Table 16-1)

## Table 16-1 Samplers for Liquids/Solid Hazardous Materials

| Category | Sampler |
|---|---|
| Liquids, Sludges, Slurries | Open tube<br>Pond sampler<br>Manual hand pump<br>Weighted bottle sampler<br>Kemmer sampler<br>Extended bottle sampler |
| Powdered or granular solids | Grain sampler<br>Sampling trier<br>Trowel/scoop/spoon<br>Waste pile sampler |
| Soil | Soil auger |

### Sample Containers and Closures*

| Category | Recommended Container | Recommended Closure |
|---|---|---|
| Metals, inorganics, weak acids/bases | Glass or Plastic | Plastic caps with plastic or Teflon liner |
| Organic solvents, hydrocarbons, chlorinated hydrocarbons | Glass | Plastic caps with Teflon liner |
| Photosensitive materials | Amber plastic or glass | Plastic caps with plastic or Teflon liner |
| Strong acids/bases | Glass | Plastic caps with Teflon liner |
| Hydrofluoric acid, phosphoric acid | Plastic | Plastic caps with plastic liner |

*For more specific applications refer to Standard Methods for the Examination of Water and Wastewater of the US EPA Methods for Chemical Analysis of Water and Wastes.

## 16.4.3 Documentation

All information pertinent to field activities will be recorded in various forms: logbooks, sample tags, photographs, etc. Proper documentation and documentation control are crucial to enforcement actions, since cases in a formal hearing or criminal prosecution often hinges on evidence gathered by the site entry team. Therefore, each field worker must keep detailed records of

inspections, investigations, photographs, and thoroughly review all notes before leaving the site.

The purpose of document control is to ensure that all documents for a specific project are accounted for when the project is completed. Accountable documents include items such as logbooks, field data records, correspondence, sample tags, graphs, chain-of-custody records, analytical records, and photographs. Each document should bear a serial number and should be listed, with the number, in a project document inventory assembled at the project's completion. Waterproof ink must be used in recording all data in documents bearing serial numbers.

A documentation coordinator (DC), appointed by the project leader, numbers all logbooks, sample tags, graphs, chain-of-custody records, etc. In a logbook, the DC records transfer of other logbooks to individuals who have been designated to perform specific tasks on the project. All project logbooks are to be turned over to the DC at the completion of each work period, and to a central file at the completion of the field activity.

Accountable documents include such items as logbooks, field data records, analytical records, and photographs. Each document should bear a serial number and should be listed, with the number, in a project inventory assembled at the project's completion. Waterproof ink must be used in recording all data in serial bearing documents.

Samples should be analyzed as soon as possible after collection for best results. Hazardous wastes are such complex mixtures that it is difficult to predict exactly the physical, biological, and chemical changes that occur in the samples. In a number of cases, these changes can be slowed down or prevented by refrigeration at 4-6°C.

At times, samples may have to be transported to a separate location for analysis. Samples must be transported so as to protect their integrity, as well as to protect against any detrimental effects from the samples leaking or breaking. Regulations for packaging, marking, labeling, and shipping hazardous materials and wastes are promulgated by the DOT and described in the Code of Federal Regulations (49 CFR), in particular 172.402(h). The EPA has deemed it prudent to package, mark, label, and ship samples observing DOT procedures.

Samples should be classified as either environmental or hazardous material samples. A distinction must be made between the two types of samples in order to determine the appropriate procedure for transportation of the sample, and to protect the health and safety of laboratory personnel receiving the sample.

Special precautions are used at laboratories when samples other than environmental samples are received.

Sample tags should be used as a means for identifying and recording the sample and the pertinent information about the sample. The sample tag should be legibly written and completed with an indelible pencil or waterproof ink. The information should also be recorded in a log book. The tag should be firmly affixed to the sample container and at a minimum should include the following:

- Exact location of sample.
- Time and date sample was collected.
- Name of sampler and witnesses (if necessary).
- Project codes, sample station number and identifying code (if applicable).
- Type of sample.
- Hazardous substance or environmental sample.
- Tag number (if sequential tag system is used).
- Laboratory number (if applicable).
- Any other pertinent information.

## 16.4.4 Samplers

The various samplers currently available can be applied in certain situations, but they have limitations that must be recognized.

### 16.4.4.1 Liquids

#### 16.4.4.1a Open-Tube/Drum Sampler

A glass open-tube is the most versatile of hazardous liquid samplers because of its wide range of applications, relatively low cost, and ease of operation.

**Description:** The open-tube sampler is made of shallow glass (or plastic tubing), usually 4 feet (ft.) long. The inside diameter (I.D.) is generally ¼ - ½ inch depending on viscosity of sample. Open tubes made specifically for sampling (called drum samplers) can be purchased. The only difference is that drum samplers have a constricted orifice at the top to facilitate plugging the opening to maintain a vacuum in the tube.

**Procedure for Use:**

- Slowly lower tube into the liquid to the desired depth. It may be desirable not to mix the contents of the container so that a more representative sample can be collected.

- At desired depth, stopper tube with a rubber stopper or thumb or crease a piece of flexible tubing attached to the open end of the sample tube. Stopper establishes a vacuum in the tube, enabling withdrawal of the sample from the container.

- Slowly withdraw tube from vessel and expel sample into appropriate sample container. Avoid handling the portion of sampler that was in the liquid.

- Dispose of tube on site by placing it back into the container that was sampled.

**16.4.4.1b Composite Liquid Waste Sampler (COLIWASA).**

The composite liquid waste sampler (COLIWASA) is a valuable tool in some applications. In sampling hazardous liquids, however, it is difficult to decontaminate and may cause cross-contamination.

**Description:** The main parts of the COLIWASA are sampling tube, closure-locking mechanism, and closure system. The sampling tube consists of 5 ft. x 1 5/8 in I.D. translucent pipe usually polyvinyl chloride (PVC) or borosilicate glass plumbing tube. The closure-locking mechanism consists of short-length, channel aluminum bar attached to the sampler's stopper rod by an adjustable swivel. An aluminum bar serves both as a T-handle and lock for the sampler's closure system.

**Procedure for Use:**

- Put sampler in open position by placing stopper rod handle in T-position and pushing rod handle until it sits against sampler's locking block.

- Slowly lower sampler into liquid so that liquid inside and outside the tube are about the same. If the level inside the sampler tube is lower than outside sampler, sampling rate is too fast, resulting in a nonrepresentative sample.

- When sampler stopper hits bottom of waste container, push the tube downward against stopper to close sampler. Lock sampler in close position by turning T-handle until it is upright and one end rests tightly on locking block.

- Slowly withdraw the sampler from container.

- Carefully discharge sample into a suitable sample container by opening sampler. This is done by slowly pulling lower end of T-handle away from locking block, while lower end of sampler is positioned in a sample container.

### 16.4.4.1c Pond (Dip) Sampler

The pond (dip) sampler can be used to collect liquids or sludges from ponds, pits, lagoons, or open vessels, but only as far as its limited reach.

**Description:** The pond (dip) sampler consists of a container in an adjustable clamp attached to the end of a telescoping pole 8-16 ft. long . The pole can be of wood, plastic, or metal because the sample is collected in a jar or beaker which is secured in the clamp.

**Procedure for Use:** Ladle liquids from sampler into sample containers.

### 16.4.4.1d Manual Pumps

The principal drawback of manual pumps is that they require large amounts of disposable tubing, which must be compatible with the waste being sampled.

Description: Manual pumps most commonly operate by peristalsis, bellows, diaphragm or siphon. They are available in various sizes and configurations.

**Procedure for Use:** Operate according to manufacturer's instructions. In most cases this involves placing sample inlet hose into liquid, then manually activating a crank or bellows. To avoid contamination of the pump, a liquid trap is inserted in the sample inlet hose where the sample is collected. The compatibility of the plastic inlet hose with the sample must be determined to avoid sample contamination.

### 16.4.4.1e Weight Bottle Sampler

Weighted bottle samplers are difficult to use in very viscous liquids. In addition, the outside of the bottle is exposed to the waste. This is undesirable if the bottle is used as the sample container.

**Description:** The weighted bottle sampler consists of a glass sinker, a bottle stopper, and a line for opening the bottle and lowering and raising the sampler during sampling. There are variations of this sampler, as illustrated in the

American Society of Testing Materials (ASTM) methods D 270 and E 300. This sampler can be either fabricated or purchased.

**Procedure for Use:**

- Gently lower sampler into liquid to desired depth so as not to remove stopper prematurely.
- Pull out stopper with a sharp jerk of sampler line.
- Allow bottle to fill completely until air bubbles stop.
- Raise sampler and cap bottle.
- Wipe bottle, which can be used as sampler container.

Alternative to the weighted bottle sampler are the Kemmer sampler and the extended bottle sampler.

## Table 16-2 Samplers for Hazardous Materials

| SAMPLER | APPLICATIONS | LIMITATIONS | SUPPLIERS |
|---|---|---|---|
| Open-tube/COLIWASA | Liquids, Slurries | Not for containers over 1.5 meters (m.) (5 ft.) deep | Open-tube: Laboratory supply houses |
| Plastic | | Not for materials containing ketones, nitrobenzene, dimethylformamide, mesityl oxide, tetrahydrofuran, or many common solvents such as acetone | COLIWSA: Nasco, 901 Janesville Avenue, Fort Atkinson, WI 53538 |
| Glass | | Not for materials containing hydrofluoric acid and concentrated alkali solutions<br>COLIWASA may be difficult to decontaminate and may cause cross-contamination of samples | |
| Pond (dip) sampler | Liquids, Sludges | Not for sampling beyond 3.5 m (11.5 ft.) | Fabricate. Clamps available Cole-Palmer Instrument Co. 7425 N. Oak Park Avenue Chicago, IL 60648 |
| Manual pump | Liquids | Requires large amounts of disposable tubing that must be compatible with material | Local hardware stores and/or laboratory supplies houses |
| Weighted bottle samplers | Liquids | Difficult to use with very viscous liquids. Exterior of sample bottle exposed to hazardous materials | Fabricate |
| Extended bottle sampler | Liquids | Difficult to use with very viscous liquids. Exterior of sample bottle exposed to hazardous materials | Ace Glass Company Vineland, NJ 08360 |
| Kemmere Sampler | Liquids | Must be compatible with sample | Laboratory supply houses |
| Train sampler | Granular solid | Limited application for sampling moist and sticky solids with a diameter of 0.6 cm (¼ inc.) | Laboratory supply house |
| Sampling trier | Solids | Possible difficulty in retaining core sample of very dry granular materials during sampling | Laboratory supply house |
| Trowel/scoop/spoon | Solids, soil surface | Not for sampling deeper than 8 cm (3 in.).<br>Difficult to obtain reproducible mass of samples | Laboratory supply house |

| SAMPLER | APPLICATIONS | LIMITATIONS | SUPPLIERS |
|---|---|---|---|
| Waste pile | Loose solids | Not for sampling solid wastes with dimensions greater than half the diameter of the sampling tube | Fabricate from pipe |
| Soil auger (manual) | Soil deeper than 102-106 cm (3-4 inc.) | Does not collect undisturbed core sample | Weyco Distribution, Sacramento, CA |

## 16.4.4.2 Solids

### 16.4.4.2a Grain Sampler

Grain samplers are best used for collecting granular or loose solids. Moist, compressed, and large particle solids are difficult to collect.

**Description:** The grain sampler consists of two slotted telescoping tubes, usually made of brass or stainless steel. The outer tube has a conical, pointed tip on one end that permits the sampler to penetrate the material being sampled. The sampler is opened and closed by rotating the inner tube. Grain samplers are generally 24 to 40 inches long by ½ to 1½ inches in diameter.

**Procedure for Use:**

- Insert sampler (in the close position) into material being sampled from a point near a top edge or corner, through the center, and to a point diagonally opposite point of entry.
- Rotate inner tube into open position.
- Wiggle sampler a few times to allow materials to enter open slits.
- Place sampler in close position and withdraw.
- Place sampler in a horizontal position, if possible, with slots facing upward.
- Rotate and slide out outer tube from the inner tube.
- Transfer sample in inner tube into a suitable sample container. If inner tube is not removable, turn sampler upside down and pour contents out of an opening in end of the tube.
- Store sampler in a plastic bag until decontamination.

### 16.4.4.2b Sampling Trier

Sampling triers are used to sample compressed solids. One difficulty, however, is the removal of the core sample cut with the trier.

**Description:** A typical sampling trier is a long tube about 24 to 40 inches long and ½ to 1 inch in diameter, with a slot that extends almost its entire length. The tip and edges of the tube slot are sharpened to allow the trier to cut a core when rotated in a solid material.

Sampling triers are usually made of stainless steel with wooden handles.

**Procedure for Use:**

- Insert trier into solid material at 0 to 45° angle from horizontal to minimize spillage from sampler. Tilt containers if necessary.
- Rotate trier once or twice to cut a core of material.
- Slowly withdraw trier, making sure that slot is facing upward.
- Transfer sample into suitable container with aid of a spatula and/or brush.

Store sampler in a plastic bag until decontamination.

#### 16.4.4.2c Waste Pile Sampler

The waste pile sampler is used to sample wet and large-diameter solids.

**Description:** A waste pile sampler is essentially a large sampling trier. It is commercially available, but it is easy to fabricate from sheet metal or plastic pipe. Polyvinyl chloride pumping pipe 5 feet long by 1¼ inch I.D. with 1/8 inch wall thickness is adequate. The pipe is sawed off lengthwise, leaving a slot in the pipe. The edges of the slot and the tip of the pipe are sharpened to permit the sampler to cut into the material being sampled. The unsplit 4 inches of the pipe serves as the handle.

**Procedure for Use:**

- Insert sampler into material being sampled at 0 to 45° from horizontal, tilting container if necessary.
- Rotate sampler two or three times in order to cut a core of material.
- Slowly withdraw sampler making sure that the slot is facing upward.
- Transfer sample into a suitable container with the aid of a spatula and/or brush.
- Store sampler in a plastic bag until decontamination.

### 16.4.4.2d Trowel/Scoop/Spoon

Trowels, scoops, and spoons are inexpensive, but they can sample only to a depth of 4 to 5 inches.

**Description:** A garden-variety trowel looks like a small shovel. The blade is usually about 3 x 5 inches with a sharp tip. A laboratory scoop is similar, but the blade is usually more curved and has a closed upper end to contain material. Scoops come in different sizes and materials. Stainless steel or polypropylene scoops with 2¾ by 6 inch blades are preferred. Another alternative for small samples is a stainless steel table spoon.

**Procedure for Use:**

- Collect small, equal portions of sample from surface or near the surface of material to be sampled.
- Deposit samples in a suitable container.
- Dispose of sampler or place in a plastic bag until decontamination.

### 16.4.4.2e Soil Auger (Manual)

A manual soil auger can sample deeper and more compacted soils and solids than other samplers, but it is difficult to get the sample in a container.

**Description:** The soil auger consists of a hard metal central shaft and sharpened spiral blades. When the tool is rotated clockwise by its handle, it cuts the soil as it moves downward and deposits most of the loose soil upward. Augers are available in various sizes and configurations.

**Procedures for use:** Follow manufacturer's instructions.

### 16.4.42f Cleaning and Storage Procedures

All samplers must be clean before use. After use, they must be washed with warm detergent solution (for example, Liquinox or Alconox), rinsed several times with tap water rinsed with distilled water, drained of excess water, and air dried, dried with a stream of warm, dry air, or wiped dry. Samplers used on petroleum products and oil residues may first have to be wiped with absorbent clothes to eliminate the residues. The equipment is then rinsed with an organic solvent, followed by washing with detergent solution and rinsing with water. A necessary piece of equipment for cleaning the tube of a COLIWASA is a bottle brush that fits tightly in the tube. The brush is connected to a rod long enough to reach the

entire length of the sampler tube. This ramrod and fiber-reinforced paper towels clean the COLIWASA tube quickly.

Improper cleaning of sampling equipment will cause cross contamination of samples. Such contamination is particularly important in samples taken for legal or regulatory purposes. Also, contamination becomes important when sampling wastes from different sources at the same time. If samples are to be taken for legal or regulatory purposes, or if they are expected to contain low concentrations of hazardous substances, a clean, unused sampler is needed.

If the cleaning process has the potential for producing toxic fumes, ensure adequate ventilation. If the washing is hazardous, store them in containers whose type and size comply with DOT regulations.

## 16.5 Containers Closures/Closure Liners

### 16.5.1 Containers

The most important factors to consider when choosing containers for hazardous material samples are compatibility, resistance to breakage, and volume. Containers must not melt, leach, rupture, or leak as a result of chemical reactions with constituents of a sample. Thus it is important to have some idea of the composition of the sample. The containers must have walls thick enough to survive impacts and large sample mouths to make it easier to transfer samples from samplers. Also, the containers must be large enough to contain the required volume of the sample or the entire volume of a sampler.

Plastic and glass containers are generally used for collection and storage of hazardous materials samples. Commonly available plastic containers are made of high-density or linear polyethylene (LPE), conventual polyethylene, polypropylent, polycarbonate, Teflon FEP (fluorinated ethylene propylent), polyvinyl chloride (PVC), or polymethylpentene. Teflon FEP is the most inert, giving it the widest range of application. Plastic containers are used only when the constituents of the material are know not to react with the plastic.

Glass containers are relatively inert to most chemicals and can be used to collect and store almost all hazardous material samples. Two exceptions are strong alkali solutions and hydrofluoric acid. Glass bottles with wide mouth (to facilitate sample collection) are recommended for samples containing petroleum distillates, chlorinated hydrocarbons, pesticides, solvents, and other substances incompatible with plastic.

Several types of glass containers are available. Flint glass bottles are cheap and available in various shapes and sizes. Borosilicate glass is more inert, but the selection of containers is smaller. Also, it is more expensive.

### 16.5.2 Closures/Closure Liners

Sample containers must have tight, screw-type lids. Plastic bottles are usually provided with screw caps made of the same material as the bottles. Cap liners usually are not required. Glass containers usually come with glass or rigid plastic screw caps. Caps often have paper liners coated with wax. Other liner materials are polyethylene, polypropylene, neoprene, and Teflon FEP.

For containing hydrocarbons, pesticides, and petroleum residues, caps with Teflon liners are recommended for use with amber glass bottles. Teflon liners may be purchased from plastic specialty supply houses.

The selection of containers, closures, and linings must be coordinated with the laboratory, which may require specific containers for certain analyses.

Containers (type and size) must comply with DOT regulations.

## 16.6 Preservation and Storage of Samples

Samples should be analyzed immediately after collection for best results. Hazardous wastes are such complex mixtures that it is difficult to predict exactly the physical, biological, and chemical changes that occur in the samples. The pH may change significantly in a matter of minutes, sulfides and cyanides may be oxidized or evolve as gases, and hexavalent chromium may slowly be reduced to the trivalent state. Certain constituents may be partly lost as they are partly absorbed on the walls of the sample containers. Microorganisms may grow in certain constituents. Volatile compounds may be rapidly lost.

In a number of cases, such changes may be slowed down or prevented by refrigeration at 4 to 6°C, or by adding preservatives. However, these treatments may be only partially effective. Refrigeration may reduce loss of volatile components and acid gases such as hydrogen sulfide and hydrogen cyanide, but is also introduces the possibility that some salts may precipitate at lower temperatures. On warming to room temperature for analysis, the precipitates may not re-dissolve, thus giving inaccurate results. Preservatives may retard constituent to stable hydroxides, salts, or compounds, but they may also convert other forms (such as the products of nitration, sulfonation, and oxidation, of organic components). Thus, subsequent analyses may not identify the original components or concentrations.

Safety must also be considered because a preservative may be highly reactive with the sample. Addition of a preservative may change the DOT packaging, labeling, and shipping requirements for a sample. Shipping hazardous samples packed in ice may not be permitted by DOT regulations.

## 16.7 Log Book

All information pertinent to a field activity must be entered in a bound book with consecutively numbered pages. Entries in the logbook must include at least the following:

- Date and time of entry.
- Purpose of sampling.
- Name and address of field contact (Federal, State local representative).
- Producer of waste and address (if known)
- Type of process (if known) producing waste.
- Description of sample.
- Waste components and concentrations (if known).
- Number of size of sample taken.
- Description of sampling point.
- Date and time of collection of sample.
- Collector's sampler identification of sample.
- References such as maps or photographs of the sampling site.
- Field observations.
- Any field measurements made such as pH, flammability, or explosiveness.

Because sampling situations vary widely notes should be as descriptive and inclusive as possible. Someone reading the entries should be able to construct the sampling situation from the recorded information. Language must be objective, factual, and free of personal feelings or any other inappropriate terminology. If anyone other than the person to whom the logbook was assigned makes an entry, he/she must date and sign it.

## 16.8 Photographs

Photographs are the most accurate demonstration of the field worker's observations. They can be significant to the field team during future inspections, information meetings, and hearings. A photograph must be documented if it is to be a valid presentation of an existing situation. Therefore, for each photograph taken, several items should be recorded in the field logbook.

- Date and time.
- Name and identification number of site.

- General direction faced and description of the subject.
- Location on site.
- Sequential number of the photograph and the roll number.

Comments are to be limited to the photograph's location because any remarks about its contents could jeopardize its value as legal evidence.

Photographs should be taken with a camera-lens system with a perspective similar to that afforded by the naked eye. Telephoto or wide-angle shots cannot be used in enforcement proceedings.

## 16.9 Sample Labels

Each sample must be labeled using waterproof ink and sealed immediately after it is collected. Labels should be filled out before collection to minimize handling of sample container.

The DC records the assignment of serial sample tags to field personnel in his/her logbook. Sample tags must never be discarded. Lost, voided, or damaged tags are immediately noted in the logbook of the person to whom they were assigned.

Labels must be firmly affixed to the sample containers. Tags attached by string are acceptable when gummed labels are not available or applicable. Be sure that the container is dry enough for a gummed label to be securely attached.

The label must include at least the following information:

- name of collector,
- date and time of collection,
- place of collection, and
- sample number.

## 16.10 Chain-of-Custody Procedures

As in any other activity that may be used to support litigation, regulatory agencies must be able to provide the chain of possession and custody of any samples which are offered for evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed or destroyed. The primary objective of these procedures is to create an accurate written record which can be used to trace the possession and handling of the sample from the moment of its collection through analysis and its introduction as evidence.

# Appendix A

# Site Safety Plan Amendments

# Site Safety Plan Amendments

**Amendment No.:** _____

| | | | |
|---|---|---|---|
| **Client:** | Waste Management, Inc. | **Proj. No.:** | 3-4198 |
| **Location:** | Austin, Texas | **Date:** | |
| **Proj. Mgr.:** | Steve Dischler | **Site Geol.:** | Mark R. Riggle |
| **Site Health & Safety Officer:** | Robert Crone | | |
| **Amendment:** | | | |
| **Reason for Amendment:** | | | |
| **Alternate Safeguard Procedures:** | | | |
| **Required Changes in PPE:** | | | |

_____ _____

Site Health & Safety Officer Date

_____ _____

Corporate Health & Safety Officer Effective Date of Amendment

# Appendix B

# Site Safety Plan Acknowledgment Form

# SITE SAFETY PLAN
# ACKNOWLEDGMENT FORM

I have been informed and understand and will abide by all the procedures and protocols set forth in the Site Health and Safety Plan for the WMI - ACL site.

| Name (Print) | Signature | Affiliation | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# Appendix C

# Visitor Sign-in Form

# Visitor Sign-in Form

| | | | |
|---|---|---|---|
| **Client:** | Waste Management, Inc. | **Proj. No.:** | 3-4198 |
| **Location:** | Austin, Texas | **Site Geol.:** | Mark R. Riggle |
| **Proj. Mgr.:** | Steve Dischler | **Site H&S Ofcr:** | Robert Crone |

| Date | Name | Affiliation | Site Walk | | Site H&S Training | | Approp PPE | | Time In | Time Out |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Yes | No | Yes | No | Yes | No | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | |

# Appendix D

# Safety Meeting Form

# Site Safety Meeting

**Proj. Name:** WMI - ACL **Location:** Austin, Texas

**Date:** **Time:**

**Proj. No.:** 3-4198

## SAFETY TOPICS PRESENTED

**Planned Activities**

**Special Permits Required** **Status**

____ UST Removal

____ Confined Entry

____ Other: ____

**Personal Protective Equipment**

**Chemical Hazards**

**Other**

| Name | Attendees' Signatures |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| **Meeting conducted by:** | |
| | |

# Appendix E

# Notification of Access to Employee Exposure And Medical Records

# Notice

**TO ALL EMPLOYEES:** THIS NOTICE IS TO PROVIDE INFORMATION FOR COMPLIANCE WITH 29 CFR PART 1910 SUBPART C — GENERAL SAFETY AND HEALTH PROVISIONS — PARAGRAPH 1910.20, ACCESS TO EMPLOYEE EXPOSURE AND MEDICAL RECORDS.

(i) The existence, location, and availability of any records covered by this section is as follows:

ThermoRetec
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238
ATTN: Corporate Health and Safety Officer

(ii) The person responsible for maintaining and providing access to these records is ThermoRetec's Corporate Health and Safety Officer.

(iii) Each employee has the right to access these records.

(iv) A copy of this standard and its appendices are available to all affected employees at each ThermoRetec office location.

**FOR MORE INFORMATION OR QUESTIONS CONTACT**

**MR. WILLIAM A. ODENTHAL**
**CORPORATE HEALTH AND SAFETY OFFICER**

**(412) 826-3340**

# Appendix F

# Cold Stress

# Cold Stress

These Threshold Limit Values (TLVs) are intended to protect workers from the severe effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body core temperature from falling below 36°C and to prevent cold injury to body extremities. Deep body temperature is the core temperature of the body as determined by rectal temperature measurements. For a single, occasional exposure to a cold environment, a drop in core temperature to no lower than 35°C should be permitted. In addition to provisions for total body protection, TLV objective is to protect all parts of the body with emphasis on hands, feet, and head from cold injury.

## Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 1 (taken from Dembert in *AFP*, January, 1982). Workmen should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air or to immersion in cold water in temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating clothing to maintain core temperatures above 36°C must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill factor[1] or the cooling power of the air is a critical factor. An

[1]Wind chill factor is a unit of heat loss from a body defined in watts per meter squared per hour being a function of the air temperature and wind velocity upon the exposed body.

equivalent chill temperature chart relating the actual dry bulb air temperature and the wind velocity is presented in Table 2. The equivalent chill temperatures on exposed skin when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

2. Unless there are unusual or extenuating circumstances, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary action to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

## Evaluation and Control

For exposed skin, continuous exposure should not be permitted when the air speed and temperature result in an equivalent chill temperature of -32°C (-25°F). Superficial or deep local tissue freezing will occur only at temperatures below -1°C regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

## Table 1 Progress Clinical Presentations of Hypothermia[2]

| Core Temperature | | Clinical Signs |
|---|---|---|
| °C | °F | |
| 37.6 | 99.6 | "Normal" rectal temperature |
| 37 | 98.6 | "Normal" oral temperature |
| 36 | 96.8 | Metabolic rate increases in an attempt to compensate for heat loss |
| 35 | 95.0 | Maximum shivering |
| 34 | 93.2 | Victim conscious and responsive, with normal blood |
| 33 | 91.4 | Severe hypothermia below this temperature |
| 32<br>31 | 89.6<br>87.8 | Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases |
| 30<br>29 | 86.0<br>84.2 | Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases. |
| 28 | 82.4 | Ventricular fibrillation possible with myocardial irritability |
| 27 | 80.6 | Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent |
| 26 | 78.8 | Victim seldom conscious |
| 25 | 77.0 | Ventricular fibrillation may occur spontaneously |
| 24 | 75.2 | Pulmonary edema |
| 22<br>21 | 71.6<br>69.8 | Maximum risk of ventricular fibrillation |
| 20 | 68.0 | Cardiac standstill |
| 18 | 64.4 | Lowest accidental hypothermia victim to recover |
| 17 | 62.6 | Isoelectric electroencephalogram |
| 9 | 48.2 | Lowest artificially cooled hypothermia patient to recover |

[2]Presentations approximately related to core temperature. Reprinted from the January 1982 issue of *American Family Physician* published by the American Academy of Family Physicians.

## Table 2 Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)

| Est. Wind Speed (mph) | Actual Temperature Reading (°F) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 40 | 30 | 20 | 10 | 0 | -10 | -20 | -30 | -40 | -50 | -60 |
| | Equivalent Chill Temperature (°F) | | | | | | | | | | | |
| calm | 50 | 40 | 30 | 20 | 10 | 0 | -10 | -20 | -30 | -40 | -50 | -60 |
| 5 | 48 | 37 | 27 | 16 | 6 | -5 | -15 | -26 | -36 | -47 | -57 | -68 |
| 10 | 40 | 28 | 16 | 4 | -9 | -24 | -33 | -46 | -58 | -70 | -83 | -95 |
| 15 | 36 | 22 | 9 | -5 | -18 | -32 | -45 | -58 | -72 | -85 | -99 | -112 |
| 20 | 32 | 18 | 4 | -10 | -25 | -39 | -53 | -67 | -82 | -96 | -110 | -131 |
| 25 | 30 | 16 | 0 | -15 | -29 | -44 | -59 | -74 | -88 | -104 | -118 | -133 |
| 30 | 28 | 13 | -2 | -18 | -33 | -48 | -63 | -79 | -94 | -109 | -125 | -1450 |
| 35 | 27 | 11 | -4 | -20 | -35 | -51 | -67 | -82 | -98 | -113 | -129 | -145 |
| 40 | 26 | 10 | -6 | -21 | -37 | -53 | -69 | -85 | -100 | -116 | -132 | -148 |
| (Wind speeds greater than 40 mph have little additional effect.) | Little Danger - In < 1 hr. with dry skin. Maximum danger of false sense of security. | | | | Increasing Danger - Danger from freezing of exposed flesh within one minute. | | | Greater Danger - Flesh may freeze within 30 seconds. | | | | |
| | Trench foot and immersion foot may occur at any point on this chart. | | | | | | | | | | | |

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

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 3. Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10-20 minutes in an environment below 16°C (60°F), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars shall be covered by thermal insulating material at temperatures below -1°C (30°F).

To prevent contact frostbite, the workers should wear anti-contact gloves.

1. When cold surfaces below -7°C (20°F) are within reach, a warning should be given to each worker by his supervisor to prevent inadvertent contact by skin.

2. If the air temperature is -17.5°C (9°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (40°F). The workers shall wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind shall be reduced by shielding the work area, or by wearing an easily removable outer windbreak layer garment. Wind chill cooling rates are illustrated in Table 4.

2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing used may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent and the outerwear should be changed as it becomes wet. The outer garments must include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, and the clothing is wet, the employee shall change into dry clothes before entering the cold area. The workers shall change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change shall be determined empirically and will vary individually and according to the type shoe worn and how much the individual's feet sweat.

3. If extremities, ears, toes, and nose cannot be protected sufficiently to prevent sensation of excessive cold or frostbite by handwear, footwear, and face masks, these protective items shall be supplied in auxiliary heated versions.
4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.

5. Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperature below 4°C (40°F) shall take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point only just above ambient temperatures.

## Table 3 Threshold Limit Values Work/Warm-up Schedule for Four Hour Shift

| Air Temp. — Sunny Sky | | Non Noticeable Wind | | 5 mph Wind | | 10 mph Wind | | 15 mph Wind | | 20 mph Wind | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| °C | °F | Max. Work Period (min.) | No. of Breaks | Max Work Period | No. of Breaks | Max. Work Period | No. of Breaks | Max Work Period | No. of Breaks | Max. Work Period | No. of Breaks |
| -26° to -28° | '15° to -1° | Normal Breaks | | Normal Breaks | | 75 | 2 | 55 | 3 | 40 | 4 |
| -29° to -31° | -20° to -24° | Normal Breaks | | 75 | 2 | 55 | 3 | 40 | 4 | 30 | 5 |
| -32° to -34° | -25° to -29° | 75 | 2 | 55 | 3 | 40 | 4 | 30 | 5 | Non-emergency work should cease | |
| -35° to -37° | -30° to 34° | 55 | 3 | 40 | 4 | 30 | 5 | Non-emergency work should cease | | | |
| -38°to -39° | -35° to -39° | 40 | 4 | 30 | 5 | Non-emergency work should cease | | | | | |
| -40° to -42° | -40° to -44° | 30 | 5 | Non-emergency work should cease | | | | | | | |
| -43° & below | -45° below | Non-emergency work should cease | | | | | | | | | |

**Notes:**

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at 30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended: 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: (1) special warm-up breaks should be initiated at a wind chill of about 1720 $Wm^2$; (2) all non-emergency work should have ceased at or before a wind chill of 2250 $W/m_2$. In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.
   Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labor.

## Table 4 Wind Chill Cooling Rate Effects*

| Wind Chill Rates (Watts/$m^2$) | Comments/Effects |
|---|---|
| 700 | Conditions considered comfortable when dressed for skiing. |
| 1200 | Conditions no longer pleasant for outdoor activities on overcast days. |
| 1400 | Conditions no longer pleasant for outdoor activities on sunny days. |
| 1600 | Freezing of exposed skin begins for most people depending on the degree of activity and the amount of sunshine. |
| 2300 | Conditions for outdoor travel such as walking become dangerous. Exposed areas of the face freeze in less than 1 minute for the average person. |
| 2700 | Exposed flesh will freeze within half a minute for the average person. |

*Adapted from Canadian Department of the Environment, Atmospheric Environment Service.

### Work-Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (20°F), heated warming shelters (tents, cabins, rest rooms, etc.) shall be made available nearby and the workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostbite, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for the immediate return to the shelter. When entering the heated shelter, the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of the diuretic and circulatory effects.

For work practices at or below -12°C (10°F) ECT, the following shall apply:

1. The worker shall be under constant protective observation (buddy system or supervision).

2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing shall be provided.

3. New employees shall not be required to work full time in cold in the first days until they become accustomed to the working conditions and required protective clothing.

4. The weight and bulkiness of clothing shall be included in estimating the required work performance and weights to be lifted by the worker.

5. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used. The worker should be protected from drafts to the greatest extent possible.

6. The workers shall be instructed in safety and health procedures. The training program shall include, as a minimum, instruction in:

    a. Proper re-warming procedures and appropriate first aid treatment.
    b. Proper clothing practices.
    c. Proper eating and drinking habits.
    d. Recognition of impending frostbite.
    e. Recognition of signs and symptoms of impending hypothermia or excessive cooling of body even when shivering does not occur.
    f. Safe work practices.

**Special Workplace Recommendations**

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.

2. Special wind-protective clothing shall be provided based upon existing air velocities to which workers are exposed.

Special caution shall be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed outdoors in a snow and/or ice-covered terrain shall be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals are required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60°F) to enable overall compliance with the requirements of the TLV to be maintained.

2. Whenever the air temperature at a workplace falls below -1°C (30°F), the dry bulb temperature should be measured and recorded at least every 4 hours.

3. In an indoor workplace, the wind speed should also be recorded at least every 2 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).

4. In an outdoor work situation, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below -1°C (30°F).

5. The equivalent chill temperature shall be recorded with the other data whenever the equivalent chill temperature is below -7°C (20°F).

Employees shall be excluded from work in cold at -1°C (30°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -24°C (-10°F) with wind speeds less than five miles per hour, or air temperatures should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing for first aid treatment.

# Appendix G

# Heat Stress

## Heat Stress and Other Physiological Factors

Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat and fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of most common (and potentially serious) illnesses at hazardous wastes sites, regular monitoring and other preventative precautions are vital.

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include:

- Lack of physical fitness
- Lack of acclimatization
- Age
- Dehydration
- Obesity
- Alcohol and drug use
- Infection
- Sunburn
- Diarrhea
- Chronic disease

Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount and type of PPE worn. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the following:

- Anticipated work rate
- Ambient temperature and other environmental factors
- Type of protective ensemble
- Individual worker characteristics and fitness

### Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

- For workers wearing permeable clothing (eg., 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 work clothing differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly.
- For workers wearing semipermeable or impermeable[1] 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, measure the following:

- **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 the oral temperature exceeds 99.6°F (37.7°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, If Possible.** Measure weight on a scale accurate to $\pm$0.25 lb 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. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

[1]Although no protective ensemble is "completely" impermeable, for practical purposes an outfit may be considered impermeable when calculating heat stress risk.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 1). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

## Table 1 Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[2]

| Adjusted Temp.[3] | Normal Work Ensemble[4] | Impermeable Ensemble |
|---|---|---|
| 90°F (32.2°C) or above | After each 45 minutes of work | After each 15 minutes of work |
| 87.5°-87.5°F (30.8°to 32.2°C) | After each 60 minutes of work | After each 30 minutes of work |
| 87.5°-87.5°F (28.1°to 30.8°C) | After each 90 minutes of work | After each 60 minutes of work |
| 77.5°-82.5°F (25.3°to 28.1°C) | After each 120 minutes of work | After each 90 minutes of work |
| 72.5°-77.5°F (22.5°to 25.3°C) | After each 150 minutes of work | After each 120 minutes of work |

### Prevention

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, the person may be predisposed to additional heat injuries. To avoid heat stress, management should take the following steps.

- Adjust work schedules:
  - Modify work/rest schedules according to monitoring requirements.
  - Mandate work slowdowns as needed.
  - Rotate personnel: alternate job functions to minimize overstress or over-exertion at one task.
  - Add additional personnel to work teams.

---

[2]For work levels of 250 Kilocalories/hour.

[3]Calculate the adjusted air temperature (ta adj) using this equation: ta adj = ta ° = (13 x % sunshine). Measure air temp. (ta) with a standard thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distant shadow, 0 percent sunshine = no shadows).

[4]A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

  - Perform work during cooler hours of the day, if possible, or at night, if adequate lighting can be provided.

- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.

- Maintain workers' body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost water. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:

  - Maintain water temperature at 50° to 60°F (10° to 15.6°C).
  - Provide small disposable cups that hold about 4 ounces (0.1 liter).
  - Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or diluted drinks) before beginning work.
  - Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
  - Weigh workers before and after work to determine if fluid replacement is adequate.

- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:

  - Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.
  - Cooling jackets, vests, or suits.

- Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress.

### Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This section discusses the demonstrated physiological responses to PPE, the individual human traits that play a factor in these responses, and some of the precautionary and training measures that need to be taken to avoid PPE-induced injury.

The physiological that factors which may affect worker ability to function using PPE include:

- Physical condition
- Level of acclimatization
- Age
- Gender
- Weight

**Physical Condition.** Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work a fit person, relative to an unfit person, will have:

- Less physiological strain.
- A lower heart rate.
- A lower body temperature, which indicates less retained body heat (a rise in internal temperature precipitates heat injury.)
- A more efficient sweating mechanism.
- Slightly lower oxygen consumption.
- Slightly lower carbon dioxide production.

**Level of Acclimatization.** The degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions affects his or her ability to do work. Acclimatized individuals generally have lower heart rates and body temperatures than unacclimatized individuals, and sweat sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work loads than unacclimatized workers. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss.

Acclimatization can occur after just a few days of exposure to a hot environment. NIOSH recommends a progressive 6-day acclimatization period for the unacclimatized worker before allowing him/her to do full work on a hot job. Under this regimen, the first day of work on site is begun using only 50 percent of the anticipated workload and exposure time, and is increased slowly over the next several days. If the workers can acclimatize quickly, this period may be shortened by two or three days. If this period includes time off however, workers can lose acclimatization in a matter of days, and work regimens should be adjusted taking this into account.

When enclosed in an impermeable suit, fit-acclimatized individuals sweat more profusely than unfit or unacclimatized individuals and may therefore actually face a greater danger of heat exhaustion due to rapid dehydration. This can be prevented by consuming

adequate quantities of water. See previous section on Prevention for additional information.

**Age.** Generally, maximum work capacity declines with increasing age, but this is not always the case. Active, well conditioned seniors often have performance capabilities equal to or greater than young sedentary individuals. However, there is some evidence, indicated by lower sweat rate and higher body core temperatures, that older individuals are less effective in compensating for a given level of environmental heat and work load. At moderate thermal loads, however, the physiological responses of "young" and "old" are similar and performance is not affected.

Age should not be the sole criterion for judging whether or not an individual should be subjected to moderate heat stress. Fitness level is a more important factor.

**Gender.** The literature indicates that women tolerate heat stress at least as well as their male counterparts. Generally, a woman's work capacity averages 10 to 30 percent less than that of a man. The primary reasons for this are the greater oxygen-carrying capacity and the stronger heart in the male. However, a similar situation exists as with aging: not all men have greater work capacities than all women.

**Weight.** The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). Heat loss (dissipation) is a function of surface area and heat production is dependent on mass. Therefore, heat balance is described by the ratio of the two.

Since overweight individuals (those with a low ratio) produce more heat per units of surface area than thin individuals (those with a high ratio), overweight individuals should be given special consideration in heat stress situations. However, when wearing impermeable clothing, the weight of an individual is not a critical factor in determining the ability to dissipate excess heat.

### Signs and Symptoms of Heat Stress

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - Muscle spasms
  - Pain in the hands, feet, and abdomen

- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

  - Pale, cool, moist skin
  - Heavy sweating
  - Dizziness
  - Nausea
  - Fainting

- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:

  - Red, hot, usually dry skin
  - Lack of or reduced perspiration
  - Nausea
  - Dizziness and confusion
  - Strong, rapid pulse
  - Coma

## References

1. Goldman, R.F. 1970. Tactical Implications of the Physiological Stress Imposed by Chemical Protective Clothing Systems. Army Science Conference, Natick, MA.

2. U.S. EPA, 1984. Standard Operating Safety Guides. Office of Emergency and Remedial Response, Hazardous Response Support Division, Edison, NJ. November, 1984.

3. McArdle, W.D.; Katch, F.I; and V.L. Katch. 1981. Exercise Physiology: Energy, Nutrition, and Human Performance. Lea and Febiger, Philadelphia, PA.

4. American Conference of Governmental Industrial Hygienists. 1985. Threshold Limit Values for Chemical Substances and Physical Agents in the Workplace Environment and Biological Exposure Indices with Intended Changes for 1985-86. Cincinnati, OH.

5. NIOSH. 1981. Chemical Control Corporation, Elizabeth New Jersey. Hazard Evaluation Report. TA-80-77-853.

6. Henschel, A. 1985. Memorandum to Sheldon Rabinovitz from Austin Henschel, NIOSH, Cincinnati, OH June 20, 1985.

7. Goldman, R.F. 1983. Heat Stress in Industrial Protective Encapsultating Garments. Contract deliverable to U.S. Department of Health and Human Services, Order No. 83-211.

8. Dukes-Dubos, F.N., and a Henschel, eds. 1980. Proceeding of a NIOSH Workshop on Recommended Heat Stress Standards. U.S. Department of Health and Human Services, Cincinnati, OH p. 153.

9. Ramsey, J.D. 1976. NIOSH, Standards Advisory Committee on Heat Stress - Recommended Standard for Work in Hot Environments. Appendix C in Standards for Occupation Exposure to Hot Environments, proceedings of symposium, Cincinnati, OH.

10. Astrand, I.; Axelson, O.; Erikson, U.; and L. Olander. 1975. Heat stress in occupational work. Ambio 4:37-42.

11. Eocjma. L.W.; Park, C.R.; Nelson, N.; Horvarth, S.m.; and E.D. Palmes. 1950. Thermal regulation during acclimatization in a hot, dry (desert type) environment. Am. J. Physiol. I63:50-56.

12. Lind, A.R.; Humphreys, P.W.; Collins, K.J.; Foster, K; and K.F. Sweetland. 1970. Influence of age and dayily duration of expsoure on responses of men to work in heat. J. Appl. Physiol. 28:50-56.

13. Shapiro, Y.; Pandolf, K.B.; Avellini, B.A.; Pimental, N.A.; and R.F. Goldman. 1981. Heat balance and heat transfer in men and women exercising in hot-dry and hot-wet condition. Ergonomics 24:375-386.

# Appendix H

# Material Safety and Data Sheets

# ACETONE

ACT

| Common Synonyms | Watery liquid | Colorless | Sweet odor |
|---|---|---|---|
| Dimethyl ketone<br>Propanone<br>2-Propanone | Floats and mixes with water. Flammable, irritating vapor is produced. | | |

Stay upwind and use water spray to "knock down" vapor.
Shut off ignition sources and call fire department. Keep people away.
Stop discharge if possible.
Isolate and remove discharged material.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Extinguish with dry chemical, alcohol foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, may cause difficult breathing or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to eyes.
Not irritating to skin.
IF IN EYES, hold eyelids open and flush with plenty of water.

**Water Pollution**

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and pollution control officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Disperse and flush

## 2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Ketone
3.2 Formula: $CH_3COCH_3$
3.3 IMO/UN Designation: 3.1/1090
3.4 DOT ID No.: 1090
3.5 CAS Registry No.: 67-64-1

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Sweetish, pleasant, resembling that of mint or fruit; pungent; sharp, penetrating residual; tartonic, pleasant, non-residual

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor canister or air-supplied mask; synthetic rubber gloves; chemical safety goggles or face splash shield.
5.2 Symptoms Following Exposure: INHALATION: vapor irritating to eyes and mucous membranes; acts as an anesthetic in very high concentrations. INGESTION: low order of toxicity but very irritating to mucous membranes. SKIN: prolonged excessive contact causes defatting of the skin, possibly leading to dermatitis.
5.3 Treatment of Exposure: INHALATION: if victim is overcome, remove to fresh air and call a physician; administer artificial respiration if breathing is irregular or stopped. INGESTION: if victim has swallowed large amounts and is conscious and not having convulsions, induce vomiting and get medical help promptly; no specific antidote known. SKIN: wash well with water. EYES: flush with water immediately for at least 15 min. Consult a physician.
5.4 Threshold Limit Value: 750 ppm
5.5 Short Term Inhalation Limits: 1000 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 1; $LD_{50}$ - 5 to 15 g/kg (dog)
5.7 Late Toxicity: Not pertinent
5.8 Vapor (Gas) Irritant Characteristics: If present in high concentrations, vapors cause moderate irritation of the eyes or respiratory system. Effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard. Practically harmless to the skin because it is very volatile and evaporates quickly from the skin.
5.10 Odor Threshold: 100 ppm
5.11 IDLH Value: 20000 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 4°F O.C.; 0°F C.C.
6.2 Flammable Limits in Air: 2.6%-12.8%
6.3 Fire Extinguishing Agents: Alcohol foam, dry chemical, carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water in straight hose stream will scatter and spread fire and should not be used.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 869°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 3.9 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 18

## 8. WATER POLLUTION

8.1 Aquatic Toxicity:
14,250 ppm/24 hr/sunfish/killed/tap water
13,000 ppm/48 hr/mosquito fish/$TL_m$/ turbid water
8.2 Waterfowl Toxicity: Not pertinent
8.3 Biological Oxygen Demand (BOD): (Theor) 122%, 5 days
8.4 Food Chain Concentration Potential: None noted

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical 99.5% plus 0.5% water Reagent: 99.5% plus 0.5% water
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-R-S

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations:
Flammable liquid

11.2 NAS Hazard Rating for Bulk Water

Transportation:

| Category | Rating |
|---|---|
| Fire | 3 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 0 |
| Poisons | 0 |
| Water Pollution | |
| Human Toxicity | 1 |
| Aquatic Toxicity | 1 |
| Aesthetic Effect | 1 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 2 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 1 |
| Flammability (Red) | 3 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15 C and 1 atm: Liquid
12.2 Molecular Weight: 58.08
12.3 Boiling Point at 1 atm:
133°F 56.1°C 329.3 K
12.4 Freezing Point:
−139°F −94.7°C 178.5 K
12.5 Critical Temperature:
455°F 235°C 508°K
12.6 Critical Pressure:
682 psia 46.4 atm 4.70 MN/m²
12.7 Specific Gravity:
0.791 at 20°C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 2.0
12.11 Ratio of Specific Heats of Vapor (Gas): 1.127
12.12 Latent Heat of Vaporization:
220 Btu/lb 122 cal/g
5.11 X $10^5$ J/kg
12.13 Heat of Combustion: −12,250 Btu/lb
−6808 cal/g −285.0 X $10^5$ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 23.42 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 7.25 psia

NOTES

# ACETONE

## 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| —120 | 56.350 |
| —110 | 55.980 |
| —100 | 55.620 |
| —90 | 55.250 |
| —80 | 54.880 |
| —70 | 54.520 |
| —60 | 54.150 |
| —50 | 53.780 |
| —40 | 53.400 |
| —30 | 53.030 |
| —20 | 52.650 |
| —10 | 52.280 |
| 0 | 51.900 |
| 10 | 51.520 |
| 20 | 51.140 |
| 30 | 50.760 |
| 40 | 50.380 |
| 50 | 50.000 |
| 60 | 49.610 |
| 70 | 49.230 |
| 80 | 48.840 |
| 90 | 48.450 |
| 100 | 48.070 |
| 110 | 47.680 |
| 120 | 47.280 |

## 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 34 | .507 |
| 36 | .508 |
| 38 | .508 |
| 40 | .509 |
| 42 | .510 |
| 44 | .511 |
| 46 | .512 |
| 48 | .513 |
| 50 | .514 |
| 52 | .514 |
| 54 | .515 |
| 56 | .516 |
| 58 | .517 |
| 60 | .518 |
| 62 | .519 |
| 64 | .519 |
| 66 | .520 |
| 68 | .521 |
| 70 | .522 |
| 72 | .523 |
| 74 | .524 |
| 76 | .525 |
| 78 | .525 |
| 80 | .526 |
| 82 | .527 |
| 84 | .528 |

## 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| 30 | 1.193 |
| 35 | 1.184 |
| 40 | 1.174 |
| 45 | 1.164 |
| 50 | 1.155 |
| 55 | 1.145 |
| 60 | 1.135 |
| 65 | 1.126 |
| 70 | 1.116 |
| 75 | 1.106 |
| 80 | 1.097 |
| 85 | 1.087 |
| 90 | 1.077 |
| 95 | 1.068 |
| 100 | 1.058 |
| 105 | 1.048 |

## 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| | NOT PERTINENT |

## 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| | MISCIBLE |

## 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| —20 | .245 |
| —10 | .354 |
| 0 | .501 |
| 10 | .698 |
| 20 | .956 |
| 30 | 1.291 |
| 40 | 1.719 |
| 50 | 2.260 |
| 60 | 2.935 |
| 70 | 3.770 |
| 80 | 4.791 |
| 90 | 6.029 |
| 100 | 7.516 |
| 110 | 9.290 |
| 120 | 11.390 |
| 130 | 13.850 |
| 140 | 16.720 |
| 150 | 20.060 |
| 160 | 23.890 |
| 170 | 28.290 |
| 180 | 33.300 |
| 190 | 38.980 |

## 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| —20 | .00302 |
| —10 | .00426 |
| 0 | .00590 |
| 10 | .00804 |
| 20 | .01079 |
| 30 | .01427 |
| 40 | .01862 |
| 50 | .02399 |
| 60 | .03056 |
| 70 | .03851 |
| 80 | .04803 |
| 90 | .05934 |
| 100 | .07266 |
| 110 | .08823 |
| 120 | .10630 |
| 130 | .12710 |
| 140 | .15090 |
| 150 | .17800 |
| 160 | .20860 |
| 170 | .24310 |
| 180 | .28170 |
| 190 | .32460 |

## 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .275 |
| 25 | .286 |
| 50 | .296 |
| 75 | .307 |
| 100 | .317 |
| 125 | .327 |
| 150 | .337 |
| 175 | .347 |
| 200 | .357 |
| 225 | .367 |
| 250 | .377 |
| 275 | .386 |
| 300 | .395 |
| 325 | .405 |
| 350 | .414 |
| 375 | .423 |
| 400 | .431 |
| 425 | .440 |
| 450 | .449 |
| 475 | .457 |
| 500 | .466 |
| 525 | .474 |
| 550 | .482 |
| 575 | .490 |
| 600 | .498 |

KOP-COAT -- MIL-L-81352A (36081 GRAY) - LACQUER, ACRYLIC RESIN, PIGMENTED GRAY 36081
MATERIAL SAFETY DATA SHEET
NSN: 8010012703631
Manufacturer's CAGE: 00297
Part No. Indicator: A
Part Number/Trade Name: MIL-L-81352A (36081 GRAY)

==========

General Information

==========

Item Name: LACQUER, ACRYLIC RESIN, PIGMENTED GRAY 36081
Company's Name: KOP-COAT INC
Company's Street: 436 7TH AVE SUITE 1850
Company's City: PITTSBURGH
Company's State: PA
Company's Country: US
Company's Zip Code: 15219-1818
Company's Emerg Ph #: 800-548-0489
Company's Info Ph #: 800-547-2468
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 002
Status: SM
Date MSDS Prepared: 01APR90
Safety Data Review Date: 07DEC90
Supply Item Manager: GSA
Preparer's Company: KOP-COAT INC
Preparer's St Or P. O. Box: 436 7TH AVE SUITE 1850
Preparer's City: PITTSBURGH
Preparer's State: PA
Preparer's Zip Code: 15219-1818
MSDS Serial Number: BJNDP
Specification Number: MIL-L-81352A
Unit Of Issue: GL
Unit Of Issue Container Qty: 1 GL CAN
Type Of Container: METAL

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: TITANIUM DIOXIDE
Ingredient Sequence Number: 01
Percent: 1-5
NIOSH (RTECS) Number: XR2275000
CAS Number: 13463-67-7
OSHA PEL: 15 MG/M3 TDUST
ACGIH TLV: 10 MG/M3 TDUST; 9293
Other Recommended Limit: NONE SPECIFIED

---

Proprietary: NO
Ingredient: TALC (CONTAINING NO ASBESTOS)
Ingredient Sequence Number: 02
Percent: 1-5
NIOSH (RTECS) Number: WW2710000
CAS Number: 14807-96-6
OSHA PEL: 2 MG/M3 RDUST
ACGIH TLV: 2 MG/M3 RDUST; 9192
Other Recommended Limit: NONE SPECIFIED

---

Proprietary: NO
Ingredient: TOLUENE (SARA III)
Ingredient Sequence Number: 03
Percent: 35-40

NIOSH (RTECS) Number: XS5250000
CAS Number: 108-88-3
OSHA PEL: 200 PPM/150 STEL
ACGIH TLV: 50 PPM; 9293
Other Recommended Limit: NONE SPECIFIED
---
Proprietary: NO
Ingredient: METHYL ETHYL KETONE (2-BUTANONE) (MEK) (SARA III)
Ingredient Sequence Number: 04
Percent: 10-15
NIOSH (RTECS) Number: EL6475000
CAS Number: 78-93-3
OSHA PEL: 200 PPM/300 STEL
ACGIH TLV: 200 PPM/300STEL 9192
Other Recommended Limit: SARA 313
---
Proprietary: NO
Ingredient: N-BUTYL ALCOHOL (SARA III)
Ingredient Sequence Number: 05
Percent: 1.5
NIOSH (RTECS) Number: EO1400000
CAS Number: 71-36-3
OSHA PEL: 100 PPM
ACGIH TLV: S, C 50 PPM; 9293
Other Recommended Limit: SARA 313
---
Proprietary: NO
Ingredient: 2-METHOXYETHANOL (EGME) (SARA III)
Ingredient Sequence Number: 06
Percent: 1-5
NIOSH (RTECS) Number: KL5775000
CAS Number: 109-86-4
OSHA PEL: S, 25 PPM
ACGIH TLV: S, 5 PPM; 9192
Other Recommended Limit: SARA 313

## Physical/Chemical Characteristics

Appearance And Odor: GRAY VISCOUS LIQUID WITH TYPICAL SOLVENT ODOR.
Vapor Density (Air=1): > 1
Solubility In Water: NEGLIGIBLE

## Fire and Explosion Hazard Data

Flash Point: 40F/4C
Extinguishing Media: USE CARBON DIOXIDE, FOAM, OR DRY CHEMICAL. WATER MAY BE INEFFECTIVE. USE PER MANUFACTURER'S RECOMMENDATIONS.
Special Fire Fighting Proc: WEAR FULL-FACE MSHA/NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS. USE WATER TO COOL FIRE-EXPOSED CONTAINER/STRUCTURE/PROTECT PERSONNEL.
Unusual Fire And Expl Hazrds: HEAT/FIRE COND: VAPORS FORM FLAM/EXPLOS MIXTURES IN AIR. VAPORS HEAVY, MAY TRAVEL TO IGNITE SOURCE-FLASH. OPEN/CLOSED CONTAINERS MAY CONTAIN FLAM/EXPLOS VAPORS.

## Reactivity Data

Stability: YES
Materials To Avoid: OXIDIZING AGENTS, HEAT, SPARKS AND OPEN FLAMES.
Hazardous Decomp Products: CARBON MONOXIDE, CARBON DIOXIDE UPON THERMAL DECOMPOSITION.
Hazardous Poly Occur: NO

## Health Hazard Data

Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: MAY CAUSE IRRITATION TO EYES, SKIN, & RESPIRATORY TRACT. MAY ALSO BE ABSORBED THROUGH SKIN RESULTING IN SYSTEMIC EFFECTS. INHALATION OF HIGH CONCENTRATIONS MAY CAUSE CENTRAL NERVOUS SYS DEPRESSION & LUNG CHANGES. INGESTION MAY CAUSE GASTROINTESTINAL DISTURBANCES & CHEMICAL PNEUMONITIS.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Signs/Symptoms Of Overexp: HEADACHES, WEAKNESS, DIZZINESS, INCOORDINATION, & COLLAPSE FROM INHALATION. NAUSEA, VOMITING, & DIARRHEA FROM INGESTION. REDNESS, CRACKING, BLISTERING, & IRRITATION FROM DIRECT CONTACT WITH SKIN. EYE IRRITATION WITH EYE CONTACT.
Med Cond Aggravated By Exp: PERSONS W/PRE-EXISTING DISEASE IN OR A HISTORY OF AILMENTS INVOLVING SKIN, EYE, RESPIRATORY TRACT, LIVER, KIDNEY, CENTRAL NERVOUS SYSTEM ARE AT GREATER THAN NORMAL RISK OF DEVELOPING ADVERSE EFFECTS.
Emergency/First Aid Proc: EYES: IMMEDIATELY FLUSH W/LARGE AMTS OF WATER 15 MIN. SKIN: WASH W/SOAP & WATER. WASH CONTAM CLOTHING BEFORE REUSE. INHALATION: REMOVE FROM EXPOSURE. IF BREATHING STOPPED/DIFFICULT, GIVE CPR OR OXYGEN. INGESTION: DO NOT INDUCE VOMIT. GIVE 1 GLASS MILK OR 1-2 OZ ACTIVATED CHARCOAL IN WATER. NEVER GIVE ANYTHING BY MOUTH TO UNCONSCIOUS PERSON. GET MEDICAL ATTN IMMEDIATELY FOR ANY OF THESE CONDITIONS.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: STOP SPILL/LEAK IF NO RISK. AVOID BREATHING VAPORS OR CONTACT WITH HOT LIQ/FUMES. ELIMINATE ALL IGNITE SOURCES. VENTILATE AREA. TAKE UP CAREFULLY TO AVOID HEAT/SPARKS. USE INERT ABSORBENT TO COMPLETE CLEANUP. REPORT SPILL TO NATIONAL RESPONSE CENTER.
Waste Disposal Method: THIS PRODUCT IS A US EPA DEFINED IGNITABLE HAZARDOUS WASTE. DISPOSE OF AS AN IGNITABLE WASTE IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.
Precautions-Handling/Storing: STORE IN COMPLIANCE W/OSHA 1910.106. KEEP IN CLOSED, LABELED CONTAINER WITHIN COOL, WELL SHADED, DRY-VENTILATED AREA. PROTECT FROM PHYSICAL DAMAGE.
Other Precautions: EMPTY CONTAINERS MAY RETAIN FLAMMABLE/EXPLOS VAPORS. DO NOT CUT, DRILL, GRIND, WELD ON OR NEAR FULL, PARTIAL FULL OR EMPTY CONTAINERS. GROUND/BOND DRUMS. NEVER USE PRESSURE TO EMPTY DRUMS. KEEP CONTAINERS CLOSED WHEN MATERIAL NOT IN USE.

## Control Measures

Respiratory Protection: USE MSHA/NIOSH APPROVED UNITS IF VENTILATION DOES NOT MAINTAIN INHALATION EXPOSURES BELOW PEL (TLV). IF WITHIN OSHA PROTECTION FACTOR, AIR PURIFYING OV/FILTER UNITS OK.
Ventilation: PROVIDE SUFFICIENT GENERAL/LOCAL EXHAUST VENTILATION. USE LOCAL EXHAUST IN ENCLOSED/CONFINED SPACES.
Protective Gloves: INDUSTRIAL RESISTANT FLEX-TYPE GLOVES
Eye Protection: SAFETY GLASSES/GOGGLES, SIDE/FACE SHIELD
Other Protective Equipment: INDUS-TYPE CLOTHES, SAFETY FOOTWEAR. IF CONTACT POTENTIAL, WEAR HEAD/NECK COVER, APRON, JACKET, PANTS, COVERALLS, BOOTS.
Work Hygienic Practices: DO NOT WEAR CONTAMINATED CLOTHES. DISCARD CONTAMINATED FOOTWEAR. OBSERVE GOOD HYGIENE PRACTICES/RECOMMENDED PROCEDURES.

Suppl. Safety & Health Data: WASH EXPOSED AREAS THOROUGHLY AFTER SKIN CONTACT FROM WORKING WITH PRODUCT & BEFORE EATING, DRINKING, USING TOBACCO PRODUCTS OR RESTROOMS. DO NOT WEAR CONTACT LENS WITHOUT PROPER EYE PROTECTION.

==========

Transportation Data

==========

Trans Data Review Date: 90341
DOT PSN Code: LFJ
DOT Proper Shipping Name: PAINT RELATED MATERIAL
DOT Class: 3
DOT ID Number: UN1263
DOT Pack Group: II
DOT Label: FLAMMABLE LIQUID
IMO PSN Code: LCP
IMO Proper Shipping Name: PAINT OR PAINT RELATED MATERIAL
IMO Regulations Page Number: 3268
IMO UN Number: 1263
IMO UN Class: 3.2
IMO Subsidiary Risk Label: -
IATA PSN Code: SXL
IATA UN ID Number: 1263
IATA Proper Shipping Name: PAINT RELATED MATERIAL
IATA UN Class: 3
IATA Label: FLAMMABLE LIQUID
AFI PSN Code: SXI
AFI Prop. Shipping Name: PAINT OR PAINT RELATED MATERIAL
AFI Class: 3
AFI ID Number: UN1263
AFI Pack Group: II
AFI Basic Pac Ref: 7-8
MMAC Code: NK
N.O.S. Shipping Name: PAINT-FLAMMABLE LIQUID

==========

Disposal Data

==========

==========

Label Data

==========

Label Required: YES
Label Status: G
Common Name: MIL-L-81352A (36081 GRAY)
Special Hazard Precautions: MAY CAUSE IRRITATION TO EYES, SKIN, & RESPIRATORY TRACT. MAY ALSO BE ABSORBED THROUGH SKIN RESULTING IN SYSTEMIC EFFECTS. INHALATION OF HIGH CONCENTRATIONS MAY CAUSE CENTRAL NERVOUS SYS DEPRESSION & LUNG CHANGES. INGESTION MAY CAUSE GASTROINTESTINAL DISTURBANCES & CHEMICAL PNEUMONITIS. HEADACHES, WEAKNESS, DIZZINESS, INCOORDINATION, & COLLAPSE FROM INHALATION. NAUSEA, VOMITING, & DIARRHEA FROM INGESTION. REDNESS, CRACKING, BLISTERING, & IRRITATION FROM DIRECT CONTACT WITH SKIN. EYE IRRITATION WITH EYE CONTACT.
Label Name: KOP-COAT INC
Label Street: 436 7TH AVE SUITE 1850
Label City: PITTSBURGH
Label State: PA
Label Zip Code: 15219-1818
Label Country: US
Label Emergency Number: 800-548-0489

# BENZENE

BNZ

| Common Synonyms | Watery liquid | Colorless | Gasoline-like odor |
|---|---|---|---|
| Benzol<br>Benzole | Floats on water. Flammable, irritating vapor is produced. Freezing point is 42°F. | | |

Avoid contact with liquid and vapor. Keep people away.
Wear goggles and self-contained breathing apparatus.
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

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

**Water Pollution**

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Restrict access

## 2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: $C_6H_6$
3.3 IMO/UN Designation: 3.2/1114
3.4 DOT ID No.: 1114
3.5 CAS Registry No.: 71-43-2

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Aromatic; rather pleasant aromatic odor; characteristic odor

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Hydrocarbon vapor canister, supplied air or a hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene.
5.2 Symptoms Following Exposure: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death.
5.3 Treatment of Exposure: SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.
5.4 Threshold Limit Value: 10 ppm
5.5 Short Term Inhalation Limits: 75 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 3; $LD_{50}$ = 50 to 500 mg/kg
5.7 Late Toxicity: Leukemia
5.8 Vapor (Gas) Irritant Characteristics: If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 4.68 ppm
5.11 IDLH Value: 2,000 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 12°F C.C.
6.2 Flammable Limits in Air: 1.3%-7.9%
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back
6.7 Ignition Temperature: 1097°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 6.0 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

## 8. WATER POLLUTION

8.1 Aquatic Toxicity:
5 ppm/6 hr/minnow/lethal/distilled water
20 ppm/24 hr/sunfish/$TL_m$/tap water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 1.2 lb/lb, 10 days
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity:
Industrial pure ——98 + %
Thiophene-free ——99 + %
Nitration ——99 + %
Industrial 90% ——85 + %
Reagent ——99 + %
9.2 Storage Temperature: Open
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-V-W

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 3 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 1 |
| Poisons | 3 |
| Water Pollution | |
| Human Toxicity | 3 |
| Aquatic Toxicity | 1 |
| Aesthetic Effect | 3 |
| Reactivity | |
| Other Chemicals | 2 |
| Water | 1 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 3 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 78.11
12.3 Boiling Point at 1 atm: 176°F = 80.1°C = 353.3°K
12.4 Freezing Point: 42.0°F = 5.5°C = 278.7°K
12.5 Critical Temperature: 552.0°F = 288.8°C = 562.1°K
12.6 Critical Pressure: 710 psia = 48.3 atm = 4.89 MN/m²
12.7 Specific Gravity: 0.879 at 20°C (liquid)
12.8 Liquid Surface Tension: 28.8 dynes/cm = 0.0288 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 35.0 dynes/cm = 0.035 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 2.7
12.11 Ratio of Specific Heats of Vapor (Gas): 1.061
12.12 Latent Heat of Vaporization: 169 Btu/lb = 94.1 cal/g = 3.94 X $10^4$ J/kg
12.13 Heat of Combustion: —17,460 Btu/lb = —9698 cal/g = —406.0 X $10^4$ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 30.45 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 3.22 psia

NOTES

BNZ

# BENZENE

## 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 55 | 55.330 |
| 60 | 55.140 |
| 65 | 54.960 |
| 70 | 54.770 |
| 75 | 54.580 |
| 80 | 54.400 |
| 85 | 54.210 |
| 90 | 54.030 |
| 95 | 53.840 |
| 100 | 53.660 |
| 105 | 53.470 |
| 110 | 53.290 |
| 115 | 53.100 |
| 120 | 52.920 |
| 125 | 52.730 |
| 130 | 52.540 |
| 135 | 52.360 |
| 140 | 52.170 |
| 145 | 51.990 |
| 150 | 51.800 |
| 155 | 51.620 |
| 160 | 51.430 |
| 165 | 51.250 |
| 170 | 51.060 |
| 175 | 50.870 |

## 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 45 | .394 |
| 50 | .396 |
| 55 | .398 |
| 60 | .400 |
| 65 | .403 |
| 70 | .405 |
| 75 | .407 |
| 80 | .409 |
| 85 | .411 |
| 90 | .414 |
| 95 | .416 |
| 100 | .418 |

## 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| 75 | .988 |
| 80 | .981 |
| 85 | .975 |
| 90 | .969 |
| 95 | .962 |
| 100 | .956 |
| 105 | .950 |
| 110 | .944 |
| 115 | .937 |
| 120 | .931 |
| 125 | .925 |
| 130 | .919 |
| 135 | .912 |
| 140 | .906 |
| 145 | .900 |
| 150 | .893 |
| 155 | .887 |
| 160 | .881 |
| 165 | .875 |
| 170 | .868 |

## 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| 55 | .724 |
| 60 | .693 |
| 65 | .665 |
| 70 | .638 |
| 75 | .612 |
| 80 | .588 |
| 85 | .566 |
| 90 | .544 |
| 95 | .524 |
| 100 | .505 |
| 105 | .487 |
| 110 | .470 |
| 115 | .453 |
| 120 | .438 |

## 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| 77.02 | .180 |

## 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 50 | .881 |
| 60 | 1.171 |
| 70 | 1.535 |
| 80 | 1.989 |
| 90 | 2.547 |
| 100 | 3.227 |
| 110 | 4.049 |
| 120 | 5.033 |
| 130 | 6.201 |
| 140 | 7.577 |
| 150 | 9.187 |
| 160 | 11.060 |
| 170 | 13.220 |
| 180 | 15.700 |
| 190 | 18.520 |
| 200 | 21.740 |
| 210 | 25.360 |

## 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 50 | .01258 |
| 60 | .01639 |
| 70 | .02109 |
| 80 | .02681 |
| 90 | .03371 |
| 100 | .04196 |
| 110 | .05172 |
| 120 | .06317 |
| 130 | .07652 |
| 140 | .09184 |
| 150 | .10960 |
| 160 | .12980 |
| 170 | .15270 |
| 180 | .17850 |
| 190 | .20750 |
| 200 | .23970 |
| 210 | .27560 |

## 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .204 |
| 25 | .219 |
| 50 | .234 |
| 75 | .248 |
| 100 | .261 |
| 125 | .275 |
| 150 | .288 |
| 175 | .301 |
| 200 | .313 |
| 225 | .325 |
| 250 | .337 |
| 275 | .349 |
| 300 | .360 |
| 325 | .371 |
| 350 | .381 |
| 375 | .392 |
| 400 | .402 |
| 425 | .412 |
| 450 | .421 |
| 475 | .431 |
| 500 | .440 |
| 525 | .449 |
| 550 | .457 |
| 575 | .465 |
| 600 | .474 |

# CARBON TETRACHLORIDE

CBT

| Common Synonyms | Watery liquid | Colorless | Sweet odor |
|---|---|---|---|
| Carbon Tet<br>Tetrachloromethane<br>Benzinoform<br>Necatorina<br>Perchloromethane | Sinks in water. Poisonous vapor is produced. | | |

Avoid contact with liquid and vapor. Keep people away.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Notify local health and pollution control agencies.

**Fire**

Not flammable.
POISONOUS AND IRRITATING GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.

**Exposure**

CALL FOR MEDICAL AID

VAPOR
POISONOUS IF INHALED.
Irritating to eyes.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

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

**Water Pollution**

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and pollution control officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison
Restrict access
Should be removed

## 2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: $CCl_4$
3.3 IMO/UN Designation: 6.1/1846
3.4 DOT ID No.: 1846
3.5 CAS Registry No.: 56-23-5

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Sweetish, aromatic, moderately strong ethereal; somewhat resembling that of chloroform.

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor canister with full face mask; protective clothing; rubber gloves.
5.2 Symptoms Following Exposure: Dizziness, incoordination, anesthesia; may be accompanied by nausea and liver damage. Kidney damage also occurs, often producing decrease or stopping of urinary output.
5.3 Treatment of Exposure: EYES AND SKIN: flush with plenty of water; for eyes, get medical attention. Remove contaminated clothing and wash before reuse. INHALATION: immediately remove to fresh air, keep patient warm and quiet and get medical attention promptly. Start artificial respiration if breathing stops. INGESTION: induce vomiting and get medical attention promptly. No specific antidote known.
5.4 Threshold Limit Value: 5 ppm
5.5 Short Term Inhalation Limits: 25 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: Causes severe liver damage and death if ingested.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Greater than 10 ppm
5.11 IDLH Value: 300 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Forms poisonous phosgene gas when exposed to open flames.
6.6 Behavior in Fire: Decomposes to form chlorine and phosgene
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 36

## 8. WATER POLLUTION

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

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial; technical; USP
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS Hazard Rating for Bulk Water

Transportation:

| Category | Rating |
|---|---|
| Fire | 0 |
| Health | |
| Vapor Irritant | 2 |
| Liquid or Solid Irritant | 1 |
| Poisons | 4 |
| Water Pollution | |
| Human Toxicity | 2 |
| Aquatic Toxicity | 2 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 0 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 3 |
| Flammability (Red) | 0 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 153.83
12.3 Boiling Point at 1 atm: 170°F = 76.5°C = 349.7°K
12.4 Freezing Point: −9.4°F = −23.0°C = 250.2°K
12.5 Critical Temperature: 541°F = 283°C = 556°K
12.6 Critical Pressure: 660 psia = 45 atm = 4.6 MN/m²
12.7 Specific Gravity: 1.58 at 20°C (liquid)
12.8 Liquid Surface Tension: 27.0 dynes/cm = 0.027 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 45.0 dynes/cm = 0.045 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 5.3
12.11 Ratio of Specific Heats of Vapor (Gas): 1.111
12.12 Latent Heat of Vaporization: 84.2 Btu/lb = 46.8 cal/g = 1.958 X $10^5$ J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 5.09 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 3.8 psia

NOTES

CBT

# CARBON TETRACHLORIDE

## 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 35 | 101.700 |
| 40 | 101.400 |
| 45 | 101.099 |
| 50 | 100.700 |
| 55 | 100.400 |
| 60 | 100.099 |
| 65 | 99.750 |
| 70 | 99.410 |
| 75 | 99.080 |
| 80 | 98.740 |
| 85 | 98.410 |
| 90 | 98.070 |
| 95 | 97.730 |
| 100 | 97.389 |
| 105 | 97.059 |
| 110 | 96.719 |
| 115 | 96.379 |
| 120 | 96.040 |

## 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 35 | .201 |
| 40 | .203 |
| 45 | .206 |
| 50 | .208 |
| 55 | .210 |
| 60 | .212 |
| 65 | .215 |
| 70 | .217 |
| 75 | .219 |
| 80 | .221 |
| 85 | .223 |
| 90 | .226 |
| 95 | .228 |
| 100 | .230 |
| 105 | .232 |
| 110 | .235 |
| 115 | .237 |
| 120 | .239 |
| 125 | .241 |
| 130 | .243 |
| 135 | .246 |
| 140 | .248 |

## 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| 30 | .724 |
| 40 | .715 |
| 50 | .707 |
| 60 | .698 |
| 70 | .690 |
| 80 | .682 |
| 90 | .673 |
| 100 | .665 |
| 110 | .656 |
| 120 | .648 |
| 130 | .640 |
| 140 | .631 |
| 150 | .623 |
| 160 | .615 |
| 170 | .606 |

## 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| 35 | 1.307 |
| 40 | 1.247 |
| 45 | 1.192 |
| 50 | 1.140 |
| 55 | 1.091 |
| 60 | 1.045 |
| 65 | 1.001 |
| 70 | .961 |
| 75 | .922 |
| 80 | .886 |
| 85 | .852 |
| 90 | .820 |
| 95 | .790 |
| 100 | .761 |
| 105 | .734 |
| 110 | .708 |
| 115 | .683 |
| 120 | .660 |
| 125 | .638 |
| 130 | .617 |
| 135 | .597 |
| 140 | .578 |

## 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| 77.02 | .080 |

## 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 40 | .815 |
| 50 | 1.088 |
| 60 | 1.435 |
| 70 | 1.874 |
| 80 | 2.422 |
| 90 | 3.102 |
| 100 | 3.937 |
| 110 | 4.956 |
| 120 | 6.190 |
| 130 | 7.672 |
| 140 | 9.442 |
| 150 | 11.540 |
| 160 | 14.010 |
| 170 | 16.910 |
| 180 | 20.300 |
| 190 | 24.210 |
| 200 | 28.740 |
| 210 | 33.930 |

## 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 40 | .02339 |
| 50 | .03059 |
| 60 | .03958 |
| 70 | .05069 |
| 80 | .06431 |
| 90 | .08087 |
| 100 | .10080 |
| 110 | .12470 |
| 120 | .15300 |
| 130 | .18650 |
| 140 | .22560 |
| 150 | .27130 |
| 160 | .32410 |
| 170 | .38500 |
| 180 | .45470 |
| 190 | .53410 |
| 200 | .62430 |
| 210 | .72610 |

## 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .123 |
| 25 | .126 |
| 50 | .128 |
| 75 | .130 |
| 100 | .132 |
| 125 | .134 |
| 150 | .136 |
| 175 | .138 |
| 200 | .139 |
| 225 | .141 |
| 250 | .143 |
| 275 | .144 |
| 300 | .145 |
| 325 | .147 |
| 350 | .148 |
| 375 | .149 |
| 400 | .150 |
| 425 | .151 |
| 450 | .152 |
| 475 | .152 |
| 500 | .153 |
| 525 | .153 |
| 550 | .154 |
| 575 | .154 |
| 600 | .155 |

# CHLOROBENZENE

CRE

| Common Synonyms | Watery liquid | Colorless | Sweet, almond odor |
|---|---|---|---|
| Monochlorobenzene<br>Phenyl chloride<br>Benzene chloride<br>MCB | Sinks in water. Flammable vapor is produced. | | |

Avoid contact with liquid and vapor. Keep people away.
Stop discharge if possible.
Call fire department.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus
Extinguish with dry chemical, foam, or carbon dioxide.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
If inhaled, will cause coughing or dizziness.
Not irritating to eyes, nose and throat.
Move to fresh air.
If breathing has stopped, give artificial respiration
If breathing is difficult, give oxygen

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

**Water Pollution**

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

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

## 2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: $C_6H_5Cl$
3.3 IMO/UN Designation: 3.3/1134
3.4 DOT ID No.: 1134
3.5 CAS Registry No.: 108-90-7

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Mild amine odor; sweet, almond- like; aromatic

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor-acid gas respirator where appropriate; neoprene or vinyl gloves; chemical safety spectacles, plus face shield where appropriate; rubber footwear; apron or impervious clothing for splash protection; hard hat.
5.2 Symptoms Following Exposure: Irritating to skin, eyes and mucous membranes. Repeated exposure of skin may cause dermatitis due to defatting action. Chronic inhalation of vapors or mist may result in damage to lungs, liver, and kidneys. Acute vapor exposures can cause symptoms ranging from coughing to transient anesthesia and central nervous system depression.
5.3 Treatment of Exposure: Get medical attention for all eye exposures and any serious over-exposures. Treat the symptoms. INHALATION: remove to clean air; administer oxygen as needed. INGESTION: dilute by drinking water; if vomiting occurs, administer more water. Administer saline laxative. EYES: flush thoroughly with water. SKIN: remove contaminated clothing, wash exposed area with soap and water.
5.4 Threshold Limit Value: 75 ppm
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 0.5 to 5 g/kg (rat, rabbit)
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to the eyes and throat.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.21 ppm
5.11 IDLH Value: 2,400 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 84°F C.C.; 87°F O.C.
6.2 Flammable Limits in Air: 1.3%-7.1%
6.3 Fire Extinguishing Agents: Carbon dioxide, dry chemical, foam or water spray
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Burning in open flame can form toxic phosgene and hydrogen chloride gases.
6.6 Behavior in Fire: Heavy vapor can travel a considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 1184°F
6.8 Electrical Hazard: Data not available
6.9 Burning Rate: (est.) 4.6 mm/min.
6.10 Adiabatic Flame Temperature: Data not available

(Continued)

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 36

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: 20 ppm/96 hr/bluegill/$TL_m$/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0.3 lb/lb, 5 days
8.4 Food Chain Concentration Potential: Data not available

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: 99.5%; technical
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-X

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 3 |
| Health | |
| Vapor Irritant | 0 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 1 |
| Aquatic Toxicity | 3 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 0 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 3 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 112.56
12.3 Boiling Point at 1 atm: 270°F = 132°C = 405°K
12.4 Freezing Point: —50.1°F = —45.6°C = 227.6°K
12.5 Critical Temperature: 676°F = 359°C = 632°K
12.6 Critical Pressure: 656 psia = 44.6 atm = 4.52 MN/m²
12.7 Specific Gravity: 1.11 at 20°C (liquid)
12.8 Liquid Surface Tension: 33 dynes/cm = 0.033 N/m at 25°C
12.9 Liquid Water Interfacial Tension: 37.41 dynes/cm = 0.03741 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.094
12.12 Latent Heat of Vaporization: 135 Btu/lb = 75 cal/g = 3.140 X $10^3$ J/kg
12.13 Heat of Combustion: (est.) 12,000 Btu/lb = 6700 cal/g = 280 X $10^3$ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 20.40 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.5 psia

## 6. FIRE HAZARDS (Continued)

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

CRB

# CHLOROBENZENE

## 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 35 | 70.419 |
| 40 | 70.230 |
| 45 | 70.040 |
| 50 | 69.849 |
| 55 | 69.660 |
| 60 | 69.469 |
| 65 | 69.270 |
| 70 | 69.080 |
| 75 | 68.889 |
| 80 | 68.700 |
| 85 | 68.500 |
| 90 | 68.309 |
| 95 | 68.120 |
| 100 | 67.919 |
| 105 | 67.730 |
| 110 | 67.530 |
| 115 | 67.339 |
| 120 | 67.139 |
| 125 | 66.950 |
| 130 | 66.750 |
| 135 | 66.559 |
| 140 | 66.360 |
| 145 | 66.169 |
| 150 | 65.969 |
| 155 | 65.770 |
| 160 | 65.580 |

## 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 40 | .316 |
| 50 | .317 |
| 60 | .319 |
| 70 | .321 |
| 80 | .323 |
| 90 | .325 |
| 100 | .327 |
| 110 | .329 |
| 120 | .331 |
| 130 | .333 |
| 140 | .335 |
| 150 | .337 |
| 160 | .339 |
| 170 | .341 |
| 180 | .343 |
| 190 | .345 |
| 200 | .347 |
| 210 | .349 |

## 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| —20 | .956 |
| —10 | .946 |
| 0 | .937 |
| 10 | .927 |
| 20 | .917 |
| 30 | .908 |
| 40 | .898 |
| 50 | .888 |
| 60 | .879 |
| 70 | .869 |
| 80 | .859 |
| 90 | .850 |
| 100 | .840 |
| 110 | .830 |
| 120 | .821 |
| 130 | .811 |
| 140 | .801 |
| 150 | .792 |
| 160 | .782 |
| 170 | .772 |

## 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| 35 | 1.027 |
| 40 | .987 |
| 45 | .949 |
| 50 | .914 |
| 55 | .880 |
| 60 | .848 |
| 65 | .818 |
| 70 | .790 |
| 75 | .763 |
| 80 | .738 |
| 85 | .713 |
| 90 | .690 |
| 95 | .668 |
| 100 | .648 |
| 105 | .628 |
| 110 | .609 |
| 115 | .591 |
| 120 | .574 |
| 125 | .558 |
| 130 | .542 |
| 135 | .527 |
| 140 | .513 |
| 145 | .499 |
| 150 | .486 |
| 155 | .473 |

## 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| 77.02 | .049 |

## 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 20 | .032 |
| 30 | .048 |
| 40 | .069 |
| 50 | .099 |
| 60 | .140 |
| 70 | .195 |
| 80 | .269 |
| 90 | .366 |
| 100 | .492 |
| 110 | .656 |
| 120 | .865 |
| 130 | 1.130 |
| 140 | 1.464 |
| 150 | 1.880 |
| 160 | 2.394 |
| 170 | 3.026 |
| 180 | 3.797 |
| 190 | 4.731 |
| 200 | 5.856 |
| 210 | 7.203 |

## 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 20 | .00071 |
| 30 | .00102 |
| 40 | .00145 |
| 50 | .00204 |
| 60 | .00283 |
| 70 | .00386 |
| 80 | .00522 |
| 90 | .00698 |
| 100 | .00923 |
| 110 | .01207 |
| 120 | .01565 |
| 130 | .02010 |
| 140 | .02560 |
| 150 | .03233 |
| 160 | .04051 |
| 170 | .05039 |
| 180 | .06224 |
| 190 | .07636 |
| 200 | .09309 |
| 210 | .11280 |

## 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .178 |
| 25 | .188 |
| 50 | .198 |
| 75 | .207 |
| 100 | .217 |
| 125 | .226 |
| 150 | .235 |
| 175 | .244 |
| 200 | .252 |
| 225 | .261 |
| 250 | .269 |
| 275 | .277 |
| 300 | .285 |
| 325 | .292 |
| 350 | .300 |
| 375 | .307 |
| 400 | .314 |
| 425 | .320 |
| 450 | .327 |
| 475 | .333 |
| 500 | .340 |
| 525 | .345 |
| 550 | .351 |
| 575 | .357 |
| 600 | .362 |

ENVIROMENTAL RESOURCE ASSOCIATES -- DEMAND LAB WASTEWATR
MATERIAL SAFETY DATA SHEET
NSN: 685000N038656
Manufacturer's CAGE: 1R664
Part No. Indicator: A
Part Number/Trade Name: DEMAND LAB WASTEWATR

==========

General Information

==========

Company's Name: ENVIROMENTAL RESOURCE ASSOCIATES
Company's Street: 5540 MARSHALL ST
Company's City: ARVADA
Company's State: CO
Company's Country: US
Company's Zip Code: 80002
Company's Emerg Ph #: 303-431-8454
Company's Info Ph #: 303-431-8454
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 15MAR92
Safety Data Review Date: 21JAN93
MSDS Preparer's Name: DANIEL A. GOLDSTEIN
Preparer's Company: SAME
MSDS Serial Number: BRHJM
Hazard Characteristic Code: NK

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: D-GLUCOSE; (DEXTROSE)
Ingredient Sequence Number: 01
Percent: < 1.0
NIOSH (RTECS) Number: LZ6600000
CAS Number: 50-99-7
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

---

Proprietary: NO
Ingredient: GLUTAMIC ACID, L-; (GLUTAMIC ACID)
Ingredient Sequence Number: 02
Percent: < 1.0
NIOSH (RTECS) Number: LZ9700000
CAS Number: 56-86-0
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

---

Proprietary: NO
Ingredient: POTASSIUM PHOSPHATE, MONOBASIC; (POTASSIUM PHOSPHATE)
Ingredient Sequence Number: 03
Percent: < 1.0
NIOSH (RTECS) Number: 1002090PP
CAS Number: 7778-77-0
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

---

Proprietary: NO
Ingredient: GLYCEROPHOSPHATE; (GLYCEROPHOSPHORIC ACID)
Ingredient Sequence Number: 04
Percent: <1.0
NIOSH (RTECS) Number: 1008700GL

CAS Number: 27082-31-1
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE
---
Proprietary: NO
Ingredient: SODIUM HYDROXIDE (SARA III)
Ingredient Sequence Number: 05
Percent: <1.0
NIOSH (RTECS) Number: WB4900000
CAS Number: 1310-73-2
OSHA PEL: 2 MG/M3
ACGIH TLV: C 2 MG/M3; 9293

## Physical/Chemical Characteristics

Appearance And Odor: COLORLESS TO YELLOW ORANGE. NO ODOR.
Boiling Point: 212F,100C
Melting Point: N/A
Vapor Pressure (MM Hg/70 F): 23.75@ 25C
Vapor Density (Air=1): N/A
Specific Gravity: COMPLETE
Evaporation Rate And Ref: 1 (WATER=1)
Solubility In Water: COMPLETE
pH: 13

## Fire and Explosion Hazard Data

Flash Point: NONE
Lower Explosive Limit: N/A
Upper Explosive Limit: N/A
Extinguishing Media: EXTINGUISHING MEDIA SUITABLE FOR SURROUNDING FIRE (FP N).
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA AND FULL PROTECTIVE EQUIPMENT (FP N).
Unusual Fire And Expl Hazrds: NONE

## Reactivity Data

Stability: YES
Cond To Avoid (Stability): NONE
Materials To Avoid: NONE SPECIFIED BY MANUFACTURER.
Hazardous Decomp Products: NONE SPECIFIED BY MANUFACTURER.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

## Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ALTHOUGH WELL BUFFERED THIS SUBSTANCE MAY CAUSE SOME IRRITATION, BURNING, REDNESS, PAIN AND COUGH IF SPILLED ON THE SKIN, OR SPLASHED IN THE EYE, OR INHALED. IF INGESTED MAY CAUSE MINOR DISCOMFORT BUT ESOPHAGEAL BURNS, GASTRIC BURNS OR OTHER SERIOUS BURNS ARE UNLIKELY.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: BURNING, PAIN, IRRITATION, DEFATTING,

CONSISTENT WITH PH OF 13.5 BUT MODIFIED BY BUFFERING. MAY CAUSE COUGH OR BRONCHITIS.
Med Cond Aggravated By Exp: DERMATITIS, BRONCHITITIS.
Emergency/First Aid Proc: INHAL: REMOVE FROM EXPOSURE. SKIN: FLUSH WITH WATER. INGEST: DILUTE WITH WATER OR MILK. CONSULT LOCAL PHYSICIAN OR PCC. EYES: IMMEDIATELY FLUSH WITH POTABLE WATER FOR A MINIMUM OF 15 MIN. SEEK ASSISTANCE FROM MD (FP N).

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: DAM UP, DILUTE, AND WASH TO DRAINS OR ABSORB AND COLLECT. MAY BE NEUTRALIZED WITH ACID FORMING CLEANUP KIT.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DILUTE AND WASH TO DRAINS, OR NEUTRALIZE AND ABSORB. DISPOSAL MUST BE IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS (FP N).
Precautions-Handling/Storing: PROTECT FROM FREEZING. AVOID BREAKAGE.
Other Precautions: IF PACKAGED IN GLASS, TAKE CARE TO AVOID BREAKAGE AND SKIN OR EYE CONTACT.

## Control Measures

Respiratory Protection: NIOSH/MSHA APPROVED DUST/MIST MASK IF MIST IS FORMED.
Ventilation: LOCAL EXHAUST/MECHANICAL: FOR MIST.
Protective Gloves: WATER/ALKALI RESISTANT.
Eye Protection: CHEMICAL WORKERS GOGGLES (FP N).
Other Protective Equipment: LABORATORY COAT, CLOSED SHOES.
Work Hygienic Practices: AVOID MAKING MIST OR BREATHING FUME WHICH MAY BE IRRITANT TO A MINOR DEGREE.
Suppl. Safety & Health Data: NONE SPECIFIED BY MANUFACTURER.

## Transportation Data

## Disposal Data

## Label Data

Label Required: YES
Technical Review Date: 21JAN93
Label Date: 18JAN93
Label Status: G
Common Name: DEMAND LAB WASTEWATR
Chronic Hazard: NO
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE: SKIN OR EYE CONTACT MAY CAUSE IRRITATION. INHALATION MAY CAUSE PAIN AND COUGH. INGESTION MAY CAUSE MINOR DISCOMFORT. CHRONIC: NONE SPECIFIED BY MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: ENVIROMENTAL RESOURCE ASSOCIATES
Label Street: 5540 MARSHALL ST
Label City: ARVADA
Label State: CO

Label Zip Code: 80002
Label Country: US
Label Emergency Number: 303-431-8454

# 1,1-DICHLOROETHANE

DCH

| Common Synonyms | Oily liquid | Colorless | Chloroform like ethereal |
|---|---|---|---|
| Ethylidene chloride<br>Ethylidene dichloride<br>Chlorinated hydrochloric ether | Sinks and mixes with water. | | |

Wear goggles, self-contained breathing apparatus, and rubber overclothing
Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

Flammable.
POISONOUS GAS MAY BE PRODUCED IN FIRE OR WHEN HEATED.
Containers may explode in fire.
Wear goggles and self-contained breathing apparatus.
Extinguish with alcohol foam, carbon dioxide, or dry chemical.
Water may be ineffective on fire.

**Exposure**

CALL FOR MEDICAL AID.

LIQUID
If swallowed may cause nausea, vomiting and faintness.
Irritating to skin and eyes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS have victim drink water or milk and induce vomiting.

**Water Pollution**

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability.
Restrict access.
Chemical and physical treatment.

## 2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: $C_2H_4Cl_2$
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 2362
3.5 CAS Registry No.: 75-34-3

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Oily liquid
4.2 Color: Colorless
4.3 Odor: Chloroform

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: In areas of poor ventilation or high concentration, a self-contained breathing apparatus with full face mask should be worn. Chemical workers goggles, rubber gloves, and protective clothing should be worn.

5.2 Symptoms Following Exposure: INHALATION: Irritation of respiratory tract. Salivation, sneezing, coughing, dizziness, nausea, and vomiting. EYES: Irritation, lacrimation, and reddening of conjunctiva. SKIN: Irritation. Prolonged or repeated skin contact can produce a slight burn. INGESTION: Ingestion incidental to industrial handling is not considered to be a problem. Swallowing of substantial amounts could cause nausea, vomiting, faintness, drowsiness, cyanosis, and circulatory failure.

5.3 Treatment of Exposure: Call a doctor. INHALATION: Remove from contaminated area; keep warm and quiet. If breathing has stopped, give artificial respiration. Administer oxygen. EYES: Flush with large amounts of water or weak bicarbonate of soda solution. SKIN: Dilute with large amounts of water. Remove contaminated clothing. INGESTION: Attempt to empty stomach, dilute by administering fluids (tap water, soapy water, salt water, or milk).

5.4 Threshold Limit Value: 200 ppm.

5.5 Short Term Inhalation Limits: 250 ppm.

5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 0.5 to 5 g/kg (rat).

5.7 Late Toxicity: Chronic exposure may cause liver damage and dermatitis. Animal experimentation has shown this compound to be slightly embryo-toxic and to retard fetal development.

5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.

5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.

5.10 Odor Threshold: Data not available

5.11 IDLH Value: 4,000 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 57°F O.C. = 22°F C.C.

6.2 Flammable Limits in Air: 5.6% to 11.4%

6.3 Fire Extinguishing Agents: Alcohol foam, water, foam, $CO_2$, dry chemical, carbon tetrachloride

6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective

6.5 Special Hazards of Combustion Products: When heated to decomposition emits highly toxic fumes to phosgene.

6.6 Behavior in Fire: Explosion hazard

6.7 Ignition Temperature: 856°F

6.8 Electrical Hazard: Data not available

6.9 Burning Rate: Data not available

6.10 Adiabatic Flame Temperature: Data not available

6.11 Stoichiometric Air to Fuel Ratio: Data not available

6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction

7.2 Reactivity with Common Materials: Data not available

7.3 Stability During Transport: Data not available

7.4 Neutralizing Agents for Acids and Caustics: Data not available

7.5 Polymerization: Data not available

7.6 Inhibitor of Polymerization: Iable Data not available

7.7 Molar Ratio (Reactant to Product): Data not available

7.8 Reactivity Group: 36

## 8. WATER POLLUTION

8.1 Aquatic Toxicity:
$TL_m$ (Marine pinperch) 250 to 275 mg/l
24-hour $TL_m$ Brine shrimp: 320 mg/l
24-hour $TL_m$ Pinperch: 160 mg/l

8.2 Waterfowl Toxicity: Data not available

8.3 Biological Oxygen Demand (BOD): Percent, 0.05 g/g for 10 days Percent, 0.002 g/g for 5 days

8.4 Food Chain Concentration Potential: Data not available

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Data not available

9.2 Storage Temperature: Cool

9.3 Inert Atmosphere: Data not available

9.4 Venting: Data not available

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-R-S

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Not listed

11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 3 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid

12.2 Molecular Weight: 98.97

12.3 Boiling Point at 1 atm: 135.14°F = 57.3°C = 330.5°K

12.4 Freezing Point: —143.32°F = —97.4°C = 175.75°K

12.5 Critical Temperature: 502.7°F = 261.5°C = 534.65°K

12.6 Critical Pressure: 734.8 psia = 50 atm = 5.065 MN/m²

12.7 Specific Gravity: 1.174 at 20°C

12.8 Liquid Surface Tension: 24.75 dynes/cm = 0.02475 N/m at 20°C

12.9 Liquid Water Interfacial Tension: Data not available

12.10 Vapor (Gas) Specific Gravity: 3.42

12.11 Ratio of Specific Heats of Vapor (Gas): 1.136 at 20°C (68°F)

12.12 Latent Heat of Vaporization: 131.8 Btu/lb = 73.1 cal/g = $3.06 \times 10^4$ J/kg

12.13 Heat of Combustion: —4,774 Btu/lb = —2,652 cal/g = $-111 \times 10^4$ J/kg

12.14 Heat of Decomposition: Data not available

12.15 Heat of Solution: Data not available

12.16 Heat of Polymerization: Data not available

12.25 Heat of Fusion: Data not available

12.26 Limiting Value: Data not available

12.27 Reid Vapor Pressure: 7.35 psia

NOTES

DCH

# DICHLOROETHANE

## 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 35 | 75.198 |
| 40 | 74.929 |
| 45 | 74.660 |
| 50 | 74.389 |
| 55 | 74.120 |
| 60 | 73.851 |
| 65 | 73.580 |
| 70 | 73.311 |
| 75 | 73.042 |
| 80 | 72.771 |
| 85 | 72.502 |

## 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| | DATA NOT AVAILABLE |

## 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| 35 | .804 |
| 40 | .799 |
| 45 | .795 |
| 50 | .791 |
| 55 | .786 |
| 60 | .782 |
| 65 | .778 |
| 70 | .773 |
| 75 | .769 |
| 80 | .765 |
| 85 | .760 |
| 90 | .756 |
| 95 | .752 |
| 100 | .747 |
| 105 | .743 |
| 110 | .739 |

## 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| 35 | .617 |
| 40 | .595 |
| 45 | .574 |
| 50 | .555 |
| 55 | .537 |
| 60 | .520 |
| 65 | .504 |
| 70 | .489 |
| 75 | .475 |
| 80 | .462 |
| 85 | .449 |
| 90 | .437 |
| 95 | .426 |
| 100 | .415 |
| 105 | .405 |
| 110 | .395 |
| 115 | .386 |
| 120 | .377 |

## 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| 68 | .500 |

## 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| —70 | —1.334 |
| —60 | —1.944 |
| —50 | —.555 |
| —40 | .835 |
| —30 | .225 |
| —20 | .386 |
| —10 | .996 |
| 0 | 1.607 |
| 10 | 2.217 |
| 20 | 2.827 |
| 30 | 3.438 |
| 40 | 4.048 |
| 50 | 4.658 |
| 60 | 5.269 |
| 70 | 5.879 |
| 80 | 6.489 |
| 90 | 7.100 |
| 100 | 7.710 |
| 110 | 8.321 |
| 120 | 8.931 |
| 130 | 9.541 |

## 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| —100 | .07407 |
| —80 | .05000 |
| —60 | .02594 |
| —40 | .00187 |
| —20 | .02219 |
| 0 | .04626 |
| 20 | .07032 |
| 40 | .09439 |
| 60 | .11845 |
| 80 | .14252 |
| 100 | .16658 |
| 120 | .19065 |
| 140 | .21471 |
| 160 | .23878 |

## 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| | DATA NOT AVAILABLE |

Please reduce your browser font size for better viewing and printing.

**MSDS** Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Rod School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

# ETHYLENE GLYCOL MONOETHYL ETHER

**MSDS Number: E2600 — *Effective Date: 12/08/96***

## 1. Product Identification

**Synonyms:** 2-Ethoxyethanol; Cellosolve(tm)
**CAS No.:** 110-80-5
**Molecular Weight:** 90.12
**Chemical Formula:** C2H5OCH2CH2OH
**Product Codes:** J.T. Baker: 9058, L210 Mallinckrodt: 1843, 5079

## 2. Composition/Information on Ingredients

| Ingredient | CAS No | Percent | Hazardous |
|---|---|---|---|
| 2-Ethoxyethanol | 110-80-5 | 100% | Yes |

## 3. Hazards Identification

**Emergency Overview**

**WARNING! FLAMMABLE LIQUID AND VAPOR. MAY FORM EXPLOSIVE PEROXIDES IN AIR. HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM, BLOOD AND BLOOD FORMING ORGANS, REPRODUCTIVE SYSTEM, LIVER AND KIDNEYS. POSSIBLE BIRTH DEFECT HAZARD. MAY CAUSE BIRTH DEFECTS BASED ON ANIMAL DATA.**

**MAY CAUSE IRRITATION TO SKIN.**

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

---

Health Rating: 3 - Severe (Life)
Flammability Rating: 2 - Moderate
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Life)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

---

**Potential Health Effects**

---

**Inhalation:**
Causes irritation to the respiratory tract. Symptoms may include sore throat, coughing, headache, nausea and shortness of breath. High concentrations have a narcotic effect.

**Ingestion:**
Swallowing may cause nausea, vomiting, abdominal pain, breathing difficulties, weakness. Liver and kidney damage may result from swallowing large quantities of the material.

**Skin Contact:**
May cause irritation with redness and pain. May be absorbed through the skin with possible systemic effects.

**Eye Contact:**
Vapors are irritating and may produce immediate pain, redness and tearing. Splashes can cause severe pain, stinging, swelling.

**Chronic Exposure:**
Prolonged exposure may cause injury to bone marrow, blood cells, kidney, liver and reproductive system. A suspected human reproductive and birth defect hazard.

**Aggravation of Pre-existing Conditions:**
Persons with pre-existing blood or central nervous system disorders may be more susceptible to the effects of this substance.

---

# 4. First Aid Measures

**Inhalation:**
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

**Ingestion:**

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Call a physician.

**Skin Contact:**
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

**Eye Contact:**
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

# 5. Fire Fighting Measures

**Fire:**
Flash point: 43C (109F) CC Autoignition temperature: 235C (455F) Flammable limits in air % by volume: lel: 1.7; uel: 15.7 Flammable liquid. May produce a floating fire hazard in extreme fire conditions.

**Explosion:**
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Sealed containers may rupture when heated. Contact with strong oxidizers may cause fire. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.

**Fire Extinguishing Media:**
Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.

**Special Information:**
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

# 6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number

for the US Coast Guard National Response Center is (800) 424-8802. J. T. Baker SOLUSORB(tm) solvent adsorbent is recommended for spills of this product.

## 7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Sudden release of hot organic chemical vapors or mists from process equipment operating at elevated temperatures and pressure, or sudden ingress of air into vacuum equipment, may result in ignitions without the presence of ignition sources. Published "autoignition" or "ignition" temperature values cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions.

## 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**
-OSHA Permissible Exposure Limit (PEL): 200 ppm (TWA) skin -ACGIH Threshold Limit Value (TLV): 5 ppm (TWA) skin

**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

**Personal Respirators (NIOSH Approved):**
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. (Butyl).

**Eye Protection:**
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye

wash fountain and quick-drench facilities in work area.

## 9. Physical and Chemical Properties

**Appearance:**
Clear, colorless liquid.

**Odor:**
Mild pleasant odor.

**Solubility:**
Miscible in water.

**Density:**
0.93 @ 20C/20C

**pH:**
No information found.

**% Volatiles by volume @ 21C (70F):**
100

**Boiling Point:**
135C (275F)

**Melting Point:**
-70C (-94F)

**Vapor Density (Air=1):**
3.1

**Vapor Pressure (mm Hg):**
3.8 @ 20C (68F)

**Evaporation Rate (BuAc=1):**
0.32

## 10. Stability and Reactivity

**Stability:**
Stable under ordinary conditions of use and storage. Do not distill to dryness. Avoid excessive temperatures or prolonged reflux, such as in batch distillations. Formation of explosive peroxides has been reported from auto-oxidation. Reported to dissolve aluminum from scratched or heated aluminum surfaces.

**Hazardous Decomposition Products:**

Carbon dioxide and carbon monoxide may form when heated to decomposition.

**Hazardous Polymerization:**
Will not occur.

**Incompatibilities:**
Strong oxidizers, strong acids, strong bases, copper, aluminum.

**Conditions to Avoid:**
Heat, flame, ignition sources, air, incompatibles

---

# 11. Toxicological Information

**Toxicological Data:**
Oral rat LD50: 2125 mg/kg; inhalation rat LC50: 2000 ppm/7H; irritation eye rabbit, standard Draize: 50 mg moderate; skin rabbit, standard Draize: 500 mg open mild; investigated as a tumorigen, mutagen, reproductive effector.

**Reproductive Toxicity:**
In laboratory animals, this compound has caused both birth defects and damage to the reproductive system. Exposure to this compound has also caused decreased sperm counts in humans.

--------\Cancer Lists\----------

| Ingredient | ---NTP Carcinogen--- Known | Anticipated | IARC Category |
|---|---|---|---|
| 2-Ethoxyethanol (110-80-5) | No | No | None |

---

# 12. Ecological Information

**Environmental Fate:**
When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material may leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of less than 1 day.

**Environmental Toxicity:**
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

---

# 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

# 14. Transport Information

**Domestic (Land, D.O.T.)**

---

Proper Shipping Name: ETHYLENE GLYCOL MONOETHYL ETHER
Hazard Class: 3
UN/NA: UN1171
Packing Group: III
Information reported for product/size: 20L

**International (Water, I.M.O.)**

---

Proper Shipping Name: ETHYLENE GLYCOL MONOETHYL ETHER
Hazard Class: 3.3
UN/NA: UN1171
Packing Group: III
Information reported for product/size: 20L

**International (Air, I.C.A.O.)**

---

Proper Shipping Name: ETHYLENE GLYCOL MONOETHYL ETHER
Hazard Class: 3.3
UN/NA: UN1171
Packing Group: III
Information reported for product/size: 20L

---

# 15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

| Ingredient | TSCA | EC | Japan | Australia |
|---|---|---|---|---|
| 2-Ethoxyethanol (110-80-5) | Yes | Yes | Yes | Yes |

--------\Chemical Inventory Status - Part 2\--------

| Ingredient | Korea | --Canada-- DSL | NDSL | Phil. |
|---|---|---|---|---|
| 2-Ethoxyethanol (110-80-5) | Yes | Yes | No | Yes |

--------\Federal, State & International Regulations - Part 1\----------

| Ingredient | -SARA 302- RQ | TPQ | List | ------SARA 313------ Chemical Catg. |
|---|---|---|---|---|
| 2-Ethoxyethanol (110-80-5) | No | No | Yes | No |

--------\Federal, State & International Regulations - Part 2\----------

| Ingredient | CERCLA | -RCRA- 261.33 | -TSCA- 8(d) |
|---|---|---|---|
| 2-Ethoxyethanol (110-80-5) | 1000 | U359 | No |

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: Yes (Pure / Liquid)

**Prop 65:**
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

**Australian Hazchem Code:** 2S
**Poison Schedule:** No information found.

**WHMIS:**
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

# 16. Other Information

**NFPA Ratings: Health:** 2 **Flammability:** 2 **Reactivity:** 3

**Label Hazard Warning:**
WARNING! FLAMMABLE LIQUID AND VAPOR. MAY FORM EXPLOSIVE PEROXIDES IN AIR. HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM, BLOOD AND BLOOD FORMING ORGANS, REPRODUCTIVE SYSTEM, LIVER AND KIDNEYS. POSSIBLE BIRTH DEFECT HAZARD. MAY CAUSE BIRTH DEFECTS BASED ON ANIMAL DATA. MAY CAUSE IRRITATION TO SKIN.

**Label Precautions:**
Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Keep away from heat, sparks and flame. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation.

**Label First Aid:**
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately

flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

**Product Use:**
Laboratory Reagent.

**Revision Information:**
Pure. New 16 section MSDS format, all sections have been revised.

**Disclaimer:**
**********
**Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.**
**********

**Prepared by:** Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

Please reduce your browser font size for better viewing and printing.

**MSDS** Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

# HEPTANE

**MSDS Number: H0584 --- *Effective Date: 09/30/97***

## 1. Product Identification

**Synonyms:** n-Heptane; normal heptane; dipropyl methane; heptyl hydride; Heptane blend
**CAS No.:** Not applicable to mixtures.
**Molecular Weight:** Not applicable to mixtures.
**Chemical Formula:**
**Product Codes:**
J.T. Baker: 5872, 9177, 9198, 9338, 9365, M955, M956
Mallinckrodt: 3162, 4830, 5139, 5166, 5177, 5178, V554

## 2. Composition/Information on Ingredients

| Ingredient | CAS No | Percent | Hazardous |
|---|---|---|---|
| Heptane | 142-82-5 | 40 - 60% | Yes |
| Methylhexanes | N/A | 20 - 30% | Yes |
| Dimethylpentanes | N/A | 5 - 10% | Yes |
| Methylcyclohexane | 108-87-2 | 10% | Yes |
| Toluene | 108-88-3 | 5% | Yes |

## 3. Hazards Identification

**Emergency Overview**

**DANGER! FLAMMABLE LIQUID AND VAPOR. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS.**

**J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)**

---

Health Rating: 1 - Slight
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

---

**Potential Health Effects**

---

**Inhalation:**
Inhalation of vapors irritates the respiratory tract. May produce light headedness, dizziness, muscle incoordination, loss of appetite and nausea. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.
**Ingestion:**
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
**Skin Contact:**
Causes irritation to skin. Symptoms include redness, itching, and pain.
**Eye Contact:**
Vapors may cause irritation. Splashes may cause redness and pain. Vapors may irritate the eyes. Splashes may produce redness, pain.
**Chronic Exposure:**
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Long term exposures may affect liver, kidneys, and central nervous system.
**Aggravation of Pre-existing Conditions:**
Persons with pre-existing skin disorders or impaired pulmonary function may be more susceptible to the effects of this substance.

## 4. First Aid Measures

**Inhalation:**
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
**Ingestion:**
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
**Skin Contact:**
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
**Eye Contact:**
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

## 5. Fire Fighting Measures

**Fire:**
Flash point: -4C (25F) CC
Autoignition temperature: 204C (399F)
Flammable limits in air % by volume:
lel: 1.05; uel: 6.7
Listed fire data is for n-Heptane. Flammable Liquid and Vapor!
**Explosion:**
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
**Fire Extinguishing Media:**
Dry chemical, foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool.
**Special Information:**
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

## 6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(tm) solvent adsorbent is recommended for spills of this product.

## 7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

## 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**
- OSHA Permissible Exposure Limit (PEL):
n-Heptane ..... 500 ppm (TWA)
Methylcyclohexane ..... 500 ppm (TWA)
Toluene ..... 200 ppm (TWA), 300 ppm (Ceiling), 500 ppm (Max. Conc; 10 minutes).
- ACGIH Threshold Limit Value (TLV):
n-Heptane ..... 400 ppm (TWA), 500 ppm (STEL)
Methylcyclohexane ..... 400 ppm (TWA)
Toluene ..... 50 ppm (TWA), skin, A4 - not classifiable as a human carcinogen.

**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
**Personal Respirators (NIOSH Approved):**
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
**Eye Protection:**
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

# 9. Physical and Chemical Properties

**Appearance:**
Clear, colorless liquid.
**Odor:**
Mild, gasoline-like.
**Solubility:**
Insoluble in water.
**Specific Gravity:**
0.697 @ 15.6C/15.6C
**pH:**
No information found.
**% Volatiles by volume @ 21C (70F):**
100
**Boiling Point:**
91C (196F)
**Melting Point:**
- 91C (-132F)
**Vapor Density (Air=1):**

3.5
**Vapor Pressure (mm Hg):**
40 @ 20C (68F)
**Evaporation Rate (BuAc=1):**
> 1

## 10. Stability and Reactivity

**Stability:**
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
**Hazardous Decomposition Products:**
Carbon dioxide and carbon monoxide may form when heated to decomposition.
**Hazardous Polymerization:**
Will not occur.
**Incompatibilities:**
Strong oxidizers.
**Conditions to Avoid:**
Heat, flames, ignition sources and incompatibles.

## 11. Toxicological Information

For n-Heptane: LC50 inhalation rat 103 gm/m3/4H.
For Toluene: LD50 oral rat 6365 mg/kg; LC50 inhalation rat 49 gm/m3/4H; LD50 skin rabbit 14100 ul/kg; investigated as a tumorigen, mutagen and reproductive effector.

--------\Cancer Lists\----------

| Ingredient | ---NTP Carcinogen--- Known | Anticipated | IARC Category |
|---|---|---|---|
| Heptane (142-82-5) | No | No | None |
| Methylhexanes | No | No | None |
| Dimethylpentanes | No | No | None |
| Methylcyclohexane (108-87-2) | No | No | None |
| Toluene (108-88-3) | No | No | 3 |

## 12. Ecological Information

**Environmental Fate:**
For n-Heptane: When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. This material has an estimated bioconcentration factor (BCF) of greater than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material may bioaccumulate to some extent. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
**Environmental Toxicity:**
No information found.

## 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

## 14. Transport Information

**Domestic (Land, D.O.T.)**

**Proper Shipping Name:** HEPTANES
**Hazard Class:** 3
**UN/NA:** UN1206
Packing Group: II
**Information reported for product/size:** 302LB

**International (Water, I.M.O.)**

**Proper Shipping Name:** HEPTANES
**Hazard Class:** 3.2
**UN/NA:** UN1206
Packing Group: II
**Information reported for product/size:** 302LB

## 15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

| Ingredient | TSCA | EC | Japan | Australia |
|---|---|---|---|---|
| Heptane (142-82-5) | Yes | Yes | Yes | Yes |
| Methylhexanes | Yes | Yes | Yes | Yes |
| Dimethylpentanes | Yes | Yes | Yes | Yes |
| Methylcyclohexane (108-87-2) | Yes | Yes | Yes | Yes |
| Toluene (108-88-3) | Yes | Yes | Yes | Yes |

--------\Chemical Inventory Status - Part 2\----------

| Ingredient | Korea | --Canada-- DSL | NDSL | Phil. |
|---|---|---|---|---|
| Heptane (142-82-5) | Yes | Yes | No | Yes |
| Methylhexanes | Yes | Yes | No | Yes |
| Dimethylpentanes | Yes | No | Yes | Yes |
| Methylcyclohexane (108-87-2) | Yes | Yes | No | Yes |
| Toluene (108-88-3) | Yes | Yes | No | Yes |

--------\Federal, State & International Regulations - Part 1\----------

| Ingredient | -SARA 302- RQ | TPQ | ------SARA 313------ List | Chemical Catg. |
|---|---|---|---|---|

| Ingredient | | | | |
|---|---|---|---|---|
| Heptane (142-82-5) | No | No | No | No |
| Methylhexanes | No | No | No | No |
| Dimethylpentanes | No | No | No | No |
| Methylcyclohexane (108-87-2) | No | No | No | No |
| Toluene (108-88-3) | No | No | Yes | No |

--------\Federal, State & International Regulations - Part 2\----------

| Ingredient | CERCLA | -RCRA- 261.33 | -TSCA- 8(d) |
|---|---|---|---|
| Heptane (142-82-5) | No | No | Yes |
| Methylhexanes | No | No | No |
| Dimethylpentanes | No | No | Yes |
| Methylcyclohexane (108-87-2) | No | No | Yes |
| Toluene (108-88-3) | 1000 | U220 | No |

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

**WARNING:**
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

**Australian Hazchem Code:** 3[Y]E
**Poison Schedule:** No information found.
**WHMIS:**
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

# 16. Other Information

**NFPA Ratings:** Health: **1** Flammability: **3** Reactivity: **0**
**Label Hazard Warning:**
DANGER! FLAMMABLE LIQUID AND VAPOR. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS.
**Label Precautions:**
Keep away from heat, sparks and flame.
Keep container closed.
Avoid breathing vapor or mist.
Use only with adequate ventilation.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
**Label First Aid:**
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
**Product Use:**
Laboratory Reagent.

**Revision Information:**
MSDS Section(s) changed since last revision of document include: 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 15, 16.
**Disclaimer:**
**********

**Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.**
**********

**Prepared by:** Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

# HYDROGEN CYANIDE

HCN

| Common Synonyms | Watery liquid, or gas | Colorless | Bitter almond odor |
|---|---|---|---|
| Hydrocyanic acid<br>Prussic acid | Sinks and mixes with water. Poisonous, flammable vapor is produced and rises. Boiling point is 78°F. | | |

AVOID CONTACT WITH LIQUID AND VAPOR. EVACUATE AREA.
WEAR CHEMICAL PROTECTIVE SUIT WITH SELF-CONTAINED BREATHING APPARATUS.
Stop discharge if possible. Call fire department.
Shut off ignition sources.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
WEAR CHEMICAL PROTECTIVE SUIT WITH SELF-CONTAINED BREATHING APPARATUS.
Stop discharge if possible.
Cool exposed containers and protect men effecting shutoff with water.
Let fire burn.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
POISONOUS IF INHALED OR IF SKIN IS EXPOSED.
Irritating to eyes.
Move to fresh air.
If breathing has stopped, give artificial respiration (but NOT mouth to mouth).
If breathing is difficult, give oxygen.

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

**Water Pollution**

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability, water contaminant
Restrict access
Evacuate area

## 2. LABEL

2.1 Category: Poison
2.2 Class: 6

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: HCN
3.3 IMO/UN Designation: 2.0/1051
3.4 DOT ID No.: 1051
3.5 CAS Registry No.: 74-90-8

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless to bluish white
4.3 Odor: Characteristic sweetish, like almond

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: CAUTION-Class A poison; asphyxiation can be caused by ingestion, inhalation, or absorption of liquid or vapor through skin (particularly eyes, mucous membranes, and feet). Escape purposes only-air escape mask with 5-minute air cylinder. Work purposes-vapor-proof emergency suit or vinyl-coated coverall, plus air mask with clear-view facepiece, speaking diaphragm, demand regulator, and 30-minute air cylinder. Rubber gloves; chemical safety goggles; quick-opening safety shower.

5.2 Symptoms Following Exposure: Irritation of throat, palpitation, difficult breathing, reddening of eyes, salivation, nausea, headache, weakness of arms and legs, giddiness-followed by collapse and convulsions.

5.3 Treatment of Exposure: Call a doctor. If breathing has stopped, give artificial respiration until doctor arrives. INHALATION: remove patient to fresh air. SKIN CONTACT: remove contaminated clothing and wash skin thoroughly with copious quantities of water and soap. EYE CONTACT: hold eyelids apart and wash eye with continuous gentle stream of water for at least 15 min. If patient is unconscious, administer amyl nitrite by crushing a pearl (ampule) in a cloth and holding this under patient's nose for 15 seconds in every minute. Do not interrupt artificial respiration. Replace amyl nitrite pearl when its strength is spent. Continue treatment until patient's condition improves or doctor arrives.

5.4 Threshold Limit Value: 10 ppm
5.5 Short Term Inhalation Limits: 20 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 4; $LD_{50}$ less than 50 mg/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapor is not very irritating but is extremely poisonous.
5.9 Liquid or Solid Irritant Characteristics: Liquid is not irritating but is extremely poisonous if absorbed through skin or eyes.
5.10 Odor Threshold: 1 mg/m³
5.11 IDLH Value: 50 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 0°F C.C.
6.2 Flammable Limits in Air: 5.6%-40.0%
6.3 Fire Extinguishing Agents: Stop flow of gas
6.4 Fire Extinguishing Agents Not to be Used: None
6.5 Special Hazards of Combustion Products: Extremely toxic vapors are generated even at ordinary temperatures.
6.6 Behavior in Fire: Containers may explode with ignition of contents.
6.7 Ignition Temperature: 1004°F
6.8 Electrical Hazard: Data not available
6.9 Burning Rate: 1.8 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: 6.350 (Est.)
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Dissolves with a moderate reaction.
7.2 Reactivity with Common Materials: None
7.3 Stability During Transport: May become unstable and subject to explosion if stored for extended time or exposed to high temp. and pressure.
7.4 Neutralizing Agents for Acids and Caustics: The weak acidity can be neutralized by slaked lime, but this does not destroy the poisonous property.
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: 0.16 ppm/72 hr/young bass/$TL_m$/fresh water
0.069 ppm/24 hr/pin perch/$TL_m$/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: 96%; sometimes shipped as a water solution, or absorbed on an inert solid. All forms are extremely toxic.
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: May be padded
9.4 Venting: Data not available

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-B-C-K-L-M-N

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Poison, A

11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 4 |
| Health | |
| Vapor Irritant | 2 |
| Liquid or Solid Irritant | 1 |
| Poisons | 4 |
| Water Pollution | |
| Human Toxicity | 4 |
| Aquatic Toxicity | 4 |
| Aesthetic Effect | 1 |
| Reactivity | |
| Other Chemicals | 3 |
| Water | 0 |
| Self Reaction | 3 |

11.3 NFPA Hazard Classification:

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

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 27.03
12.3 Boiling Point at 1 atm: 78.3°F = 25.7°C = 298.9°K
12.4 Freezing Point: 8.1°F = —13.3°C = 259.9°K
12.5 Critical Temperature: 362.3°F = 183.5°C = 456.7°K
12.6 Critical Pressure: 735 psia = 50 atm = 5.07 MN/m²
12.7 Specific Gravity: 0.689 at 20°C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 0.9
12.11 Ratio of Specific Heats of Vapor (Gas): 1.303
12.12 Latent Heat of Vaporization: 444 Btu/lb = 247 cal/g = 10.3 X 10⁴ J/kg
12.13 Heat of Combustion: —10,560 Btu/lb = —5864 cal/g = —245.3 X 10⁴ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 74.36
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

# HCN HYDROGEN CYANIDE

### 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 10 | 45.620 |
| 15 | 45.400 |
| 20 | 45.170 |
| 25 | 44.950 |
| 30 | 44.720 |
| 35 | 44.500 |
| 40 | 44.270 |
| 45 | 44.050 |
| 50 | 43.820 |
| 55 | 43.600 |
| 60 | 43.370 |
| 65 | 43.150 |
| 70 | 42.920 |
| 75 | 42.690 |

### 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 15 | .621 |
| 20 | .622 |
| 25 | .624 |
| 30 | .625 |
| 35 | .626 |
| 40 | .627 |
| 45 | .628 |
| 50 | .629 |
| 55 | .630 |
| 60 | .631 |
| 65 | .632 |
| 70 | .633 |
| 75 | .634 |

### 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| | N |
| | O |
| | T |
| | |
| | P |
| | E |
| | R |
| | T |
| | I |
| | N |
| | E |
| | N |
| | T |

### 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| | N |
| | O |
| | T |
| | |
| | P |
| | E |
| | R |
| | T |
| | I |
| | N |
| | E |
| | N |
| | T |

### 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| | M |
| | I |
| | S |
| | C |
| | I |
| | B |
| | L |
| | E |

### 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 15 | 3.274 |
| 20 | 3.742 |
| 25 | 4.265 |
| 30 | 4.847 |
| 35 | 5.495 |
| 40 | 6.214 |
| 45 | 7.010 |
| 50 | 7.890 |
| 55 | 8.859 |
| 60 | 9.925 |
| 65 | 11.100 |
| 70 | 12.380 |
| 75 | 13.780 |
| 80 | 15.310 |
| 85 | 16.980 |
| 90 | 18.790 |
| 95 | 20.760 |
| 100 | 22.900 |
| 105 | 25.210 |
| 110 | 27.710 |
| 115 | 30.400 |
| 120 | 33.310 |

### 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 15 | .01737 |
| 20 | .01964 |
| 25 | .02216 |
| 30 | .02493 |
| 35 | .02797 |
| 40 | .03132 |
| 45 | .03498 |
| 50 | .03898 |
| 55 | .04334 |
| 60 | .04809 |
| 65 | .05325 |
| 70 | .05884 |
| 75 | .06490 |
| 80 | .07144 |
| 85 | .07849 |
| 90 | .08609 |
| 95 | .09426 |
| 100 | .10300 |
| 105 | .11240 |
| 110 | .12250 |
| 115 | .13320 |
| 120 | .14470 |

### 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .303 |
| 25 | .308 |
| 50 | .313 |
| 75 | .317 |
| 100 | .322 |
| 125 | .327 |
| 150 | .331 |
| 175 | .335 |
| 200 | .339 |
| 225 | .343 |
| 250 | .347 |
| 275 | .351 |
| 300 | .354 |
| 325 | .358 |
| 350 | .361 |
| 375 | .364 |
| 400 | .367 |
| 425 | .370 |
| 450 | .372 |
| 475 | .375 |
| 500 | .377 |
| 525 | .380 |
| 550 | .382 |
| 575 | .384 |
| 600 | .386 |

# ISOPROPYL ALCOHOL

IPA

| Common Synonyms | Watery liquid | Colorless | Unpleasant alcohol odor like rubbing alcohol |
|---|---|---|---|
| Isopropanol<br>2-Propanol<br>Dimethylcarbinol<br>sec-Propyl alcohol<br>Rubbing alcohol<br>Petrohol | Floats and mixes with water. Flammable, irritating vapor is produced. | | |

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Extinguish with dry chemical, alcohol foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to eyes.
Harmful if swallowed.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

**Water Pollution**

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability
Disperse and flush

## 2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Alcohol, glycol
3.2 Formula: $CH_3CH(OH)CH_3$
3.3 IMO/UN Designation: 3.2/1219
3.4 DOT ID No.: 1219
3.5 CAS Registry No.: 67-63-0

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like ethyl alcohol; sharp, somewhat unpleasant; characteristic mild alcoholic; nonresidual

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor canister or air-supplied mask; chemical goggles or face splash shield.
5.2 Symptoms Following Exposure: Vapors cause mild irritation of eyes and upper respiratory tract; high concentrations may be anesthetic. Liquid irritates eyes and may cause injury; harmless to skin; if ingested causes drunkenness and vomiting.
5.3 Treatment of Exposure: INHALATION: if victim is overcome by vapors, remove from exposure immediately; call a physician; if breathing is irregular or has stopped, start resuscitation and administer oxygen. EYES: flush with water for at least 15 min.
5.4 Threshold Limit Value: 400 ppm
5.5 Short Term Inhalation Limits: 400 ppm for 10 min.
5.6 Toxicity by Ingestion: Grade 1; $LD_{50}$ = 5 to 15 g/kg (rat: $LD_{50}$: 5.84 g/kg)
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard. Practically harmless to the skin.
5.10 Odor Threshold: 90 mg/m³
5.11 IDLH Value: 20,000 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 65°F O.C.; 53°F C.C.
6.2 Flammable Limits in Air: 2.3%-12.7%
6.3 Fire Extinguishing Agents: Alcohol foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 750°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 2.3 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 20

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: 900-1100 ppm/24 hr/chub/critical range/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 133%, 5 days
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: 91%, 95% Anhydrous
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-P-Q-R-S

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 3 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 0 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 2 |
| Aquatic Toxicity | 2 |
| Aesthetic Effect | 1 |
| Reactivity | |
| Other Chemicals | 2 |
| Water | 0 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 1 |
| Flammability (Red) | 3 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 60.10
12.3 Boiling Point at 1 atm: 180.1°F = 82.3°C = 355.5°K
12.4 Freezing Point: —127.3°F = —88.5°C = 184.7°K
12.5 Critical Temperature: 455.4°F = 235.2°C = 508.4°K
12.6 Critical Pressure: 691 psia = 47.0 atm = 4.76 MN/m²
12.7 Specific Gravity: 0.785 at 20°C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 2.1
12.11 Ratio of Specific Heats of Vapor (Gas): 1.105
12.12 Latent Heat of Vaporization: 286 Btu/lb = 159 cal/g = 6.66 X 10⁵ J/kg
12.13 Heat of Combustion: —12,960 Btu/lb = —7,201 cal/g = —301.5 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: (est.) —9 Btu/lb = —5 cal/g = —0.2 X 10⁵ J/kg
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 21.37 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 1.4 psia

NOTES

| IPA | ISOPROPYL ALCOHOL |
|---|---|

### 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 34 | 49.940 |
| 36 | 49.890 |
| 38 | 49.830 |
| 40 | 49.780 |
| 42 | 49.720 |
| 44 | 49.660 |
| 46 | 49.610 |
| 48 | 49.550 |
| 50 | 49.500 |
| 52 | 49.440 |
| 54 | 49.380 |
| 56 | 49.330 |
| 58 | 49.270 |
| 60 | 49.210 |
| 62 | 49.160 |
| 64 | 49.100 |
| 66 | 49.050 |
| 68 | 48.990 |
| 70 | 48.930 |
| 72 | 48.880 |
| 74 | 48.820 |
| 76 | 48.760 |
| 78 | 48.710 |
| 80 | 48.650 |
| 82 | 48.600 |
| 84 | 48.540 |

### 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 15 | .525 |
| 20 | .533 |
| 25 | .540 |
| 30 | .547 |
| 35 | .554 |
| 40 | .561 |
| 45 | .569 |
| 50 | .576 |
| 55 | .583 |
| 60 | .590 |
| 65 | .598 |
| 70 | .605 |
| 75 | .612 |
| 80 | .619 |
| 85 | .626 |

### 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| 45 | .956 |
| 50 | .952 |
| 55 | .949 |
| 60 | .945 |
| 65 | .941 |
| 70 | .937 |
| 75 | .933 |
| 80 | .929 |
| 85 | .925 |
| 90 | .921 |
| 95 | .917 |
| 100 | .914 |
| 105 | .910 |
| 110 | .906 |
| 115 | .902 |

### 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| | NOT PERTINENT |

### 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| | MISCIBLE |

### 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 40 | .223 |
| 50 | .328 |
| 60 | .476 |
| 70 | .678 |
| 80 | .953 |
| 90 | 1.319 |
| 100 | 1.801 |
| 110 | 2.429 |
| 120 | 3.237 |
| 130 | 4.266 |
| 140 | 5.563 |
| 150 | 7.183 |
| 160 | 9.188 |
| 170 | 11.650 |
| 180 | 14.650 |
| 190 | 18.270 |
| 200 | 22.610 |
| 210 | 27.790 |

### 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 40 | .00250 |
| 50 | .00361 |
| 60 | .00513 |
| 70 | .00717 |
| 80 | .00988 |
| 90 | .01343 |
| 100 | .01802 |
| 110 | .02387 |
| 120 | .03126 |
| 130 | .04050 |
| 140 | .05194 |
| 150 | .06596 |
| 160 | .08302 |
| 170 | .10360 |
| 180 | .12820 |
| 190 | .15740 |
| 200 | .19190 |
| 210 | .23240 |

### 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .312 |
| 25 | .325 |
| 50 | .339 |
| 75 | .352 |
| 100 | .365 |
| 125 | .378 |
| 150 | .390 |
| 175 | .403 |
| 200 | .416 |
| 225 | .428 |
| 250 | .440 |
| 275 | .453 |
| 300 | .465 |
| 325 | .477 |
| 350 | .489 |
| 375 | .500 |
| 400 | .512 |
| 425 | .524 |
| 450 | .535 |
| 475 | .546 |
| 500 | .557 |
| 525 | .568 |
| 550 | .579 |
| 575 | .590 |
| 600 | .601 |

ACME AUTOMOTIVE FINISHES -- 305 LACQUER THINNER FAST
MATERIAL SAFETY DATA SHEET
NSN: 801000F028455
Manufacturer's CAGE: ACMEA
Part No. Indicator: A
Part Number/Trade Name: 305 LACQUER THINNER FAST

==========

General Information

==========

Company's Name: ACME AUTOMOTIVE FINISHES
Company's Street: 101 PROSPECT AVE NW
Company's City: CLEVELAND
Company's State: OH
Company's Country: US
Company's Zip Code: 44115
Company's Emerg Ph #: 216-566-2917
Company's Info Ph #: 216-566-2902
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SE
Date MSDS Prepared: 01APR91
Safety Data Review Date: 16JUL93
Preparer's Company: ACME AUTOMOTIVE FINISHES
Preparer's St Or P. O. Box: 101 PROSPECT AVE NW
Preparer's City: CLEVELAND
Preparer's State: OH
Preparer's Zip Code: 44115
MSDS Serial Number: BRTKZ

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: LIGHT ALIPHATIC NAPHTHA, VM & P NAPHTHA, LACOLENE *93/1*
Ingredient Sequence Number: 01
Percent: 14
NIOSH (RTECS) Number: 1002250AN
CAS Number: 64742-89-8
OSHA PEL: 300 PPM
ACGIH TLV: 300 PPM

---

Proprietary: NO
Ingredient: TOLUENE
Ingredient Sequence Number: 02
Percent: 51
NIOSH (RTECS) Number: XS5250000
CAS Number: 108-88-3
OSHA PEL: 200 PPM/150 STEL
ACGIH TLV: 50 PPM; 9293
Other Recommended Limit: 375 MG/CUM

---

Proprietary: NO
Ingredient: METHANOL (METHYL ALCOHOL), COLUMBIAN SPIRITS
Ingredient Sequence Number: 03
Percent: 4
NIOSH (RTECS) Number: PC1400000
CAS Number: 67-56-1
OSHA PEL: S,200PPM/250STEL
ACGIH TLV: S,200PPM/250STEL; 93
Other Recommended Limit: 200 PPM

---

Proprietary: NO

Ingredient: ISOPROPANOL (ISOPROPYL ALCOHOL), 2-PROPANOL, DIMETHYL CARBINOL
Ingredient Sequence Number: 04
Percent: 5
NIOSH (RTECS) Number: NT8050000
CAS Number: 67-63-0
OSHA PEL: 400 PPM
ACGIH TLV: 400 PPM
Other Recommended Limit: 400 PPM
---
Proprietary: NO
Ingredient: ACETONE; DIMETHYL KETONE
Ingredient Sequence Number: 05
Percent: 19
NIOSH (RTECS) Number: AL3150000
CAS Number: 67-64-1
OSHA PEL: 1000PPM
ACGIH TLV: 750PPM/1000STEL;9293
---
Proprietary: NO
Ingredient: HEXONE, METHYL ISOBUTYL KETONE (MIBK), 4-METHYL-2-PENTANONE
Ingredient Sequence Number: 06
Percent: 5
NIOSH (RTECS) Number: SA9275000
CAS Number: 108-10-1
OSHA PEL: 100 PPM/75 STEL
ACGIH TLV: 50 PPM/75 STEL; 9293
Other Recommended Limit: 50 PPM
---
Proprietary: NO
Ingredient: PROPYLENEGLYCOL MONOMETHYL ETHER ACETATE, 1-METHOXY-2-PROPANOL ACETATE
Ingredient Sequence Number: 07
Percent: 2
NIOSH (RTECS) Number: AI8925000
CAS Number: 108-65-6
Other Recommended Limit: NOT ESTABLISHED
---
Proprietary: NO
Ingredient: WEIGHT PER GALLON IN POUNDS: 6.81
Ingredient Sequence Number: 08
NIOSH (RTECS) Number: 9999999WG
---
Proprietary: NO
Ingredient: VOL ORGANIC CMPD: 6.81 LBS/GAL OR LESS WATER & EXEMPT SOLVENTS 6.81 LBS/GAL
Ingredient Sequence Number: 09
NIOSH (RTECS) Number: 9999999VO
==========

## Physical/Chemical Characteristics

==========
Boiling Point: 132-302F
Vapor Density (Air=1): >1
Specific Gravity: 0.82-1.2
Evaporation Rate And Ref: SLOWER THAN ETHER
Percent Volatiles By Volume: 63-100
==========

## Fire and Explosion Hazard Data

==========
Flash Point: 4F
Lower Explosive Limit: 0.7%
Upper Explosive Limit: 12.7%

Extinguishing Media: CO2, DRY CHEMICAL, FOAM
Special Fire Fighting Proc: USE FULL PROTECTIVE EQUIP & SCBA. WATER SPRAY MAY BE INEFFECTIVE. IF WATER IS USED, FOG NOZZLES ARE PREFERABLE. USE WATER TO COOL CLOSED CONTAINERS.
Unusual Fire And Expl Hazrds: CLOSED CONTAINERS MAY EXPLODE WHEN EXPOSED TO EXTREME HEAT. APPLICATION TO HOT SURFACES REQUIRES SPECIAL PRECAUTIONS.

## Reactivity Data

Stability: YES
Cond To Avoid (Stability): HEAT, SPARKS, OPEN FLAME OR OTHER IGNITION SOURCES
Hazardous Decomp Products: CO2, CO
Hazardous Poly Occur: NO

## Health Hazard Data

Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: EYES: IRRITATION. SKIN: ALCOHOLS/ACETATES MAY BE ABSORBED. INHALATION: RESPIRATORY SYSTEM IRRITATION, HEADACHE, DIZZINESS, NAUSEA, LOSS OF COORDINATION.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NONE
Signs/Symptoms Of Overexp: EYES/SKIN: REDNESS, ITCHING OR BURNING SENSATION. INHALATION: UNCONSCIOUSNESS. NERVOUS SYSTEM DEPRESSION. ADVERSE EFFECTS TO LIVER, URINARY, BLOOD-FORMING, CARDIOVASCULAR & REPRODUCTIVE SYSTEM. PERMANET BRAIN & NERVOUS SYSTEM DAMAGE. DEATH.
Emergency/First Aid Proc: INHALATION: REMOVE TO FRESH AIR. SKIN: WASH OBTAIN MEDICAL ATTENTION IN ALL CASES.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: REMOVE ALL SOURCES OF IGNITION. VENTILATE AND REMOVE WITH INERT ABSORBENT.
Waste Disposal Method: PRODUCT WASTE MAY BE HAZARDOUS DEFINED UNDER THE RCRA. TEST WASTE FOR IGNITABILITY/DETERMINE EPA HAZARDOUS WASTE NUMBERS. INCINERATE IN APPROVED FACILITY. DISPOSE OF IN ACCORDANCE W/LOCAL/STATE/ FEDERAL REGULATIONS. (SEE SUPP).
Precautions-Handling/Storing: KEEP AWAY FROM ANY HEAT SOURCES. KEEP AREA VENTILATED. DON'T SMOKE. CONSULT NFPA CODE. KEEP CONTAINER CLOSED WHEN NOT IN USE.
Other Precautions: TURN OFF STOVES, ELECTRIC TOOLS & APPLIANCES & OTHER IGNITION SOURCES. USE APPROVED BONDING & GROUNDING PROCEDURES. TRANSFER ONLY TO APPROVED CONTAINERS W/COMPLETE & APPROPRIATE LABELING. AVOID CONTACT W/SKIN/EYES. SEE SUPP.

## Control Measures

Respiratory Protection: IF PERSONAL EXPOSURE CANNOT BE CONTROLLED BELOW APPLICABLE LIMITS BY VENTILATION WEAR A PROPERLY FITTED ORGANIC VAPOR/ PARTICULATE RESPIRATOR APPROVED BY NIOSH/MSHA.
Ventilation: LOCAL EXHAUST: PREFERABLE. GENERAL EXHAUST:. ACCEPTABLE
Protective Gloves: CHEMICAL RESISTANT
Eye Protection: SAFETY GLASSES W/UNPERFORATED SIDESHIELD
Work Hygienic Practices: REMOVE/LAUNDER CONTAMINATED CLOTHING BEFORE REUSE. WASH HANDS AFTER USING.
Suppl. Safety & Health Data: CON'T PRECAUTION: DON'T TAKE INTERNALLY. KEEP

OUT OF REACH OF CHILDREN. AVOID BREATHING VAPOR & SPRAY MIST. INTENTIONAL MISUSE BY DELIBERATELY CONCENTRATING & INHALING CONTENTS CA BE HARMFUL OR FATAL. PRODUCT IS PHOTOCHEMICALLY REACTIVE. CON'T WASTE: WASTE FROM PRODUCT CONTAINING METHYL ETHYL KETONE/TEST BY EXTRACTION.

==========

Transportation Data

==========

==========

Disposal Data

==========

==========

Label Data

==========

Label Required: YES
Technical Review Date: 16JUL93
Label Date: 14JUL93
Label Status: F
Common Name: LACQUER THINNER
Chronic Hazard: YES
Signal Word: DANGER!
Acute Health Hazard-Severe: X
Contact Hazard-Severe: X
Fire Hazard-Severe: X
Reactivity Hazard-Slight: X
Special Hazard Precautions: EYES: IRRITATION. SKIN: ALCOHOLS/ACETATES MAY BE ABSORBED. INHALATION: RESPIRATORY SYSTEM IRRITATION, HEADACHE, DIZZINESS, NAUSEA, LOSS OF COORDINATION. TARGET ORGANS: SKIN, EYES, RESPIRATORY SYSTEM, NERVOUS SYSTEM, LIVER, URINARY, BLOOD-FORMING, CARDIOVASCULAR, REPRODUCTIVE SYSTEMS. BRAIN. ALDEHYDE.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: ACME AUTOMOTIVE FINISHES
Label Street: 101 PROSPECT AVE NW
Label City: CLEVELAND
Label State: OH
Label Zip Code: 44115
Label Country: US
Label Emergency Number: 216-566-2917
Year Procured: UNK

# METHYL CHLORIDE

MTC

| Common Synonyms | Gas | Colorless | Odorless or sweet odor |
|---|---|---|---|
| Chloromethane<br>Artic | Floats and boils on water. Flammable, visible vapor cloud is formed. | | |

Avoid contact with liquid and vapor. Keep people away.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
POISONOUS GASES ARE PRODUCED IN FIRE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Cool exposed containers and protect men effecting shutoff with water.
Let fire burn.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Not irritating to eyes, nose or throat.
If inhaled, will cause nausea, vomiting, headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will cause frostbite.
Flush affected areas with plenty of water.
DO NOT RUB AFFECTED AREAS.

**Water Pollution**

Not harmful to aquatic life.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-High flammability, air contaminant
Restrict access
Evacuate area

## 2. LABEL

2.1 Category: Flammable gas
2.2 Class: 2

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: $CH_3Cl$
3.3 IMO/UN Designation: 2.0/1063
3.4 DOT ID No.: 1063
3.5 CAS Registry No.: 74-87-3

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquified gas
4.2 Color: Colorless
4.3 Odor: Faint, sweet, non-irritating; faint ether-like

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved canister mask; leather or vinyl gloves; goggles or face shield.
5.2 Symptoms Following Exposure: Inhalation causes nausea, vomiting, weakness, headache, emotional disturbances; high concentrations cause mental confusion, eye disturbances, muscular tremors, cyanosis, convulsions. Contact of liquid with skin may cause frostbite.
5.3 Treatment of Exposure: Remove to fresh air. Call a doctor and have patient hospitalized for observation of slowly developing symptoms.
5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 100 ppm for 5 min.
5.6 Toxicity by Ingestion: Not pertinent
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to the eyes and throat.
5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard. Practically harmless to the skin because it evaporates quickly. May cause frostbite.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 10,000 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: <32°F C.C.
6.2 Flammable Limits in Air: 8.1%-17.2%
6.3 Fire Extinguishing Agents: Dry chemical or carbon dioxide. Stop flow of gas.
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic and irritating gases are generated in fire.
6.6 Behavior in Fire: Containers may explode
6.7 Ignition Temperature: 1170°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 2.2 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: 4.076 (Est.)
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: Reacts with zinc, aluminum, magnesium, and their alloys; reaction is not violent.
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 36

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: None
8.2 Waterfowl Toxicity: None
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical grade; "Artic" refrigerant grade
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Safety relief

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-B-C-D-E-F-G

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable gas
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 4 |
| Health | |
| Vapor Irritant | 0 |
| Liquid or Solid Irritant | 0 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 0 |
| Aquatic Toxicity | 1 |
| Aesthetic Effect | 0 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 0 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 4 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Gas
12.2 Molecular Weight: 50.49
12.3 Boiling Point at 1 atm: —11.6°F = —24.2°C = 249°K
12.4 Freezing Point: —143.9°F = 97.7°C = 175.5°K
12.5 Critical Temperature: 290.5°F = 143.6°C = 416.8°K
12.6 Critical Pressure: 969 psia = 65.9 atm = 6.68 MN/m²
12.7 Specific Gravity: 0.987 at —24°C (liquid)
12.8 Liquid Surface Tension: 16.2 dynes/cm = 0.0162 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at —24°C
12.10 Vapor (Gas) Specific Gravity: 1.7
12.11 Ratio of Specific Heats of Vapor (Gas): 1.258
12.12 Latent Heat of Vaporization: 182.5 Btu/lb = 101.5 cal/g = 4.241 X 10⁵ J/kg
12.13 Heat of Combustion: —8280 Btu/lb = —2830 cal/g = —123.1 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 116.7 psia

## NOTES

# METHYL CHLORIDE

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| —20 | 62.170 | —50 | .354 | | D | —30 | .332 |
| —15 | 61.860 | —40 | .357 | | A | —20 | .320 |
| | | —30 | .359 | | T | | |
| | | —20 | .362 | | A | | |
| | | | | | N | | |
| | | | | | O | | |
| | | | | | T | | |
| | | | | | A | | |
| | | | | | V | | |
| | | | | | A | | |
| | | | | | I | | |
| | | | | | L | | |
| | | | | | A | | |
| | | | | | B | | |
| | | | | | L | | |
| | | | | | E | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | .600 | —55 | 4.590 | —55 | .05335 | 0 | .177 |
| | | —50 | 5.298 | —50 | .06083 | 25 | .182 |
| | | —45 | 6.095 | —45 | .06913 | 50 | .187 |
| | | —40 | 6.987 | —40 | .07831 | 75 | .192 |
| | | —35 | 7.985 | —35 | .08843 | 100 | .197 |
| | | —30 | 9.096 | —30 | .09957 | 125 | .202 |
| | | —25 | 10.330 | —25 | .11180 | 150 | .207 |
| | | —20 | 11.700 | —20 | .12520 | 175 | .212 |
| | | —15 | 13.210 | —15 | .13980 | 200 | .217 |
| | | —10 | 14.880 | —10 | .15570 | 225 | .221 |
| | | —5 | 16.720 | —5 | .17300 | 250 | .226 |
| | | 0 | 18.730 | 0 | .19170 | 275 | .231 |
| | | 5 | 20.940 | 5 | .21200 | 300 | .236 |
| | | 10 | 23.350 | 10 | .23390 | 325 | .240 |
| | | 15 | 25.980 | 15 | .25740 | 350 | .245 |
| | | 20 | 28.840 | 20 | .28280 | 375 | .249 |
| | | 25 | 31.950 | 25 | .31000 | 400 | .254 |
| | | 30 | 35.320 | 30 | .33920 | 425 | .258 |
| | | 35 | 38.960 | 35 | .37040 | 450 | .263 |
| | | 40 | 42.890 | 40 | .40380 | 475 | .267 |
| | | 45 | 47.140 | 45 | .43930 | 500 | .272 |
| | | 50 | 51.700 | 50 | .47720 | 525 | .276 |
| | | 55 | 56.610 | 55 | .51740 | 550 | .281 |
| | | 60 | 61.880 | 60 | .56000 | 575 | .285 |
| | | 65 | 67.520 | 65 | .60530 | 600 | .289 |

# METHYL ETHYL KETONE

MEK

| Common Synonyms | Liquid | Colorless | Sweet odor |
|---|---|---|---|
| MEK<br>2-Butanone<br>Ethyl methyl ketone | Floats and mixes with water. Flammable, irritating vapor is produced. | | |

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Extinguish with dry chemical, alcohol foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

**Water Pollution**

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Disperse and flush

## 2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Ketone
3.2 Formula: $CH_3COCH_2CH_3$
3.3 IMO/UN Designation: 3.2/1193
3.4 DOT ID No.: 1193
3.5 CAS Registry No.: 78-93-3

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like acetone; pleasant; pungent

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic canister or air pack; plastic gloves; goggles or face shield.
5.2 Symptoms Following Exposure: Liquid causes eye burn. Vapor irritates eyes, nose, and throat; can cause headache, dizziness, nausea, weakness, and loss of consciousness.
5.3 Treatment of Exposure: INHALATION: remove victim to fresh air; if breathing is irregular or has stopped, start resuscitation and administer oxygen. EYES: wash with plenty of water for at least 15 min. and call physician.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: 290 mg/m³ for 60 min.
5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 10 ppm
5.11 IDLH Value: Data not available

## 6. FIRE HAZARDS

6.1 Flash Point: 20°F C.C.; 22°F O.C.
6.2 Flammable Limits in Air: 1.8%-11.5%
6.3 Fire Extinguishing Agents: Alcohol foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 961°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4.1 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 18

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: 5640 mg/l/48 hr/bluegill/$TL_m$/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 214%, 5 days
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: 99.5+%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-R-S

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 3 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 2 |
| Aquatic Toxicity | 1 |
| Aesthetic Effect | 1 |
| Reactivity | |
| Other Chemicals | 2 |
| Water | 0 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 1 |
| Flammability (Red) | 3 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 72.11
12.3 Boiling Point at 1 atm: 175.3°F = 79.6°C = 352.8°K
12.4 Freezing Point: −123.3°F = −86.3°C = 186.9°K
12.5 Critical Temperature: 504.5°F = 262.5°C = 535.7°K
12.6 Critical Pressure: 603 psia = 41.0 atm = 4.15 MN/m²
12.7 Specific Gravity: 0.806 at 20°C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 2.5
12.11 Ratio of Specific Heats of Vapor (Gas): 1.075
12.12 Latent Heat of Vaporization: 191 Btu/lb = 106 cal/g = 4.44 X 10⁵ J/kg
12.13 Heat of Combustion: −13,460 Btu/lb = −7481 cal/g = −313.6 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: (est.) −9 Btu/lb = −5 cal/g = −0.2 X 10⁵ J/kg
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 3.5 psia

## NOTES

MEK

# METHYL ETHYL KETONE

| 12.17 .TURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 51.460 | —35 | .501 | 10 | 1.073 | | N |
| 40 | 51.280 | —30 | .502 | 15 | 1.068 | | O |
| 45 | 51.110 | —25 | .503 | 20 | 1.063 | | T |
| 50 | 50.940 | —20 | .504 | 25 | 1.058 | | |
| 55 | 50.760 | —15 | .505 | 30 | 1.053 | | P |
| 60 | 50.590 | —10 | .507 | 35 | 1.048 | | E |
| 65 | 50.420 | —5 | .508 | 40 | 1.043 | | R |
| 70 | 50.240 | 0 | .509 | 45 | 1.038 | | T |
| 75 | 50.070 | 5 | .510 | 50 | 1.033 | | I |
| 80 | 49.900 | 10 | .511 | 55 | 1.028 | | N |
| 85 | 49.720 | 15 | .512 | 60 | 1.023 | | E |
| 90 | 49.550 | 20 | .513 | 65 | 1.018 | | N |
| 95 | 49.380 | 25 | .514 | 70 | 1.013 | | T |
| 100 | 49.200 | 30 | .516 | 75 | 1.008 | | |
| 105 | 49.030 | 35 | .517 | 80 | 1.003 | | |
| 110 | 48.860 | 40 | .518 | 85 | .998 | | |
| 115 | 48.680 | 45 | .519 | 90 | .993 | | |
| 120 | 48.510 | 50 | .520 | 95 | .988 | | |
| | | 55 | .521 | 100 | .983 | | |
| | | 60 | .522 | 105 | .978 | | |
| | | 65 | .523 | | | | |
| | | 70 | .524 | | | | |
| | | 75 | .526 | | | | |
| | | 80 | .527 | | | | |
| | | 85 | .528 | | | | |
| | | 90 | .529 | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | 27.000 | 0 | .148 | 0 | .00216 | 0 | .352 |
| | | 10 | .216 | 10 | .00310 | 25 | .368 |
| | | 20 | .310 | 20 | .00435 | 50 | .384 |
| | | 30 | .437 | 30 | .00599 | 75 | .399 |
| | | 40 | .604 | 40 | .00812 | 100 | .414 |
| | | 50 | .823 | 50 | .01085 | 125 | .429 |
| | | 60 | 1.104 | 60 | .01427 | 150 | .444 |
| | | 70 | 1.461 | 70 | .01853 | 175 | .458 |
| | | 80 | 1.909 | 80 | .02376 | 200 | .472 |
| | | 90 | 2.465 | 90 | .03012 | 225 | .486 |
| | | 100 | 3.147 | 100 | .03778 | 250 | .500 |
| | | 110 | 3.977 | 110 | .04690 | 275 | .513 |
| | | 120 | 4.977 | 120 | .05768 | 300 | .526 |
| | | 130 | 6.171 | 130 | .07030 | 325 | .538 |
| | | 140 | 7.586 | 140 | .08498 | 350 | .551 |
| | | 150 | 9.250 | 150 | .10190 | 375 | .563 |
| | | 160 | 11.190 | 160 | .12130 | 400 | .575 |
| | | 170 | 13.450 | 170 | .14350 | 425 | .586 |
| | | 180 | 16.050 | 180 | .16850 | 450 | .598 |
| | | 190 | 19.030 | 190 | .19670 | 475 | .609 |
| | | 200 | 22.420 | 200 | .22830 | 500 | .620 |
| | | 210 | 26.270 | 210 | .26350 | 525 | .630 |
| | | 220 | 30.610 | 220 | .30250 | 550 | .640 |
| | | 230 | 35.480 | 230 | .34560 | 575 | .650 |
| | | 240 | 40.930 | 240 | .39290 | 600 | .660 |

# METHYL ISOBUTYL KETONE

MIK

| Common Synonyms | Watery liquid | Colorless | Mild pleasant odor |
|---|---|---|---|
| 4-Methyl-2-pentanone<br>Isobutyl methyl ketone<br>MIBK<br>Hexone<br>Isopropylacetone<br>MIK | Floats and mixes slowly with water. Flammable, irritating vapor is produced. | | |

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, alcohol foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

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

**Water Pollution**

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Disperse and flush

## 2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Ketone
3.2 Formula: $(CH_3)_2CHCH_2COCH_3$
3.3 IMO/UN Designation: 3.2/1245
3.4 DOT ID No.: 1245
3.5 CAS Registry No.: 108-10-1

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Pleasant; mild, characteristic; sharp; non-residual; ketonic

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic canister or air pack; rubber gloves; goggles or face shield.
5.2 Symptoms Following Exposure: Vapor causes irritation of eyes and nose; high concentrations cause anesthesia and depression. Liquid dries out skin and may cause dermatitis; irritates eyes but does not injure them.
5.3 Treatment of Exposure: INHALATION: remove to fresh air, give artificial respiration if needed; call a doctor. SKIN OR EYES: wash eyes thoroughly with water; wash skin with water until irritation stops.
5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 100 ppm for 60 min.
5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.47 ppm
5.11 IDLH Value: Data not available

## 6. FIRE HAZARDS

6.1 Flash Point: 73°F C.C.; 75°F O.C.
6.2 Flammable Limits in Air: 1.4%-7.5%
6.3 Fire Extinguishing Agents: Alcohol foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Irritating vapors are generated when heated.
6.6 Behavior in Fire: Vapors may travel a considerable distance and ignite.
6.7 Ignition Temperature: 854°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: Data not available
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 18

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): (theor.) 1.8%, 0.5 day; (theor.) 12%, 5 days
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: 99+%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-T-U

## 11. HAZARD CLASSIFICATIONS

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

| Category | Rating |
|---|---|
| Fire | 3 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 1 |
| Poisons | 1 |
| Water Pollution | |
| Human Toxicity | 2 |
| Aquatic Toxicity | 1 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 2 |
| Water | 0 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 3 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 100.16
12.3 Boiling Point at 1 atm: 241.2°F = 116.2 = 389.4°K
12.4 Freezing Point: −119°F = −84°C = 189°K
12.5 Critical Temperature: 568.9°F = 298.3°C = 571.5°K
12.6 Critical Pressure: 475 psia = 32.3 atm = 3.27 MN/m²
12.7 Specific Gravity: 0.802 at 20°C (liquid)
12.8 Liquid Surface Tension: 23.6 dynes/cm = 0.0236 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 15.7 dynes/cm = 0.0157 N/m at 22.7°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.061
12.12 Latent Heat of Vaporization: 149 Btu/lb = 82.5 cal/g = 3.45 X $10^4$ J/kg
12.13 Heat of Combustion: (est.) −10,400 Btu/lb = −5,800 cal/g = −242 X $10^4$ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: (est.) −9 Btu/lb = −5 cal/g = −0.2 X $10^4$ J/kg
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.6 psia

NOTES

MIK

# METHYL ISOBUTYL KETONE

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 51.150 | —30 | .426 | | N | 77.02 | 3.800 |
| 40 | 50.990 | —20 | .429 | | O | | |
| 45 | 50.830 | —10 | .432 | | T | | |
| 50 | 50.660 | 0 | .435 | | | | |
| 55 | 50.500 | 10 | .438 | | P | | |
| 60 | 50.340 | 20 | .441 | | E | | |
| 65 | 50.170 | 30 | .444 | | R | | |
| 70 | 50.010 | 40 | .447 | | T | | |
| 75 | 49.850 | 50 | .450 | | I | | |
| 80 | 49.680 | 60 | .453 | | N | | |
| 85 | 49.520 | 70 | .457 | | E | | |
| 90 | 49.360 | 80 | .460 | | N | | |
| 95 | 49.200 | 90 | .463 | | T | | |
| 100 | 49.030 | 100 | .466 | | | | |
| 105 | 48.870 | 110 | .469 | | | | |
| 110 | 48.710 | 120 | .472 | | | | |
| 115 | 48.540 | 130 | .475 | | | | |
| 120 | 48.380 | 140 | .478 | | | | |
| | | 150 | .481 | | | | |
| | | 160 | .484 | | | | |
| | | 170 | .487 | | | | |
| | | 180 | .490 | | | | |
| | | 190 | .493 | | | | |
| | | 200 | .496 | | | | |
| | | 210 | .499 | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | 2.000 | 40 | .109 | 40 | .00203 | 0 | .306 |
| | | 50 | .157 | 50 | .00287 | 25 | .320 |
| | | 60 | .222 | 60 | .00398 | 50 | .334 |
| | | 70 | .308 | 70 | .00543 | 75 | .348 |
| | | 80 | .422 | 80 | .00730 | 100 | .361 |
| | | 90 | .569 | 90 | .00967 | 125 | .374 |
| | | 100 | .757 | 100 | .01263 | 150 | .387 |
| | | 110 | .995 | 110 | .01629 | 175 | .400 |
| | | 120 | 1.290 | 120 | .02077 | 200 | .412 |
| | | 130 | 1.655 | 130 | .02619 | 225 | .424 |
| | | 140 | 2.101 | 140 | .03270 | 250 | .436 |
| | | 150 | 2.641 | 150 | .04042 | 275 | .448 |
| | | 160 | 3.289 | 160 | .04952 | 300 | .460 |
| | | 170 | 4.060 | 170 | .06017 | 325 | .471 |
| | | 180 | 4.971 | 180 | .07251 | 350 | .482 |
| | | 190 | 6.039 | 190 | .08674 | 375 | .493 |
| | | 200 | 7.284 | 200 | .10300 | 400 | .503 |
| | | 210 | 8.724 | 210 | .12160 | 425 | .514 |
| | | 220 | 10.380 | 220 | .14250 | 450 | .524 |
| | | 230 | 12.280 | 230 | .16610 | 475 | .534 |
| | | 240 | 14.430 | 240 | .19250 | 500 | .544 |
| | | 250 | 16.880 | 250 | .22190 | 525 | .553 |
| | | 260 | 19.630 | 260 | .25450 | 550 | .562 |
| | | 270 | 22.710 | 270 | .29040 | 575 | .572 |
| | | 280 | 26.160 | 280 | .33000 | 600 | .581 |
| | | 290 | 29.990 | 290 | .37320 | | |

EM DIAGNOSTIC SYSTEMS -- AQUA FORTIS,HYDROGEN NITRATE - NITRIC ACID,TECHNICAL
MATERIAL SAFETY DATA SHEET
NSN: 6810002229655
Manufacturer's CAGE: 0GDF9
Part No. Indicator: A
Part Number/Trade Name: AQUA FORTIS,HYDROGEN NITRATE

## General Information

Item Name: NITRIC ACID,TECHNICAL
Company's Name: EM DIAGNOSTIC SYSTEMS INC
Company's Street: 480 DEMOCRAT RD
Company's P. O. Box: 70
Company's City: GIBBSTOWN
Company's State: NJ
Company's Country: US
Company's Zip Code: 08027
Company's Emerg Ph #: 609-354-9200/800-424-9300(CHEMTREC)
Company's Info Ph #: 609-354-9200
Record No. For Safety Entry: 003
Tot Safety Entries This Stk#: 014
Status: SE
Date MSDS Prepared: 15MAR89
Safety Data Review Date: 19MAY92
Supply Item Manager: CX
MSDS Serial Number: BMTVV
Specification Number: O-N-350
Hazard Characteristic Code: C1
Unit Of Issue: BT
Unit Of Issue Container Qty: 500.000 ML
Type Of Container: BOTTLE
Net Unit Weight: 1.55 LBS

## Ingredients/Identity Information

Proprietary: NO
Ingredient: NITRIC ACID (SARA III)
Ingredient Sequence Number: 01
Percent: 70
NIOSH (RTECS) Number: QU5775000
CAS Number: 7697-37-2
OSHA PEL: 2 PPM/4 STEL
ACGIH TLV: 2 PPM/4 STEL; 9192
Other Recommended Limit: NONE SPECIFIED

---

Proprietary: NO
Ingredient: WATER
Ingredient Sequence Number: 02
Percent: 30
NIOSH (RTECS) Number: ZC0110000
CAS Number: 7732-18-5
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE SPECIFIED

## Physical/Chemical Characteristics

Appearance And Odor: COLORLESS LIQUID WITH ACRID ODOR.
Boiling Point: 252F,122C
Melting Point: -29F,-34C
Vapor Pressure (MM Hg/70 F): 62 @ 68F
Vapor Density (Air=1): 2.5
Specific Gravity: 1.41
Decomposition Temperature: UNKNOWN
Evaporation Rate And Ref: UNKNOWN

Solubility In Water: COMPLETE
Viscosity: UNKNOWN
Corrosion Rate (IPY): UNKNOWN
Autoignition Temperature: NONE

## Fire and Explosion Hazard Data

Flash Point: NONE
Extinguishing Media: WATER SPRAY, DRY CHEMICAL.
Special Fire Fighting Proc: WEAR FIRE FIGHTING PROTECTIVE EQUIPMENT AND A FULL FACED SCBA. FIGHT FIRE AS FAR A DISTANCE AS POSSIBLE. COOL FIRE EXPOSED CONTAINERS WITH WATER SPRAY.
Unusual Fire And Expl Hazrds: NITRIC ACID MAY YIELD OXYGEN WHEN HEATED, WHICH WILL INCREASE THE RATE OF BURNING OF COMBUSTIBLE MATERIAL & MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLSN

## Reactivity Data

Stability: YES
Cond To Avoid (Stability): EXTREME HEAT.
Materials To Avoid: COMBUSTIBLE MATERIALS, BASES, METALLIC POWDERS, HYDROGEN SULFIDE, CARBIDES, ALCOHOLS, REACTS WITH WATER TO PRODUCE HEAT.
Hazardous Decomp Products: NITROGEN OXIDES.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT APPLICABLE

## Health Hazard Data

LD50-LC50 Mixture: LD 50 ORAL RAT IS UNKNOWN
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ACUTE: CORROSIVE TO ALL BODY TISSUES. SEVERE IRRITATION AND BURNS TO EYES, SKIN, RESPIRATORY AND GASTROINTESTINAL TRACTS. CHRONIC: DERMATITIS, MOUTH ULCERATION, EROSION OF TEETH, BRONCHIAL PNEUMONIA.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT APPLICABLE
Signs/Symptoms Of Overexp: EYES: FLUSH WITH WATER FOR AT LEAT 15 MINUTES. SKIN: WASH WITH SOAP AND WATER WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. INHALATION: REMOVE TO FRESH AIR. GIVE OXYGEN/CPR IF NEEDED. INGESTION: GIVE LARGE AMOUNTS OF WATER OR MILK. DO NOT INDUCE VOMITING. FOR ALL EXPOSURES GET IMMEDIATE MEDICAL ATTENTION.
Med Cond Aggravated By Exp: INDIVIDUALS WITH A HISTORY OF EYE, SKIN AND RESPIRATORY DISORDERS MAY BE AT INCREASED RISK FROM EXPOSURE.
Emergency/First Aid Proc: EYES:FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.IF IRRITATION PERSISTS,SEE DOCTOR. SKIN:WASH WITH MILD SOAP AND WATER WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. INHALATION:REMOVE VICTIM TO FRESH AIR.GIVE OXYGEN/CPR IF NEEDED.SEE DOCTOR. INGESTION:DO NOT INDUCE VOMIT.SEE DOCTOR IMMEDIATELY.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: REMOVE PERSONNEL. ELIMINATE IGNITION SOURCES. VENTILATE AREA. WEAR PROTECTIVE CLOTHING AND EQUIPMENT. NEUTRALIZE VERY CAUTIOUSLY. ABSORB IN FLY ASH OR CEMENT POWDER AND PLACE IN APPROPIATE DISPOSAL CONTAINER AND COVER.
Neutralizing Agent: SLAKED LIME, SODIUM BICARBONATE OR CRUSHED LIMESTONE.
Waste Disposal Method: CONTACT YOUR LOCAL ENVIRONMENTAL OFFICER. DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE AND LOCAL REGULATIONS. EPA HAZARDOUS WASTE NUMBER D002.
Precautions-Handling/Storing: STORE IN COOL, DRY, WELL VENTILATED AREA. PROTECT FROM PHYSICAL DAMAGE, HEAT, IGNITION SOURCES AND INCOMPATIBLE

MATERIALS. KEEP CONTAINERS CLOSED.
Other Precautions: AVOID EXPOSING PRODUCT TO DIRECT SUNLIGHT. AVOID EYE AND SKIN CONTACT. DO NOT BREATHE VAPORS.

## Control Measures

Respiratory Protection: NIOSH APPROVED RESPIRATOR WITH ACID GAS CARTRIDGE OR SCBA AS APPROPIATE FOR EXPOSURE OF CONCERN.
Ventilation: LOCAL EXHAUST VENTILATION TO KEEP EXPOSURE LEVELS BELOW PEL.
Protective Gloves: NATURAL RUBBER, NEOPRENE OR PVC GLOVES.
Eye Protection: SPLASH-PROOF GOGGLES AND FACE SHIELD.
Other Protective Equipment: PROTECTIVE CLOTHING AS REQUIRED TO MINIMIZE EXPOSURE FROM PROLONGED OR REPEATED CONTACT. EYE BATH AND SAFETY SHOWER.
Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING AND BEFORE EATING. LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.
Suppl. Safety & Health Data: NONE.

## Transportation Data

Trans Data Review Date: 92140
DOT PSN Code: KFD
DOT Proper Shipping Name: NITRIC ACID
DOT Class: 8
DOT ID Number: UN2031
DOT Pack Group: II
DOT Label: CORROSIVE
IMO PSN Code: KPF
IMO Proper Shipping Name: NITRIC ACID
IMO Regulations Page Number: 8195
IMO UN Number: 2031
IMO UN Class: 8
IMO Subsidiary Risk Label: -
IATA PSN Code: RWF
IATA UN ID Number: 2031
IATA Proper Shipping Name: NITRIC ACID
IATA UN Class: 8
IATA Label: CORROSIVE
AFI PSN Code: RWF
AFI Symbols: 0
AFI Prop. Shipping Name: NITRIC ACID,
AFI Class: 8
AFI ID Number: UN2031
AFI Pack Group: II
AFI Basic Pac Ref: 12-14

## Disposal Data

## Label Data

Label Required: YES
Technical Review Date: 19MAY92
Label Status: F
Common Name: AQUA FORTIS,HYDROGEN NITRATE
Signal Word: DANGER!
Acute Health Hazard-Severe: X
Contact Hazard-Severe: X
Fire Hazard-Moderate: X
Reactivity Hazard-Moderate: X
Special Hazard Precautions: ACUTE: CORROSIVE TO ALL BODY TISSUES. SEVERE IRRITATION AND BURNS TO EYES, SKIN, RESPIRATORY AND GASTROINTESTINAL TRACTS. CHRONIC: DERMATITIS, MOUTH ULCERATION, EROSION OF TEETH, BRONCHIAL PNEUMONIA. STORE IN COOL, DRY, WELL VENTILATED AREA. PROTECT FROM PHYSICAL DAMAGE, HEAT, IGNITION SOURCES AND INCOMPATIBLE MATERIALS. KEEP CONTAINERS CLOSED. FIRST AID: EYES:FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

IF IRRITATION PERSISTS,SEE DOCTOR. SKIN:WASH WITH MILD SOAP AND WATER WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. INHALATION:REMOVE VICTIM TO FRESH AIR.GIVE OXYGEN/CPR IF NEEDED.SEE DOCTOR. INGESTION:DO NOT INDUCE VOMIT.SEE DOCTOR I
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: EM DIAGNOSTIC SYSTEMS INC
Label Street: 480 DEMOCRAT RD
Label P.O. Box: 70
Label City: GIBBSTOWN
Label State: NJ
Label Zip Code: 08027
Label Country: US
Label Emergency Number: 609-354-9200/800-424-9300(CHEMTREC)

AEROSPACE LUBRICANTS -- TRIBOLUBE-F167 OIL - LUBRICATING OIL, HYDRAULIC
MATERIAL SAFETY DATA SHEET
NSN: 9150010369604
Manufacturer's CAGE: 66164
Part No. Indicator: C
Part Number/Trade Name: TRIBOLUBE-F167 OIL

==========

General Information

==========

Item Name: LUBRICATING OIL, HYDRAULIC
Company's Name: AEROSPACE LUBRICANTS INC.
Company's Street: 1505 DELASHMUT AVE
Company's City: COLUMBUS
Company's State: OH
Company's Country: US
Company's Zip Code: 43212-2641
Company's Emerg Ph #: 614-291-3045
Company's Info Ph #: 614-291-3045
Record No. For Safety Entry: 005
Tot Safety Entries This Stk#: 005
Status: SE
Date MSDS Prepared: 11OCT93
Safety Data Review Date: 04APR94
Supply Item Manager: CX
MSDS Preparer's Name: UNKNOWN
MSDS Serial Number: BSYLB
Specification Number: NONE
Spec Type, Grade, Class: NONE
Hazard Characteristic Code: N1
Unit Of Issue: LB
Unit Of Issue Container Qty: 1 LB.
Type Of Container: BOTTLE
Net Unit Weight: 1 LB.

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: NON HAZARDOUS INGREDIENTS
Ingredient Sequence Number: 01
Percent: 100
NIOSH (RTECS) Number: 1000314NH
OSHA PEL: UNKNOWN
ACGIH TLV: UNKNOWN
Other Recommended Limit: NONE RECOMMENDED

---

Proprietary: NO
Ingredient: PERFLUORINATED POLYETHER
Ingredient Sequence Number: 02
Percent: UNKNOWN
NIOSH (RTECS) Number: 1001643PP
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

==========

Physical/Chemical Characteristics

==========

Appearance And Odor: LIQUID;CLEAR;NO ODOR
Boiling Point: >392F,>200C
Vapor Pressure (MM Hg/70 F): 2.9E-12
Specific Gravity: 1.851
Decomposition Temperature: 554F,290C

Solubility In Water: NEGLIGIBLE

## Fire and Explosion Hazard Data

Flash Point: NONE
Extinguishing Media: MEDIA APPROPRIATE FOR SURROUNDING FIRE.
Special Fire Fighting Proc: USE A SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE EQUIPMENT.COOL FIRE EXPOSED CONTAINERS WITH WATER SPRAY.
Unusual Fire And Expl Hazrds: FIRE CONDITIONS AND TEMPERATURES ABOVE 554F(290C) MAY EVOLVE TOXIC FUMES.

## Reactivity Data

Stability: YES
Cond To Avoid (Stability): FIRE,TEMPERATURES ABOVE 554F(290C).
Materials To Avoid: MOLTEN ALKALI METALS, INTERHALOGEN COMPOUNDS, STRONG OR NON AQUEOUS ALKALI,LEWIS ACIDS ABOVE 100C.
Hazardous Decomp Products: TOXIC FLUORINE COMPOUNDS
Hazardous Poly Occur: NO

## Health Hazard Data

LD50-LC50 Mixture: ORAL LD50 (RAT) IS UNKNOWN
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: SKIN:PROLONGED CONTACT MAY CAUSE MILD IRRITATION.INHAL:DECOMPOSITION PRODUCTS FORMED AT HIGH TEMPERATURES MAY CAUSE "POLYMER FEVER".
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NO INGREDIENT OF A CONCENTRATION OF 0.1% OR GREATER IS LISTED AS A CARCINOGEN BY NTP, IARC, OR OSHA.
Signs/Symptoms Of Overexp: INHAL:POLYMER FEVER. SKIN:IRRITATION.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: SKIN:REMOVE CONTAMINATED CLOTHING;WASH WITH SOAP AND WATER.EYES:FLUSH WITH WATER FOR 15 MINUTES.INHAL:REMOVE TO FRESH AIR.GIVE OXYGEN OR ARTIFICIAL RESPIRATION IF NEEDED.INGEST:IF CONSCIOUS, GIVE LARGE AMOUNTS OF WATER.DO NOT INDUCE VOMITING.GET PROMPT QUALIFIED MEDICAL ATTENTION.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: SOAK UP WITH A NON-COMBUSTIBLE INERT ABSORBANT(CLAY,SAND);PLACE IN PROPER CONTAINER FOR DISPOSAL.WASH SPILL AREA TO REMOVE SLIPPINESS.
Neutralizing Agent: NONE
Waste Disposal Method: DISPOSE OF IN ACCORDANCE WITH FEDERAL,STATE AND LOCAL REGULATIONS.
Precautions-Handling/Storing: STORE AWAY FROM FLAMMABLE OR EXPLOSINVE MATERIALS.
Other Precautions: TOXIC VAPORS MAY FORM ABOVE 554F (290C).DO NOT CONTAMINATE SMOKING PRODUCTS WITH THIS MATERIAL.

## Control Measures

Respiratory Protection: NONE NORMALLY REQUIRED.
Ventilation: MAINTAIN ADEQUATE MECHANICAL VENTILATION.
Protective Gloves: PLASTIC DISPOSABLE
Eye Protection: SAFETY GLASSES

Other Protective Equipment: APRON, LAB COAT OR COVERALLS.HAVE EYE WASH AVAILABLE.
Work Hygienic Practices: WASH HANDS.SEPERATE WORK CLOTHES FROM STREET CLOTHES.Llaunder WORK CLOTHES BEFORE REUSE.KEEP FOOD OUT OF THE WORK AREA.
Suppl. Safety & Health Data: INGREDIENT #2 COMES FROM INFORMATION ON THE TIR.

## Transportation Data

Trans Data Review Date: 94094
DOT PSN Code: ZZZ
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
IMO PSN Code: ZZZ
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
IATA PSN Code: ZZZ
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
AFI PSN Code: ZZZ
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
MMAC Code: NR
Additional Trans Data: CONTAINER SHALL CONFORM TO PPP-C-186, GROUP A, CLASS 2. MARKING IAW MIL-STD-290. BAR CODING IAW MIL-STD-129.

## Disposal Data

## Label Data

Label Required: YES
Technical Review Date: 04APR94
MFR Label Number: UNKNOWN
Label Status: F
Common Name: TRIBOLUBE-F167 OIL
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-Slight: X
Reactivity Hazard-None: X
Special Hazard Precautions: SKIN:PROLONGED CONTACT MAY CAUSE MILD IRRITATION.INHAL:DECOMPOSITION PRODUCTS FORMED AT HIGH TEMPERATURES MAY CAUSE "POLYMER FEVER". STORE AWAY FROM FLAMMABLE OR EXPLOSINVE MATERIALS. FLUSH WITH WATER FOR 15 MINUTES.INHAL:REMOVE TO FRESH AIR.GIVE OXYGEN OR ARTIFICIAL RESPIRATION IF NEEDED.INGEST:IF CONSCIOUS,GIVE LARGE AMOUNTS OF WATER.DO NOT INDUCE VOMITING.GET PROMPT QUALIFIED MEDICAL ATTENTION.
Protect Eye: Y
Protect Skin: Y
Label Name: AEROSPACE LUBRICANTS INC.
Label Street: 1505 DELASHMUT AVE
Label City: COLUMBUS
Label State: OH
Label Zip Code: 43212-2641
Label Country: US
Label Emergency Number: 614-291-3045
Year Procured: 1994

ACHESON COLLOIDS DIV OF ACHESON INDUSTRIES -- OILDAG - LUBRICANT, ALUMINUM BEARING
MATERIAL SAFETY DATA SHEET
NSN: 9150010127533
Manufacturer's CAGE: 70079
Part No. Indicator: A
Part Number/Trade Name: OILDAG

## General Information

Item Name: LUBRICANT, ALUMINUM BEARING
Company's Name: ACHESON COLLOIDS CO DIV OF ACHESON INDUSTRIES INC
Company's Street: 1600 WASHINGTON AVE
Company's P. O. Box: 611747
Company's City: PORT HURON
Company's State: MI
Company's Country: US
Company's Zip Code: 48061-1747
Company's Emerg Ph #: 313-984-5581
Company's Info Ph #: 313-984-5581
Distributor/Vendor # 1: COLT INDUSTRIES OPERATING CORP FAIRBANKS
Distributor/Vendor # 1 Cage: 82796
Record No. For Safety Entry: 004
Tot Safety Entries This Stk#: 006
Status: SE
Date MSDS Prepared: 19JAN88
Safety Data Review Date: 01SEP93
Supply Item Manager: CX
MSDS Serial Number: BRLZF
Hazard Characteristic Code: N1
Unit Of Issue: PT
Unit Of Issue Container Qty: 1
Type Of Container: CAN
Net Unit Weight: 1.0 LBS

## Ingredients/Identity Information

Proprietary: NO
Ingredient: PETROLEUM (COAL OIL)
Ingredient Sequence Number: 01
Percent: 85%
NIOSH (RTECS) Number: SE7175000
CAS Number: 8002-05-9
OSHA PEL: 400 PPM
ACGIH TLV: 400 PPM
Other Recommended Limit: NONE SPECIFIED

---

Proprietary: NO
Ingredient: GRAPHITE, NATURAL
Ingredient Sequence Number: 02
Percent: 10%
NIOSH (RTECS) Number: MD9659600
CAS Number: 7782-42-5
OSHA PEL: 15 MPPCF RDUST
ACGIH TLV: 2 MG/M3 RDUST; 9293
Other Recommended Limit: NONE SPECIFIED

## Physical/Chemical Characteristics

Appearance And Odor: BLACK FLUID, BLAND ODOR.
Vapor Pressure (MM Hg/70 F): 0.10
Specific Gravity: 0.98

Decomposition Temperature: UNKNOWN
Solubility In Water: NIL
Corrosion Rate (IPY): UNKNOWN

## Fire and Explosion Hazard Data

Flash Point: 425F,218C
Flash Point Method: COC
Extinguishing Media: CARBON DIOXIDE, FOAM, OR DRY CHEMICAL.
Special Fire Fighting Proc: SELF-CONTAINED BREATHING APPARATUS.
Unusual Fire And Expl Hazrds: NONE

## Reactivity Data

Stability: YES
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.
Materials To Avoid: STRONG OXIDIZERS.
Hazardous Decomp Products: CARBON MONOXIDE AND CARBON DIOXIDE.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT APPLICABLE

## Health Hazard Data

LD50-LC50 Mixture: LD50 (ORAL RAT) IS UNKNOWN
Route Of Entry - Inhalation: NO
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: INHALATION-NO ACUTE EFFECTS EXPECTED WITHIN EXPOSURE LIMITS. INGESTION-CAM CAUSE GASTROINTESTINAL IRRITATION. EYE-MAY CAUSE TEMPORARY EYE IRRITATION. SKIN-REPEATED CONTACT CAN CAUSE IRRITATION & DERMATITIS.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: THIS COMPOUND CONTAINS NO INGREDIENTS AT CONCENTRATIONS OF 0.1% OR GREATER THAT ARE CARCINOGENS OR SUSPECT CARCINOGENS.
Signs/Symptoms Of Overexp: INGESTION-CAN CAUSE NAUSEA, VOMITING AND DIARRHEA.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: EYES: FLUSH EYEA WITH WATER AND SEEK MEDICAL ATTENTION IMMEDIATELY. SKIN: WASH WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. INHALATION: IF AFFECTED, REMOVE TO FRESH AIR. INGESTION: KEEP INDIVIDUSL CALM AND SEEK MEDICAL ATTENTION IMMEDIATELY.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: APPLY ABSORBENTMATERIAL AND TRANSFER TO CONTAINER.
Waste Disposal Method: CONSULT WITH FEDERAL, STATE AND LOCAL REGULATIONS.
Precautions-Handling/Storing: AVOID PROLONGED INHALATION OF MISTS OR VAPORS.
Other Precautions: NONE

## Control Measures

Respiratory Protection: IF THE TLV OF THE PRODUCT IS EXCEEDED, A MECHANICAL OR SELF-CONTAINED BREATHING APPARATUS IS ADVISED.
Ventilation: PROVIDE SUFFICIENT MECHANICAL(GENERAL) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV'S.
Protective Gloves: WEAR PROTECTIVE GLOVES.

Eye Protection: SAFETY GLASSES - CHEMICAL SPLASH GOGGLES
Other Protective Equipment: NO SPECIAL EQUIPMENT NECESSARY UNDER NORMAL USE. EMERGENCY EYE WASH AND SAFETY SHOWER.
Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING AND BEFORE EATING, DRINKING OR SMOKING.
Suppl. Safety & Health Data: MATERIAL ON THIS MSDS IS ACTUALLY AN INGREDIENT FOR PRODUCT PRODUCED BY COLT (COLTEC). SEE P/N A SAME NSN UNDER CAGE 2K985 FOR OTHER "INGREDIENT".

==========

Transportation Data

==========

Trans Data Review Date: 93244
DOT PSN Code: ZZZ
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
IMO PSN Code: ZZZ
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
IATA PSN Code: ZZZ
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
AFI PSN Code: ZZZ
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
MMAC Code: NR
Additional Trans Data: CONTAINER SHALL CONFORM TO A PPP-C-96 TYPE I CAN. MARKING SHALL BE IAW MIL-STD-290. BAR CODING SHALL BE IAW MIL-STD-129.

==========

Disposal Data

==========

==========

Label Data

==========

Label Required: YES
Technical Review Date: 01SEP93
MFR Label Number: UNKNOWN
Label Status: F
Common Name: OILDAG
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-Slight: X
Reactivity Hazard-None: X
Special Hazard Precautions: INHALATION-NO ACUTE EFFECTS EXPECTED WITHIN EXPOSURE LIMITS. INGESTION-CAM CAUSE GASTROINTESTINAL IRRITATION. EYE-MAY CAUSE TEMPORARY EYE IRRITATION. SKIN-REPEATED CONTACT CAN CAUSE IRRITATION & DERMATITIS. NONE IN CASE OF SPILL: APPLY ABSORBENTMATERIAL AND TRANSFER WASH WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. INHALATION: IF AFFECTED, REMOVE TO FRESH AIR. INGESTION: KEEP INDIVIDUSL CALM AND SEEK MEDICAL ATTENTION IMMEDIATELY.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: ACHESON COLLOIDS CO DIV OF ACHESON INDUSTRIES INC
Label Street: 1600 WASHINGTON AVE
Label P.O. Box: 611747
Label City: PORT HURON
Label State: MI
Label Zip Code: 48061-1747
Label Country: US
Label Emergency Number: 313-984-5581

# PHENOL

PHN

| Common Synonyms | | | |
|---|---|---|---|
| Hydroxybenzene<br>Carbolic acid<br>Phenic acid<br>Phenyl hydroxide | Solid crystals; or watery liquid | White solid, or light pink liquid | Sweet tarry odor |

May float or sink, and mixes slowly with water.

AVOID CONTACT WITH LIQUID AND SOLID. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible. Call fire department.
Evacuate area in case of large discharge.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with water, carbon dioxide, dry chemical, or foam.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

LIQUID OR SOLID
POISONOUS IF SWALLOWED.
Will burn skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

**Water Pollution**

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

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

## 2. LABEL

2.1 Category: Poison
2.2 Class: 6

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Phenol, cresol
3.2 Formula: $C_6H_5OH$
3.3 IMO/UN Designation: 9.0/1671
3.4 DOT ID No.: 1671
3.5 CAS Registry No.: 108-95-2

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid or molten liquid
4.2 Color: Colorless to light pink
4.3 Odor: Characteristically sweet; sweet, tarry; pungent, distinctive; distinct, aromatic, somewhat sickening sweet and acrid

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Fresh-air mask for confined areas; rubber gloves; protective clothing; full face shield.
5.2 Symptoms Following Exposure: Will burn eyes and skin. The analgesic action may cause loss of pain sensation. Readily absorbed through skin, causing increase in heart rate, convulsions, and death.
5.3 Treatment of Exposure: INHALATION: If victim shows any ill effects, move him to fresh air, keep him quiet and warm, and call a doctor immediately; if breathing stops, give artificial respiration. INGESTION: do NOT induce vomiting; give milk, egg whites, or large amounts of water and call doctor immediately; no known antidote; treat the symptoms. EYES: Immediately flush with plenty of water for at least 15 min.; continue for another 15 min. If doctor has not taken over. SKIN: Immediately remove all clothing while in a shower and wash affected area with abundant flowing water or soap and water for at least 15 min.; clean clothing thoroughly or discard.
5.4 Threshold Limit Value: 5 ppm (includes skin exposure).
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: Carcinogenic in laboratory animals
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Fairly severe skin irritant; may cause pain and second-degree burns after a few minutes' contact.
5.10 Odor Threshold: 0.05 ppm
5.11 IDLH Value: 100 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 185°F O.C.; 175°F C.C.
6.2 Flammable Limits in Air: 1.7%-8.6%
6.3 Fire Extinguishing Agents: Water fog, foam, carbon dioxide, or dry chemical
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic and irritating vapors are generated when heated.
6.6 Behavior in Fire: Yields flammable vapors when heated which will form explosive mixtures with air.
6.7 Ignition Temperature: 1319°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 3.5 mm/min.
6.10 Adiabatic Flame Temperature: Data not available

(Continued)

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 21

## 8. WATER POLLUTION

8.1 Aquatic Toxicity:
11.5-28.5 mg/l/96 hr/bluegill/$TL_m$/fresh water
1.5 ppm/48 hr/rainbow trout/$TL_m$/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 200%, 5 days
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: 80-90% (solid), 80-85% (liquid), Technical: 82-92% (contains cresols)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Poison, B
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 1 |
| Health | |
| Vapor Irritant | 2 |
| Liquid or Solid Irritant | 3 |
| Poisons | 3 |
| Water Pollution | |
| Human Toxicity | 2 |
| Aquatic Toxicity | 3 |
| Aesthetic Effect | 3 |
| Reactivity | |
| Other Chemicals | 2 |
| Water | 0 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 3 |
| Flammability (Red) | 2 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid or liquid
12.2 Molecular Weight: 94.11
12.3 Boiling Point at 1 atm: 359.2°F = 181.8°C = 455.0°K
12.4 Freezing Point: 105.6°F = 40.9°C = 314.1°K
12.5 Critical Temperature: 790.0°F = 421.1°C = 694.3°K
12.6 Critical Pressure: 889 psia = 60.5 atm = 6.13 MN/m²
12.7 Specific Gravity: 1.058 at 41°C (liquid)
12.8 Liquid Surface Tension: 38.5 dynes/cm = 0.0385 N/m at 55°C
12.9 Liquid Water Interfacial Tension: (est.) 20 dynes/cm = 0.02 N/m at 42°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.089
12.12 Latent Heat of Vaporization: 130 Btu/lb = 72 cal/g = 3.0 X $10^4$ J/kg
12.13 Heat of Combustion: −13,400 Btu/lb = −7,445 cal/g = −311.7 X $10^4$ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.3 psia

## 6. FIRE HAZARDS (Continued)

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

PHN

# PHENOL

**12.17 SATURATED LIQUID DENSITY**

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 110 | 65.870 |
| 115 | 65.719 |
| 120 | 65.559 |
| 125 | 65.410 |
| 130 | 65.250 |
| 135 | 65.099 |
| 140 | 64.940 |
| 145 | 64.790 |
| 150 | 64.629 |
| 155 | 64.469 |
| 160 | 64.309 |
| 165 | 64.160 |
| 170 | 64.000 |
| 175 | 63.840 |
| 180 | 63.670 |
| 185 | 63.510 |
| 190 | 63.350 |
| 195 | 63.190 |
| 200 | 63.020 |
| 205 | 62.860 |
| 210 | 62.690 |

**12.18 LIQUID HEAT CAPACITY**

| Temperature (degrees F) | British thermal unit per pound-F (estimate) |
|---|---|
| 108 | .561 |
| 109 | .561 |
| 110 | .561 |
| 111 | .561 |
| 112 | .561 |
| 113 | .561 |
| 114 | .561 |
| 115 | .561 |
| 116 | .561 |
| 117 | .561 |
| 118 | .561 |
| 119 | .561 |
| 120 | .561 |
| 121 | .561 |
| 122 | .561 |
| 123 | .561 |
| 124 | .561 |
| 125 | .561 |
| 126 | .561 |
| 127 | .561 |
| 128 | .561 |
| 129 | .561 |
| 130 | .561 |
| 131 | .561 |
| 132 | .561 |
| 133 | .561 |

**12.19 LIQUID THERMAL CONDUCTIVITY**

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| 122.02 | 1.113 |

**12.20 LIQUID VISCOSITY**

| Temperature (degrees F) | Centipoise |
|---|---|
| 110 | 4.302 |
| 115 | 3.929 |
| 120 | 3.594 |
| 125 | 3.292 |
| 130 | 3.021 |
| 135 | 2.775 |
| 140 | 2.554 |
| 145 | 2.353 |
| 150 | 2.171 |
| 155 | 2.005 |
| 160 | 1.855 |
| 165 | 1.718 |
| 170 | 1.593 |
| 175 | 1.479 |

**12.21 SOLUBILITY IN WATER**

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| 68.02 | 8.400 |

**12.22 SATURATED VAPOR PRESSURE**

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 70 | .012 |
| 80 | .017 |
| 90 | .024 |
| 100 | .034 |
| 110 | .048 |
| 120 | .066 |
| 130 | .091 |
| 140 | .123 |
| 150 | .165 |
| 160 | .220 |
| 170 | .289 |
| 180 | .378 |
| 190 | .490 |
| 200 | .629 |
| 210 | .802 |
| 220 | 1.016 |
| 230 | 1.278 |
| 240 | 1.596 |
| 250 | 1.982 |
| 260 | 2.446 |
| 270 | 3.002 |
| 280 | 3.663 |
| 290 | 4.446 |
| 300 | 5.370 |
| 310 | 6.453 |
| 320 | 7.718 |

**12.23 SATURATED VAPOR DENSITY**

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 70 | .00019 |
| 80 | .00027 |
| 90 | .00039 |
| 100 | .00054 |
| 110 | .00074 |
| 120 | .00100 |
| 130 | .00135 |
| 140 | .00180 |
| 150 | .00238 |
| 160 | .00311 |
| 170 | .00403 |
| 180 | .00518 |
| 190 | .00661 |
| 200 | .00836 |
| 210 | .01050 |
| 220 | .01311 |
| 230 | .01624 |
| 240 | .02000 |
| 250 | .02449 |
| 260 | .02980 |
| 270 | .03607 |
| 280 | .04342 |
| 290 | .05200 |
| 300 | .06197 |
| 310 | .07350 |
| 320 | .08679 |

**12.24 IDEAL GAS HEAT CAPACITY**

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .224 |
| 25 | .237 |
| 50 | .250 |
| 75 | .262 |
| 100 | .274 |
| 125 | .286 |
| 150 | .297 |
| 175 | .309 |
| 200 | .319 |
| 225 | .330 |
| 250 | .341 |
| 275 | .351 |
| 300 | .360 |
| 325 | .370 |
| 350 | .379 |
| 375 | .388 |
| 400 | .397 |
| 425 | .405 |
| 450 | .414 |
| 475 | .422 |
| 500 | .429 |
| 525 | .436 |
| 550 | .444 |
| 575 | .450 |
| 600 | .457 |

# PHOSGENE

PHG

| Common Synonyms | Liquefied compressed gas | Colorless gas, or light yellow liquid | Sweet or sharp odor |
|---|---|---|---|
| Carbonyl chloride<br>Chloroformyl chloride | | | |

Liquid sinks in water. Poisonous vapor is produced.
Boiling point is 47°F.

AVOID CONTACT WITH LIQUID AND VAPOR. Keep people away.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Evacuate area in case of large discharge.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

Not flammable.
POISONOUS GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.
Cool exposed containers and protect men effecting shutoff with water.

**Exposure**

CALL FOR MEDICAL AID.

**VAPOR**
**POISONOUS IF INHALED.**
Irritating to eyes, nose, and throat.
Effects may be delayed.
Move to fresh air.
If breathing has stopped, give artificial respiration (but NOT mouth-to-mouth).
If breathing is difficult, give oxygen.
Maintain absolute rest until medical aid arrives.

**Water Pollution**

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison
Restrict access
Evacuate area

## 2. LABEL

2.1 Category: Poison
2.2 Class: 6

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $COCl_2$
3.3 IMO/UN Designation: 2.0/1076
3.4 DOT ID No.: 1076
3.5 CAS Registry No.: 75-44-5

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Compressed gas
4.2 Color: Colorless
4.3 Odor: Sharp, pungent odor in higher concentrations; like new-mown grass in low concentrations.

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved U.S. Bureau of Mines respirator; protective clothing.
5.2 Symptoms Following Exposure: Irritates lungs, causing delayed pulmonary edema. Slight gassing produces dryness or burning sensation in the throat, numbness, pain in the chest, bronchitis, and shortness of breath.
5.3 Treatment of Exposure: INHALATION: remove victim from contaminated area; enforce absolute rest; call a doctor.
5.4 Threshold Limit Value: 0.1 ppm
5.5 Short Term Inhalation Limits: 1 ppm for 6 min.
5.6 Toxicity by Ingestion: Not pertinent
5.7 Late Toxicity: Severe delayed pulmonary edema.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations.
5.9 Liquid or Solid Irritant Characteristics: Severe irritant to all tissues.
5.10 Odor Threshold: 0.5 ppm
5.11 IDLH Value: 2 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Water to cool containers
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic gas is generated when heated.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Decomposes, but not vigorously.
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Can be absorbed in caustic soda solution. One ton of phosgene requires 2,480 lbs. of caustic soda dissolved in 1000 gal. of water.
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

## 8. WATER POLLUTION

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

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial; 100%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Safety relief

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-C-I-J-O

## 11. HAZARD CLASSIFICATIONS

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

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 4 |
| Flammability (Red) | 0 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Gas
12.2 Molecular Weight: 98.92
12.3 Boiling Point at 1 atm: 46.8°F = 8.2°C = 281.4°K
12.4 Freezing Point: −195°F = −126°C = 147°K
12.5 Critical Temperature: 360°F = 182°C = 455°K
12.6 Critical Pressure: 823 psia = 56.0 atm = 5.67 MN/m²
12.7 Specific Gravity: 1.38 at 20°C (liquid)
12.8 Liquid Surface Tension: 22.8 dynes/cm = 0.0228 N/m at 0°C
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 3.4
12.11 Ratio of Specific Heats of Vapor (Gas): 1.170
12.12 Latent Heat of Vaporization: 110 Btu/lb = 59 cal/g = 2.5 X 10⁴ J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

# PHOSGENE

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 89.009 | 0 | .250 | | N | | N |
| 40 | 88.570 | 5 | .250 | | O | | O |
| 45 | 88.139 | 10 | .250 | | T | | T |
| | | 15 | .250 | | | | |
| | | 20 | .250 | | P | | P |
| | | 25 | .250 | | E | | E |
| | | 30 | .250 | | R | | R |
| | | 35 | .250 | | T | | T |
| | | 40 | .250 | | I | | I |
| | | 45 | .250 | | N | | N |
| | | | | | E | | E |
| | | | | | N | | N |
| | | | | | T | | T |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| | R | 50 | 15.710 | 50 | .28400 | 0 | .132 |
| | E | 60 | 19.260 | 60 | .34160 | 25 | .134 |
| | A | 70 | 23.440 | 70 | .40770 | 50 | .137 |
| | C | 80 | 28.310 | 80 | .48340 | 75 | .139 |
| | T | 90 | 33.960 | 90 | .56930 | 100 | .142 |
| | S | 100 | 40.480 | 100 | .66640 | 125 | .144 |
| | | 110 | 47.940 | 110 | .77560 | 150 | .146 |
| | | 120 | 56.460 | 120 | .89760 | 175 | .148 |
| | | 130 | 66.120 | 130 | 1.03300 | 200 | .150 |
| | | 140 | 77.030 | 140 | 1.18400 | 225 | .152 |
| | | 150 | 89.290 | 150 | 1.35000 | 250 | .154 |
| | | 160 | 103.000 | 160 | 1.53200 | 275 | .155 |
| | | 170 | 118.299 | 170 | 1.73100 | 300 | .157 |
| | | 180 | 135.299 | 180 | 1.94900 | 325 | .159 |
| | | 190 | 154.000 | 190 | 2.18500 | 350 | .160 |
| | | 200 | 174.699 | 200 | 2.44100 | 375 | .161 |
| | | 210 | 197.400 | 210 | 2.71700 | 400 | .163 |
| | | | | | | 425 | .164 |
| | | | | | | 450 | .165 |
| | | | | | | 475 | .166 |
| | | | | | | 500 | .167 |
| | | | | | | 525 | .167 |
| | | | | | | 550 | .168 |
| | | | | | | 575 | .169 |
| | | | | | | 600 | .169 |

3M -- TPA-150 PART A & B #80-6106-1035-6 - ADHESIVE LIQUID, PLASTIC EPOXY RESIN
MATERIAL SAFETY DATA SHEET
NSN: 8040011479957
Manufacturer's CAGE: 04963
Part No. Indicator: A
Part Number/Trade Name: TPA-150 PART A & B #80-6106-1035-6

## General Information

Item Name: ADHESIVE LIQUID, PLASTIC EPOXY RESIN
Company's Name: 3M
Company's Street: 3M CENTER
Company's City: ST. PAUL
Company's State: MN
Company's Country: US
Company's Zip Code: 55144-1000
Company's Emerg Ph #: 612-733-1110
Company's Info Ph #: 612-733-1110
Record No. For Safety Entry: 002
Tot Safety Entries This Stk#: 007
Status: SE
Date MSDS Prepared: 23FEB95
Safety Data Review Date: 16MAY96
Supply Item Manager: CX
MSDS Serial Number: BZLLN
Specification Number: NK
Spec Type, Grade, Class: NK
Hazard Characteristic Code: NK
Unit Of Issue: KT
Unit Of Issue Container Qty: 50 GM KT
Type Of Container: NK
Net Unit Weight: NK
NRC/State License Number: NK
Net Explosive Weight: NK
Net Propellant Weight-Ammo: NK
Coast Guard Ammunition Code: NK

## Ingredients/Identity Information

Proprietary: NO
Ingredient: POLYMERIC DIAMINE
Ingredient Sequence Number: 01
Percent: 80-90
NIOSH (RTECS) Number: NK
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

---

Proprietary: NO
Ingredient: DIMETHYLENE SILOXANE
Ingredient Sequence Number: 02
Percent: 5-10
NIOSH (RTECS) Number: 1004194SD
CAS Number: 67762-90-7
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

---

Proprietary: NO
Ingredient: KAOLIN
Ingredient Sequence Number: 03

Percent: 1-5
NIOSH (RTECS) Number: GF1670500
CAS Number: 1332-58-7
OSHA PEL: 10 MG/M3
ACGIH TLV: 2 MG/M3
Other Recommended Limit: NONE RECOMMENDED

## Physical/Chemical Characteristics

Appearance And Odor: BLACK PASTE
Boiling Point: NA
Melting Point: NK
Vapor Pressure (MM Hg/70 F): NK
Vapor Density (Air=1): NK
Specific Gravity: 1.26
Decomposition Temperature: NK
Evaporation Rate And Ref: NK
Solubility In Water: NIL
Percent Volatiles By Volume: 0
Viscosity: 60000
pH: NK
Radioactivity: NK
Corrosion Rate (IPY): NK

## Fire and Explosion Hazard Data

Flash Point: >200F,>93C
Lower Explosive Limit: NK
Upper Explosive Limit: NK
Extinguishing Media: WATER SPRAY, CARBON DIOXIDE, DRY CHEMICAL, FOAM.
Special Fire Fighting Proc: WEAR FULL PROTECT CLOTHES: HELMET, POS PRES/ PRESSURE DEMAND SCBA, BUNKER COAT/PANTS, BANDS AROUND ARMS/WAIST/LEGS, FACE-MASK. PROTECT EXPOSED AREAS OF HEAD.
Unusual Fire And Expl Hazrds: NONE KNOWN

## Reactivity Data

Stability: YES
Cond To Avoid (Stability): NK
Materials To Avoid: NK
Hazardous Decomp Products: NK
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NK

## Health Hazard Data

LD50-LC50 Mixture: NK
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: CORROSIVE. IRRITATING TO SKIN & TO RESPIRATORY SYSTEM.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NK
Signs/Symptoms Of Overexp: SKIN: REDNESS/ITCHING/DRYNESS/SCALY/CRACKING.
Med Cond Aggravated By Exp: NK
Emergency/First Aid Proc: EYES: IMMED FLUSH W/PLENTY WATER. GET IMMED MED AID. INHALATION: IF SIGHS/SYMPTOMS OCCUR, GET FRESH AIR. IF SIGNS/SYMP CONTINUE CALL DR. SKIN: IMMED FLUSH W/LOTS WATER >15 MIN IN CHEM SAFETY

SHOWER, REMOVING CONTAM CLOTHES/SHOES. GET IMMED MED AID. WASH CONTAM CLOTHES BEFORE REUSE. INGEST: DON'T INDUCE VOMITING. GIVE 2 GLASSES WATER. CALL DR IMMED. NEVER GIVE ANYTHING BY MOUTH IF UNCONSCIOUS.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: CALL 612-733-1110/612-733-6100 FOR 24 HOUR SPILL ASSISTANCE. VENTILATE AREA. EXTINGUISH ALL IGNIT SOURCES. CONTAIN SPILL. COVER W/ABSORBENT. COLLECT SPILLED MAT'L. CLEAN UP RESIDUE W/WATER. PLACE IN CLOSED CONTAINER.
Neutralizing Agent: NK
Waste Disposal Method: INCINERATE UNCURRED WASTE IN INDUSTRIAL/COMMERCIAL INCINERATOR. DISPOSE OF COMPLETELY CURRED OR POLYMERIZED MAT'L IN SANITARY LANDFILL.
Precautions-Handling/Storing: STORE IN COOL PLACE. KEEP CONTAINER CLOSED WHEN NOT IN USE. KEEP IN A WELL-VENTILATED AREA.
Other Precautions: KEEP CONTAINER TIGHTLY CLOSED. KEEP AWAY FORM HEAT, SPARKS, OPEN GLAME, OTHER IGNITION SOURCES.

## Control Measures

Respiratory Protection: AVOID BREATHING VAPORS. USE HALF-MASK ORGANIC VAPOR RESPIRATOR OR FULL-FACE ORGANIC VAPOR RESPIRATOR.
Ventilation: LOCAL EXHAUST OR APPROPRIATE RESPIRATORY PROTECTION.
Protective Gloves: APPROPRIATE GLOVES
Eye Protection: VENTED GOGGLES
Other Protective Equipment: NA
Work Hygienic Practices: DON'T EAT/DRINK/SMOKE. WASH EXPOSED SKIN THOROUGHLY W/SOAP & WATER.
Suppl. Safety & Health Data: AVOID EYE/SKIN CONTACT. AVOID PROLONGED BREATHING OF VAPORS.

## Transportation Data

Trans Data Review Date: 96137
DOT PSN Code: ZZZ
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
DOT/DoD Exemption Number: NK
IMO PSN Code: ZZZ
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
IATA PSN Code: ZZZ
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
AFI PSN Code: ZZZ
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
MMAC Code: NK
N.O.S. Shipping Name: NK
Additional Trans Data: NK

## Disposal Data

## Label Data

Label Required: YES
Label Status: G
Common Name: TPA-150 PART A & B #80-6106-1035-6
Special Hazard Precautions: CORROSIVE. IRRITATING TO SKIN & TO RESPIRATORY SYSTEM. SKIN: REDNESS/ITCHING/DRYNESS/ SCALY/CRACKING.
Label Name: 3M
Label Street: 3M CENTER
Label City: ST. PAUL

Label State: MN
Label Zip Code: 55144-1000
Label Country: US
Label Emergency Number: 612-733-1110

# MATERIAL SAFETY DATA

THE GOODYEAR TIRE & RUBBER COMPANY - AKRON, OHIO 44316-001
GOODYEAR CANADA INC. - ETOBICOKE, ONTARIO M9B 6G2

| | |
|---|---|
| EMERGENCY NUMBERS | CHEMICAL TRANSPORTATION EMERGENCY ASSISTANCE<br>CHEMTREC (USA) 800-424-9300, (DISTRICT OF COLUMBIA) 202-483-7616; CANUTEC (CANADA) 613-996-6666<br>GOODYEAR: (USA / 24 Hours) 216-796-5111 (CANADA / Daytime Only) 416-828-4811 |
| TRADE NAME | POLYETHYLENE |
| CHEMICAL NAME | Polyethylene |
| SYNONYMS | Ethylene Homopolymer |
| CAS NO. | 9002-88-4 |

| ISSUED BY | Chemical Material Safety Department | DATE | MSDS NO. | SUPERSEDES MSDS DATED |
|---|---|---|---|---|
| MSDS INFORMATION | 216-796-1906 | 12/11/91 | G0382R03 | 04/18/91 |

## 1. HAZARDOUS INGREDIENTS AND OTHER COMPONENTS

| MATERIAL | CAS NO. | % | ACGIH (TLV-TWA) | OSHA (PEL-TWA) |
|---|---|---|---|---|
| Non-hazardous | | | | |

## 2. EMERGENCY OVERVIEW

If exposed to excessive heat or open flame, this product will burn.

## 3. FIRE AND EXPLOSION HAZARD DATA

| FLASH POINT & METHOD | FLAMMABLE LIMITS |
|---|---|
| NA | LEL NA |
| | UEL NA |

EXTINGUISHING MEDIA: NA

SPECIAL FIRE FIGHTING PRODECURES

During emergency conditions thermal decomposition products may present a health hazard. Approved, self-contained breathing apparatus should be worn.

UNUSUAL FIRE AND EXPLOSION HAZARDS

When exposed to open flame, emits acrid fumes

NFPA FIRE HAZARDS IDENTIFICATION SYSTEM

| | |
|---|---|
| HEALTH | 2 |
| FIRE | 2 |
| REACTIVITY | 0 |
| SPECIFIC | |

## 4. PHYSIOLOGICAL EFFECTS

| LD50 ORAL (INGESTION) | LD50 DERMAL (SKIN CONTACT) | LC50 (INHALATION) |
|---|---|---|
| NE | NE | NE |

| | |
|---|---|
| PRIMARY ROUTE OF EXPOSURE | NA |
| EXPOSURE LIMIT FOR PRODUCT | NA |

EFFECTS OF OVEREXPOSURE

ACUTE: None known

CHRONIC: None known

## 5. FIRST AID PROCEDURES

SKIN and EYE - If burned by contact with molten material, during fire situation, cool as quickly as possible with water and/or ice and see a physician for removal of any adhering material and treatment of burn.

## 6. STORAGE INFORMATION

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Keep away from excessive heat and open flame.

## 7. SPILL, LEAK, AND DISPOSAL INFORMATION

**STEPS TO BE TAKEN IN CASE MATERIAL IS SPILLED OR RELEASED**

Place in container for recycle or disposal.

**WASTE DISPOSAL METHOD**

Incinerate, treat or landfill in accordance with applicable environmental control regulations. Recycle if possible. See Additional Comments Section.

## 8. SPECIAL PROTECTION INFORMATION

| | |
|---|---|
| VENTILATION | If heated provide adequate ventilation to remove smoke and fume from work area. |
| RESPIRATORY | Under normal conditions of use, respiratory protection should not be required. |
| EYE PROTECTION | Safety glasses |
| PROTECTIVE GLOVES | NA |
| OTHER | NA |

## 9. PHYSICAL DATA

| | | |
|---|---|---|
| APPEARANCE | Clear or colored solid film | |
| ODOR<br>None | MELT POINT<br>320 to 380 F | SPECIFIC GRAVITY<br>NA |
| VAPOR DENSITY (AIR = 1)<br>NA | % VOLATILE BY VOLUME<br>NA | BULK DENSITY<br>NA |
| BOILING POINT<br>NA | VAPOR PRESSURE<br>NA | % SOLUBILITY (H2O)<br>Insoluble |
| OTHER | | |

## 10. CHEMICAL REACTIVITY

| | |
|---|---|
| CONDITIONS CAUSING INSTABILITY | NA |
| INCOMPATIBILITY (MATERIALS TO AVOID) | Fluorine/ oxygen mixtures, strong oxidizing agents. |
| HAZARDOUS DECOMPOSITION PRODUCTS | Carbon Monoxide, Methane, Carbon dioxide, Aldehydes, Acrolein |
| SPECIAL SENSITIVITY | NA |

## 11. SHIPPING INFORMATION

| | |
|---|---|
| DOT SHIPPING NAME | NA |
| FREIGHT DESCRIPTION | Plastic Articles, OIT Expanded: Film, OIT Cellulose. Per NMFC Item 156830. |

DOT HAZARD CLASSIFICATION

| | |
|---|---|
| PRIMARY | NA |
| SECONDARY | NA |

| STCC NUMBER | UN NUMBER | PACKING GROUP | IMO HAZARD CLASS |
|---|---|---|---|
| 3071445AAN | NA | | NA |

| | |
|---|---|
| DOT LABELS REQUIRED | NA |
| EPA / DOT HAZARDOUS SUBSTANCES RQ | NA |

## 12. OTHER GOVERNMENT REGULATIONS

This material is included in the US EPA Toxic Substances Control Act (TSCA) "Chemical Substances Inventory" and the Canadian "Domestic Substances List".

This product does not contain a SARA S-313 Toxic Chemical above the de minimis thresholds.

This material is not considered hazardous under the OSHA Hazard Communication Standard CFR Title 29, Part 1910.1200 or the WHMIS Canadian legislation.

## 13. ADDITIONAL COMMENTS

NOTE; If this material is going to be processed or disposed of by other than its intended use (i.e. chopping, grinding, etc.), please obtain the Goodyear MSDS for Polyethylene Scrap.

Goodyear provides the information herein in compliance with the Federal hazard communication standard, 29 CFR 1910.1200, to give warning of actual and assumed hazards, and to inform of generally applicable precautions and control measures which are known to Goodyear. Hazard information is based on available scientific evidence, but is not always obtained from sources under the direction or control of Goodyear. Goodyear makes no warranty or representation that the information is accurate, reliable, complete or representative and Buyer may rely thereon only at Buyer's own risk. Goodyear warrants only that it has made no effort to conceal other than trade secret information or to conceal hazards of its products. The data shown on these pages in no way modifies, amends or enlarges any specification or warranty.

Please reduce your browser font size for better viewing and printing.

**MSDS** Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

# Styrene (Stabilized)

**MSDS Number: S6986 --- *Effective Date: 12/08/96***

## 1. Product Identification

**Synonyms:** Styrene Monomer; Vinylbenzene; Phenylethylene; Styrol; Cinnamene
**CAS No.:** 100-42-5
**Molecular Weight:** 104.15
**Chemical Formula:** C6H5CH:CH2
**Product Codes:** V091

## 2. Composition/Information on Ingredients

| Ingredient | CAS No | Percent | Hazardous |
|---|---|---|---|
| Styrene | 100-42-5 | 90 - 100% | Yes |

## 3. Hazards Identification

**Emergency Overview**

**DANGER! FLAMMABLE! CAUSES BURNS. HARMFUL IF SWALLOWED OR INHALED. TARGET ORGAN(S): Central nervous system, respiratory system, eyes, skin.**

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

**Potential Health Effects**

**Inhalation:**
Excessive inhalation respiratory system, irritation, may cause pulmonary edema, narcosis.

**Ingestion:**
Irritation and burns to mouth and stomach.

**Skin Contact:**
Burns.

**Eye Contact:**
Irritation, burns.

**Chronic Exposure:**
Central nervous system depression.

**Aggravation of Pre-existing Conditions:**
No information found.

# 4. First Aid Measures

**Inhalation:**
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential.

**Ingestion:**
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

**Skin Contact:**
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use.

**Eye Contact:**
In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

# 5. Fire Fighting Measures

**Fire:**
Flash point: 31C (88F) CC Autoignition temperature: 490C (914F) Flammable limits in air % by volume: lel: 1.1; uel: 6.1

**Explosion:**
Vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode. Contact with strong oxidizers may cause fire.

**Fire Extinguishing Media:**
Use alcohol foam, dry chemical or carbon dioxide. (Water may be ineffective.)

**Special Information:**
Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode. Move exposed containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

---

# 6. Accidental Release Measures

Wear self-contained breathing apparatus and full protective clothing. Shut off ignition sources; no flares, smoking or flames in area. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Flush area with water. J. T. Baker SOLUSORB(tm) solvent adsorbent is recommended for spills of this product.

---

# 7. Handling and Storage

Bond and ground containers when transferring liquid. Store in light-resistant containers. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

# 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**
-OSHA Permissible Exposure Limit (PEL): 100 ppm (TWA) PEL (Ceiling) = 200 ppm.
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), 100 ppm (STEL)

**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the

general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

**Personal Respirators (NIOSH Approved):**
For conditions of use where exposure to the substance is apparent, consult an industrial hygienist. For emergencies, or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

**Eye Protection:**
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

# 9. Physical and Chemical Properties

**Appearance:**
Prisms.

**Odor:**
Odorless.

**Solubility:**
Negligible (<0.1%)

**Specific Gravity:**
0.91

**pH:**
No information found.

**% Volatiles by volume @ 21C (70F):**
100

**Boiling Point:**
145C (293F)

**Melting Point:**
-31C (-24F)

**Vapor Density (Air=1):**
3.6

**Vapor Pressure (mm Hg):**
5 @ 20C (68F)

**Evaporation Rate (BuAc=1):**
No information found.

## 10. Stability and Reactivity

**Stability:**
Stable under ordinary conditions of use and storage.

**Hazardous Decomposition Products:**
Carbon monoxide, carbon dioxide.

**Hazardous Polymerization:**
Will not occur.

**Incompatibilities:**
Strong oxidizing agents, copper, strong acids, metallic salts, polymerization catalysts & accelerators.

**Conditions to Avoid:**
Light, Heat, flame, other sources of ignition, air.

## 11. Toxicological Information

--------\Cancer Lists\----------

| Ingredient | ---NTP Carcinogen--- Known | Anticipated | IARC Category |
|---|---|---|---|
| Styrene (100-42-5) | No | No | 2B |

## 12. Ecological Information

**Environmental Fate:**
No information found.

**Environmental Toxicity:**
No information found.

## 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may

change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

# 14. Transport Information

**Domestic (Land, D.O.T.)**

---

Proper Shipping Name: STYRENE MONOMER, INHIBITED
Hazard Class: 3
UN/NA: UN2055
Packing Group: III
Information reported for product/size: 20L

**International (Water, I.M.O.)**

---

Proper Shipping Name: STYRENE MONOMER, INHIBITED
Hazard Class: 3.3
UN/NA: UN2055
Packing Group: III
Information reported for product/size: 20L

**International (Air, I.C.A.O.)**

---

Proper Shipping Name: STYRENE MONOMER, INHIBITED
Hazard Class: 3.3
UN/NA: UN2055
Packing Group: III
Information reported for product/size: 20L

# 15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

| Ingredient | TSCA | EC | Japan | Australia |
|---|---|---|---|---|
| Styrene (100-42-5) | Yes | Yes | Yes | Yes |

--------\Chemical Inventory Status - Part 2\---------------------------------

| Ingredient | Korea | Canada DSL | Canada NDSL | Phil. |
|---|---|---|---|---|
| Styrene (100-42-5) | Yes | Yes | No | Yes |

--------\Federal, State & International Regulations - Part 1\---------------

| Ingredient | SARA 302 RQ | SARA 302 TPQ | SARA 313 List | SARA 313 Chemical Catg. |
|---|---|---|---|---|
| Styrene (100-42-5) | No | No | Yes | No |

--------\Federal, State & International Regulations - Part 2\----------

| Ingredient | CERCLA | -RCRA- 261.33 | -TSCA- 8(d) |
|---|---|---|---|
| Styrene (100-42-5) | 1000 | No | No |

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

**Australian Hazchem Code:** 3[Y]
**Poison Schedule:** No information found.

**WHMIS:**
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

# 16. Other Information

**NFPA Ratings: Health:** 2 **Flammability:** 3 **Reactivity:** 2

**Label Hazard Warning:**
DANGER! FLAMMABLE! CAUSES BURNS. HARMFUL IF SWALLOWED OR INHALED. TARGET ORGAN(S): Central nervous system, respiratory system, eyes, skin.

**Label Precautions:**
Keep away from heat, sparks, flame. Do not get in eyes, on skin, on clothing. Avoid breathing vapor. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling. In case of fire, use alcohol foam, dry chemical, carbon dioxide - water may be ineffective. Flush spill area with water spray. Prevent run-off from entering drains, sewers, or streams.

**Label First Aid:**
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

**Product Use:**
Laboratory Reagent.

**Revision Information:**
Pure. New 16 section MSDS format, all sections have been revised.

**Disclaimer:**
**********

**Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.**

**********

**Prepared by:** Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

AMERICAN BATTERY ACID -- HYDROGEN SULFATE; BATTERY ELECTROLYTE - SULFURIC ACID,ELECT
MATERIAL SAFETY DATA SHEET
NSN: 6810002499354
Manufacturer's CAGE: 3A536
Part No. Indicator: B
Part Number/Trade Name: HYDROGEN SULFATE; BATTERY ELECTROLYTE

## General Information

Item Name: SULFURIC ACID,ELECTROLYTE
Company's Name: AMERICAN BATTERY ACID CORP.
Company's Street: 904 NORTH FRONT STREET
Company's City: MEMPHIS
Company's State: TN
Company's Country: US
Company's Zip Code: 38107
Company's Emerg Ph #: 901-525-1888
Company's Info Ph #: 901-525-1888
Record No. For Safety Entry: 007
Tot Safety Entries This Stk#: 013
Status: SE
Date MSDS Prepared: 19NOV93
Safety Data Review Date: 21JUN94
Supply Item Manager: CX
MSDS Serial Number: BTMYG
Specification Number: O-S-801
Spec Type, Grade, Class: CLASS 3
Hazard Characteristic Code: C1
Unit Of Issue: GL
Unit Of Issue Container Qty: 1 GAL
Type Of Container: BOTTLE
Net Unit Weight: 10.7 LBS

## Ingredients/Identity Information

Proprietary: NO
Ingredient: SULFURIC ACID (SARA III)
Ingredient Sequence Number: 01
Percent: UNKNOWN
NIOSH (RTECS) Number: WS5600000
CAS Number: 7664-93-9
OSHA PEL: 1 MG/M3
ACGIH TLV: 1 MG/M3; 9394
Other Recommended Limit: NONE RECOMMENDED

## Physical/Chemical Characteristics

Appearance And Odor: LIQUID.
Specific Gravity: 1.281
Solubility In Water: COMPLETE
pH: <1

## Fire and Explosion Hazard Data

Flash Point: NOT FLAMMABLE
Extinguishing Media: CARBON DIOXIDE OR DRY CHEMICAL.
Special Fire Fighting Proc: USE NIOSH/MSHA APPROVED POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS WHEN ANY MATERIAL IS INVOLVED IN A FIRE.
Unusual Fire And Expl Hazrds: EXPLOSIVE CONCENTRATIONS OF HYDROGEN GAS CAN ACCUMULATE INSIDE A NETAL TANK CONTAINING ACID. USE WATER FOG TO KNOCK DOWN VAPORS.

## Reactivity Data

Stability: YES

Cond To Avoid (Stability): HEATING, WATER ON SULFURIC ACID WILL CAUSE SPLATTERING, FUMING AND EVOLUTION OF HEAT.
Materials To Avoid: SOLVENTS, OXIDIZERS, COMBUSTIBLE MATERIALA, ORGANIC MATERIALS, ALKALIS, POWDERED METALS, AMINES.
Hazardous Decomp Products: HYDROGEN MAY BE EVOLVED IN CLOSED METAL CONTAINERS, SULFUR OXIDES.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT APPLICABLE

## Health Hazard Data

LD50-LC50 Mixture: ORAL LD50 (RAT) IS 2.14 G/KG
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE: BURNS, RAPID DESTRUCTION TO ALL TISSUES CONTACTED. MAY CAUSE RESPIRATORY IRRITATION. CHRONIC: DERMATITIS, TOOTH EROSION, CHRONIC COUGH.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT KNOWN TO BE CARCINOGENIC.
Signs/Symptoms Of Overexp: BURNS, RAPID DESTRUCTION OF ALL TISSUE CONTACTED, COUGHING, CHOKING, HEADACHE, DIZZINESS.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: SKIN-REMOVE CONTAMINATED CLOTHING. FLUSH WITH WATER FOR 15 MINUTES, CALL A PHYSICIAN. EYES-FLUSH WITH WATER FOR 15 MINUTES, CALL A PHYSICIAN. INGESTION-WASH OUT MOUTH WITH WATER, GIVE LARGE QUANTITIES OF WATER TO DRINK. DO NOT INDUCE VOMITING. CALL A PHYSICIAN. INHALATION-REMOVE VICTIM TO FRESH AIR, CALL A PHYSICIAN.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: WEAR NIOSH APPROVED POSITIVE PRESSURE SUPPLIED AIR RESPIRATOR. WEAR GOGGLES, COVERALLS, NEOPRENE GLOVES & BOOTS. REMOVE ALL SOURCES OF IGNITION. ISOLATE AREA OF SPILL BY DIKING. STOP SOURCE AT LEAK. ******SEE SUPPLEMENTAL******
Neutralizing Agent: LIME, SODA ASH.
Waste Disposal Method: DISPOSE OF CONTAMINATED PRODUCT, EMPTY CONTAINERS & MATERIALS USED IN CLEANING UP SPILLS OR LEAKS IN A MANNER APPROVED FOR THIS MATERIAL CONSULT APPROPIATE FEDERAL, STATE AND LOCA; REGULATORY AGENCIES TO ASCERTAIN PROPER DISPOSAL PROCEDURES.
Precautions-Handling/Storing: STORE IN COOL, DRY WELL VENTILATED PLACE. PROTECT AGAINST PHYSICAL DAMAGE AND WATER. AVOID CONTACT WITH CARBIDES, CHLORATES, FULMINATES, NITRATES, ET.
Other Precautions: USE CAUTION WHEN MIXING WITH WATER. CAN REACT VIOLENTLY WITH WATER. MAY BE FATAL IF SWALLOWED. AVOID CONTACT WITH EYES, SKIN OR CLOTHING. UPON CONTACT WITH SKIN OR EYES, WASH OFF WITH WATER. AVOID BREATHIN VAPOR.

## Control Measures

Respiratory Protection: NONE SPECIFIED BY MANUFACTURER.
Ventilation: AS REQUIRED TO KEEP AIRBORNE CONCENTRATIONS BELOW THE TLV.
Protective Gloves: NEOPRENE.
Eye Protection: GOGGLES AND FACE SHIELD.
Other Protective Equipment: COVERALLS, NEOPRENE APRON AND BOOTS.
Work Hygienic Practices: EYE WASH, SAFETY SHOWER. WASH ALL CONTAMINATE CLOTHING BEFORE REUSE.
Suppl. Safety & Health Data: TRANSFER CONTENTS TO NON-LEAKING CONTAINER OR STORAGE VESSEL. ADD NON-COMBUSTIBLE DRY ABSORBENT. CLEAN UP AND PLACE IN AN APPROVED DOT CONTAINER. ALLOW TO STABILIZE BEFORE SEALING. NEUTRALIZE SPILL AREA WITH LIME OR SODA ASH & DISPOSE OF THSI MATERIAL PROPERLY.

## Transportation Data

Trans Data Review Date: 94172
DOT PSN Code: DWE
DOT Proper Shipping Name: CORROSIVE LIQUIDS, N.O.S.
DOT Class: 8
DOT ID Number: UN1760
DOT Pack Group: II
DOT Label: CORROSIVE
IMO PSN Code: ESH
IMO Proper Shipping Name: CORROSIVE LIQUID, N.O.S. o
IMO Regulations Page Number: 8147
IMO UN Number: 1760
IMO UN Class: 8
IMO Subsidiary Risk Label: -
IATA PSN Code: HKR
IATA UN ID Number: 1760
IATA Proper Shipping Name: CORROSIVE LIQUID, N.O.S. *
IATA UN Class: 8
IATA Label: CORROSIVE
AFI PSN Code: HKR
AFI Prop. Shipping Name: CORROSIVE LIQUID, N.O.S.
AFI Class: 8
AFI ID Number: UN1760
AFI Pack Group: II
AFI Basic Pac Ref: 12-5
MMAC Code: NR

## Disposal Data

## Label Data

Label Required: YES
Technical Review Date: 21JUN94
Label Status: F
Common Name: HYDROGEN SULFATE; BATTERY ELECTROLYTE
Chronic Hazard: YES
Signal Word: WARNING!
Acute Health Hazard-Moderate: X
Contact Hazard-Moderate: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: STORE IN COOL, DRY WELL VENTILATED PLACE. PROTECT AGAINST PHYSICAL DAMAGE AND WATER. AVOID CONTACT WITH CARBIDES, CHLORATES, FULMINATES, NITRATES, ET. IN CASE OF SPILL: WEAR NIOSH APPROVED POSITIVE PRESSURE SUPPLIED AIR RESPIRATOR. WEAR GOGGLES, COVERALLS, NEOPRENE GLOVES & BOOTS. REMOVE ALL SOURCES OF IGNITION. FIRST AID: SKIN-REMOVE CONTAMINATED CLOTHING. FLUSH WITH WATER FOR 15 MINUTES, CALL A PHYSICIAN. EYES-FLUSH WITH WATER FOR 15 MINUTES, CALL A PHYSICIAN. INGESTION-WASH OUT MOUTH WITH WATER, GIVE LARGE QUANTITIES OF WATER TO DRINK. DO NOT INDUCE VOMITING. CALL A PHYSICIAN. INHALATION-REMOVE VICTIM TO FRESH AIR, CALL A PHYSICIAN.
Protect Eye: Y
Protect Skin: Y
Label Name: AMERICAN BATTERY ACID CORP.
Label Street: 904 NORTH FRONT STREET
Label City: MEMPHIS
Label State: TN
Label Zip Code: 38107
Label Country: US
Label Emergency Number: 901-525-1888

# TOLUENE



| Common Synonyms | Watery liquid | Colorless | Pleasant odor |
|---|---|---|---|
| Toluol<br>Methylbenzene<br>Methylbenzol | Floats on water. Flammable, irritating vapor is produced. | | |

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing difficult, give oxygen.

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

**Water Pollution**

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability
Evacuate area

## 2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: $C_6H_5CH_3$
3.3 IMO/UN Designation: 3.2/1294
3.4 DOT ID No.: 1294
3.5 CAS Registry No.: 108-88-3

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Pungent; aromatic, benzene-like; distinct, pleasant

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Air-supplied mask; goggles or face shield; plastic gloves.
5.2 Symptoms Following Exposure: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, gulping, dizziness, depressed respiration.
5.3 Treatment of Exposure: INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 0.5 to 5 g/kg
5.7 Late Toxicity: Kidney and liver damage may follow ingestion.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.17 ppm
5.11 IDLH Value: 2,000 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 40°F C.C.; 55°F O.C.
6.2 Flammable Limits in Air: 1.27%-7%
6.3 Fire Extinguishing Agents: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires.
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 997°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.7 mm/min.
6.10 Autoignition Flame Temperature: Data not available

(Continued)

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: 1180 mg/l/96 hr/sunfish/TL$_m$/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0%, 5 days; 36% (theor), 8 days
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Research, reagent, nitration-all 99.8 + %; industrial: contains 94 + %, with 5% xylene and small amounts of benzene and nonaromatic hydrocarbons; 90/120: less pure than industrial.
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water
Transportation:

| Category | Rating |
|---|---|
| Fire | 3 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 1 |
| Aquatic Toxicity | 3 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 0 |
| Self Reaction | 0 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 3 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 92.14
12.3 Boiling Point at 1 atm: 231.1°F = 110.6°C = 383.8°K
12.4 Freezing Point: −139°F = −95.0°C = 178.2°K
12.5 Critical Temperature: 605.4°F = 318.6°C = 591.8°K
12.6 Critical Pressure: 590.1 psia = 40.55 atm = 4.108 MN/m²
12.7 Specific Gravity: 0.867 at 20°C (liquid)
12.8 Liquid Surface Tension: 28.0 dynes/cm = 0.0280 N/m at 20
12.9 Liquid Water Interfacial Tension: 36.1 dynes/cm = 0.0361 N/m at 25
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.089
12.12 Latent Heat of Vaporization: 155 Btu/lb = 86.1 cal/g = 3.61 X 10⁴ J/kg
12.13 Heat of Combustion: −17,430 Btu/lb = −9686 cal/g = −405.5 X 10⁴ J
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 17.17 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 1.1 psia

## 6. FIRE HAZARDS (Continued)

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

TOL

# TOLUENE

## 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| —30 | 57.180 |
| —20 | 56.870 |
| —10 | 56.550 |
| 0 | 56.240 |
| 10 | 55.930 |
| 20 | 55.620 |
| 30 | 55.310 |
| 40 | 54.990 |
| 50 | 54.680 |
| 60 | 54.370 |
| 70 | 54.060 |
| 80 | 53.750 |
| 90 | 53.430 |
| 100 | 53.120 |
| 110 | 52.810 |
| 120 | 52.500 |

## 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .396 |
| 5 | .397 |
| 10 | .399 |
| 15 | .400 |
| 20 | .402 |
| 25 | .403 |
| 30 | .404 |
| 35 | .406 |
| 40 | .407 |
| 45 | .409 |
| 50 | .410 |
| 55 | .411 |
| 60 | .413 |
| 65 | .414 |
| 70 | .415 |
| 75 | .417 |
| 80 | .418 |
| 85 | .420 |
| 90 | .421 |
| 95 | .422 |
| 100 | .424 |
| 105 | .425 |
| 110 | .427 |
| 115 | .428 |
| 120 | .429 |
| 125 | .431 |

## 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| 0 | 1.026 |
| 10 | 1.015 |
| 20 | 1.005 |
| 30 | .994 |
| 40 | .983 |
| 50 | .972 |
| 60 | .962 |
| 70 | .951 |
| 80 | .940 |
| 90 | .929 |
| 100 | .919 |
| 110 | .908 |
| 120 | .897 |
| 130 | .886 |
| 140 | .876 |
| 150 | .865 |
| 160 | .854 |
| 170 | .843 |
| 180 | .833 |
| 190 | .822 |
| 200 | .811 |
| 210 | .800 |

## 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| 0 | 1.024 |
| 5 | .978 |
| 10 | .935 |
| 15 | .894 |
| 20 | .857 |
| 25 | .821 |
| 30 | .788 |
| 35 | .757 |
| 40 | .727 |
| 45 | .700 |
| 50 | .673 |
| 55 | .649 |
| 60 | .625 |
| 65 | .603 |
| 70 | .582 |
| 75 | .562 |
| 80 | .544 |
| 85 | .526 |
| 90 | .509 |
| 95 | .493 |
| 100 | .477 |

## 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| 68.02 | .050 |

## 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 0 | .038 |
| 10 | .057 |
| 20 | .084 |
| 30 | .121 |
| 40 | .172 |
| 50 | .241 |
| 60 | .331 |
| 70 | .449 |
| 80 | .600 |
| 90 | .792 |
| 100 | 1.033 |
| 110 | 1.332 |
| 120 | 1.700 |
| 130 | 2.148 |
| 140 | 2.690 |
| 150 | 3.338 |
| 160 | 4.109 |
| 170 | 5.018 |
| 180 | 6.083 |
| 190 | 7.323 |
| 200 | 8.758 |
| 210 | 10.410 |

## 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 0 | .00070 |
| 10 | .00103 |
| 20 | .00150 |
| 30 | .00212 |
| 40 | .00296 |
| 50 | .00405 |
| 60 | .00547 |
| 70 | .00727 |
| 80 | .00954 |
| 90 | .01237 |
| 100 | .01584 |
| 110 | .02007 |
| 120 | .02518 |
| 130 | .03127 |
| 140 | .03850 |
| 150 | .04700 |
| 160 | .05691 |
| 170 | .06840 |
| 180 | .08162 |
| 190 | .09675 |
| 200 | .11400 |
| 210 | .13340 |

## 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .228 |
| 25 | .241 |
| 50 | .255 |
| 75 | .268 |
| 100 | .281 |
| 125 | .294 |
| 150 | .306 |
| 175 | .319 |
| 200 | .331 |
| 225 | .343 |
| 250 | .355 |
| 275 | .367 |
| 300 | .378 |
| 325 | .389 |
| 350 | .400 |
| 375 | .411 |
| 400 | .422 |
| 425 | .432 |
| 450 | .443 |
| 475 | .453 |
| 500 | .462 |
| 525 | .472 |
| 550 | .482 |
| 575 | .491 |
| 600 | .500 |

# TRICHLOROETHYLENE

TCL

| Common Synonyms | Watery liquid | Colorless | Sweet odor |
|---|---|---|---|
| Trichloroethylene<br>Trilene; Algylen<br>Chlorylen<br>Gemalgene<br>Trethylene<br>Trichloran; Triline | Sinks in water. Irritating vapor is produced. | | |

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

**Fire**

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, carbon dioxide, or foam.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, difficult breathing, or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

**Water Pollution**

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

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

## 2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: $CHCl{=}CCl_2$
3.3 IMO/UN Designation: 6.0/1710
3.4 DOT ID No.: 1710
3.5 CAS Registry No.: 79-01-6

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Chloroform-like; ethereal

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor-acid gas canister; self-contained breathing apparatus for emergencies; neoprene or vinyl gloves; chemical safety goggles; face-shield; neoprene safety shoes; neoprene suit or apron for splash protection.

5.2 Symptoms Following Exposure: INHALATION: symptoms range from irritation of the nose and throat to nausea, an attitude of irresponsibility, blurred vision, and finally disturbance of central nervous system resulting in cardiac failure. Chronic exposure may cause organic injury. INGESTION: symptoms similar to inhalation. SKIN: defatting action can cause dermatitis. EYES: slightly irritating sensation and lachrymation.

5.3 Treatment of Exposure: Do NOT administer adrenalin or epinephrine; get medical attention for all cases of overexposure. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting; repeat three times; then give 1 tablespoon epsom salts in water. EYES: flush thoroughly with water. SKIN: wash thoroughly with soap and warm water.

5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 300 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 50 to 500 mg/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 50 ppm
5.11 IDLH Value: 1,000 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: 90°F C.C.; practically nonflammable
6.2 Flammable Limits in Air: 8.0%-10.5%
6.3 Fire Extinguishing Agents: Water fog
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic and irritating gases are produced in fire situations.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 770°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not pertinent
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 36

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: 660 mg/l/40 hr/daphnia/still/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical; dry cleaning; degreasing; extraction
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-X-Y

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS Hazard Rating for Bulk Water

| Transportation: Category | Rating |
|---|---|
| Fire | 1 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 1 |
| Aquatic Toxicity | 2 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 0 |
| Self Reaction | 1 |

11.3 NFPA Hazard Classification:

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 1 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 131.39
12.3 Boiling Point at 1 atm: 189°F = 87°C = 360°K
12.4 Freezing Point: −123.8°F = −86.4°C = 186.8°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.46 at 20°C (liquid)
12.8 Liquid Surface Tension: 28.8 dynes/cm = 0.0288 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 34.6 dynes/cm = 0.0345 N/m at 24°C
12.10 Vapor (Gas) Specific Gravity: 4.5
12.11 Ratio of Specific Heats of Vapor (Gas): 1.116
12.12 Latent Heat of Vaporization: 103 Btu/lb = 57.2 cal/g = 2.4 X $10^4$ J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.17 Heat of Fusion: Data not available
12.18 Limiting Value: Data not available
12.19 Reid Vapor Pressure: 2.5 psia

NOTES

TCL

# TRICHLOROETHYLENE

## 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 0 | 94.669 |
| 5 | 94.410 |
| 10 | 94.150 |
| 15 | 93.889 |
| 20 | 93.629 |
| 25 | 93.370 |
| 30 | 93.110 |
| 35 | 92.849 |
| 40 | 92.589 |
| 45 | 92.330 |
| 50 | 92.070 |
| 55 | 91.809 |
| 60 | 91.549 |
| 65 | 91.290 |
| 70 | 91.030 |
| 75 | 90.770 |
| 80 | 90.509 |
| 85 | 90.250 |
| 90 | 89.990 |
| 95 | 89.730 |
| 100 | 89.469 |
| 105 | 89.209 |
| 110 | 88.950 |
| 115 | 88.690 |
| 120 | 88.429 |
| 125 | 88.169 |

## 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .220 |
| 10 | .221 |
| 20 | .223 |
| 30 | .225 |
| 40 | .226 |
| 50 | .228 |
| 60 | .230 |
| 70 | .231 |
| 80 | .233 |
| 90 | .235 |
| 100 | .236 |
| 110 | .238 |
| 120 | .240 |
| 130 | .241 |
| 140 | .243 |
| 150 | .245 |
| 160 | .246 |
| 170 | .248 |

## 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| | NOT PERTINENT |

## 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| 15 | .800 |
| 20 | .775 |
| 25 | .750 |
| 30 | .727 |
| 35 | .705 |
| 40 | .684 |
| 45 | .664 |
| 50 | .645 |
| 55 | .627 |
| 60 | .610 |
| 65 | .593 |
| 70 | .577 |
| 75 | .562 |
| 80 | .548 |
| 85 | .534 |
| 90 | .521 |
| 95 | .508 |
| 100 | .496 |
| 105 | .485 |
| 110 | .474 |
| 115 | .463 |
| 120 | .453 |

## 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| 77.02 | .110 |

## 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 40 | .508 |
| 50 | .678 |
| 60 | .894 |
| 70 | 1.166 |
| 80 | 1.507 |
| 90 | 1.929 |
| 100 | 2.448 |
| 110 | 3.081 |
| 120 | 3.846 |
| 130 | 4.765 |
| 140 | 5.862 |
| 150 | 7.163 |
| 160 | 8.695 |
| 170 | 10.490 |
| 180 | 12.580 |
| 190 | 15.010 |
| 200 | 17.810 |
| 210 | 21.020 |

## 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 40 | .01245 |
| 50 | .01628 |
| 60 | .02105 |
| 70 | .02695 |
| 80 | .03418 |
| 90 | .04296 |
| 100 | .05354 |
| 110 | .06619 |
| 120 | .08120 |
| 130 | .09891 |
| 140 | .11960 |
| 150 | .14380 |
| 160 | .17180 |
| 170 | .20390 |
| 180 | .24060 |
| 190 | .28280 |
| 200 | .33040 |
| 210 | .38420 |

## 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .136 |
| 25 | .139 |
| 50 | .143 |
| 75 | .146 |
| 100 | .149 |
| 125 | .152 |
| 150 | .155 |
| 175 | .157 |
| 200 | .160 |
| 225 | .162 |
| 250 | .165 |
| 275 | .167 |
| 300 | .169 |
| 325 | .172 |
| 350 | .174 |
| 375 | .176 |
| 400 | .177 |
| 425 | .179 |
| 450 | .181 |
| 475 | .182 |
| 500 | .184 |
| 525 | .185 |
| 550 | .186 |
| 575 | .187 |
| 600 | .188 |

# TETRACHLOROETHYLENE

TTE

| Common Synonyms | Watery liquid | Colorless | Sweet odor |
|---|---|---|---|
| Tetrasap<br>Perclene<br>Perchloroethylene<br>Perk | Sinks in water. Irritating vapor is produced. | | |

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

**Fire**

Not flammable.
Poisonous gases are produced when heated.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

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

**Water Pollution**

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Should be removed
Chemical and physical treatment

## 2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $Cl_2C{=}CCl_2$
3.3 IMO/URI Designation: 6.0/1897
3.4 DOT ID No.: 1897
3.5 CAS Registry No.: 127-18-4

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Ethereal; like chloroform; mildly sweet

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: For high vapor concentrations use approved canister or air-supplied mask; chemical goggles or face shield; plastic gloves.
5.2 Symptoms Following Exposure: Vapor can affect central nervous system and cause anesthesia. Liquid may irritate skin after prolonged contact. May irritate eyes but causes no injury.
5.3 Treatment of Exposure: INHALATION: If illness occurs, remove patient to fresh air, keep him warm and quiet, and get medical attention. INGESTION: Induce vomiting only on physician's recommendation. EYES AND SKIN: flush with plenty of water and get medical attention if irritation or injury occurs.
5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 100 ppm for 60 min.
5.6 Toxicity by Ingestion: Grade 2; $LD_{50}$ = 0.5 to 5 g/kg
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or throat if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 5 ppm
5.11 IDLH Value: 800 ppm

## 6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic, irritating gases may be generated in fires.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

## 7. CHEMICAL REACTIVITY

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

## 8. WATER POLLUTION

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

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Dry cleaning and industrial grades: 95+ %
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 0 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 1 |
| Aquatic Toxicity | 3 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 0 |
| Self Reaction | 1 |

11.3 NFPA Hazard Classification: Not listed

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 165.83
12.3 Boiling Point at 1 atm: 250°F = 121°C = 394°K
12.4 Freezing Point: −8.3°F = −22.4°C = 250.8°K
12.5 Critical Temperature: 857°F = 347°C = 620°K
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.63 at 20°C (liquid)
12.8 Liquid Surface Tension: 31.8 dynes/cm = 0.0318 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 44.4 dynes/cm = 0.0444 N/m at 25°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.116
12.12 Latent Heat of Vaporization: 90.2 Btu/lb = 50.1 cal/g = 2.10 X $10^5$ J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

# TTE TETRACHLOROETHYLENE

## 12.17 SATURATED LIQUID DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 35 | 103.400 |
| 40 | 103.099 |
| 45 | 102.900 |
| 50 | 102.599 |
| 55 | 102.299 |
| 60 | 102.000 |
| 65 | 101.700 |
| 70 | 101.400 |
| 75 | 101.099 |
| 80 | 100.799 |
| 85 | 100.500 |
| 90 | 100.200 |
| 95 | 99.910 |
| 100 | 99.610 |
| 105 | 99.320 |
| 110 | 99.020 |
| 115 | 98.730 |
| 120 | 98.429 |
| 125 | 98.139 |
| 130 | 97.839 |
| 135 | 97.549 |
| 140 | 97.250 |
| 145 | 96.959 |
| 150 | 96.669 |
| 155 | 96.370 |
| 160 | 96.080 |

## 12.18 LIQUID HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .198 |
| 10 | .200 |
| 20 | .201 |
| 30 | .202 |
| 40 | .203 |
| 50 | .204 |
| 60 | .205 |
| 70 | .206 |
| 80 | .207 |
| 90 | .208 |
| 100 | .210 |
| 110 | .211 |
| 120 | .212 |
| 130 | .213 |
| 140 | .214 |
| 150 | .215 |
| 160 | .216 |
| 170 | .217 |
| 180 | .218 |
| 190 | .220 |
| 200 | .221 |
| 210 | .222 |

## 12.19 LIQUID THERMAL CONDUCTIVITY

| Temperature (degrees F) | British thermal unit-inch per hour-square foot-F |
|---|---|
| | NOT PERTINENT |

## 12.20 LIQUID VISCOSITY

| Temperature (degrees F) | Centipoise |
|---|---|
| 55 | .958 |
| 60 | .929 |
| 65 | .900 |
| 70 | .873 |
| 75 | .848 |
| 80 | .823 |
| 85 | .800 |
| 90 | .777 |
| 95 | .756 |
| 100 | .736 |
| 105 | .716 |
| 110 | .698 |
| 115 | .680 |
| 120 | .663 |
| 125 | .647 |
| 130 | .631 |
| 135 | .616 |
| 140 | .601 |
| 145 | .588 |
| 150 | .574 |
| 155 | .561 |
| 160 | .549 |
| 165 | .537 |
| 170 | .526 |
| 175 | .515 |

## 12.21 SOLUBILITY IN WATER

| Temperature (degrees F) | Pounds per 100 pounds of water |
|---|---|
| 68.02 | .016 |

## 12.22 SATURATED VAPOR PRESSURE

| Temperature (degrees F) | Pounds per square inch |
|---|---|
| 60 | .236 |
| 70 | .318 |
| 80 | .425 |
| 90 | .561 |
| 100 | .732 |
| 110 | .948 |
| 120 | 1.217 |
| 130 | 1.548 |
| 140 | 1.953 |
| 150 | 2.446 |
| 160 | 3.042 |
| 170 | 3.756 |
| 180 | 4.607 |
| 190 | 5.616 |
| 200 | 6.805 |
| 210 | 8.199 |
| 220 | 9.824 |
| 230 | 11.710 |
| 240 | 13.890 |
| 250 | 16.390 |
| 260 | 19.260 |
| 270 | 22.520 |
| 280 | 26.230 |

## 12.23 SATURATED VAPOR DENSITY

| Temperature (degrees F) | Pounds per cubic foot |
|---|---|
| 60 | .00702 |
| 70 | .00929 |
| 80 | .01216 |
| 90 | .01575 |
| 100 | .02022 |
| 110 | .02571 |
| 120 | .03242 |
| 130 | .04055 |
| 140 | .05032 |
| 150 | .06199 |
| 160 | .07583 |
| 170 | .09215 |
| 180 | .11130 |
| 190 | .13360 |
| 200 | .15940 |
| 210 | .18910 |
| 220 | .22330 |
| 230 | .26230 |
| 240 | .30660 |
| 250 | .35680 |
| 260 | .41330 |
| 270 | .47680 |
| 280 | .54790 |

## 12.24 IDEAL GAS HEAT CAPACITY

| Temperature (degrees F) | British thermal unit per pound-F |
|---|---|
| 0 | .108 |
| 25 | .110 |
| 50 | .113 |
| 75 | .116 |
| 100 | .118 |
| 125 | .120 |
| 150 | .122 |
| 175 | .125 |
| 200 | .127 |
| 225 | .129 |
| 250 | .131 |
| 275 | .132 |
| 300 | .134 |
| 325 | .136 |
| 350 | .138 |
| 375 | .139 |
| 400 | .141 |
| 425 | .142 |
| 450 | .143 |
| 475 | .144 |
| 500 | .146 |
| 525 | .147 |
| 550 | .148 |
| 575 | .148 |
| 600 | .149 |

EXXON CHEMICAL AMERICAS -- VARSOL 18 SOLVENT - DRY CLEANING SOLVENT
MATERIAL SAFETY DATA SHEET
NSN: 6850002649038
Manufacturer's CAGE: 72190
Part No. Indicator: B
Part Number/Trade Name: VARSOL 18 SOLVENT

==========

General Information

==========

Item Name: DRY CLEANING SOLVENT
Company's Name: EXXON CHEMICAL AMERICAS
Company's P. O. Box: 3272
Company's City: HOUSTON
Company's State: TX
Company's Country: US
Company's Zip Code: 77001
Company's Emerg Ph #: 800-726-2015/800-424-9300(CHEMTREC)
Company's Info Ph #: 713-870-6885
Distributor/Vendor # 1: CSD, INC (713-923-6641)
Distributor/Vendor # 1 Cage: 4N760
Safety Data Action Code: A
Record No. For Safety Entry: 018
Tot Safety Entries This Stk#: 028
Status: FE
Date MSDS Prepared: 18OCT94
Safety Data Review Date: 23APR98
Supply Item Manager: CX
MSDS Preparer's Name: UNKNOWN
MSDS Serial Number: CGMFW
Specification Number: P-D-680B
Spec Type, Grade, Class: TYPE I
Hazard Characteristic Code: F4
Unit Of Issue: CN
Unit Of Issue Container Qty: 5 GAL
Type Of Container: CAN
Net Unit Weight: 32.9 LBS
NRC/State License Number: NOT RELEVANT

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: PETROLEUM HYDROCARBONS
Ingredient Sequence Number: 01
Percent: UNKNOWN
Ingredient Action Code: A
NIOSH (RTECS) Number: 1000099PH
OSHA PEL: 5 MG/M3 (OIL MIST)
ACGIH TLV: 5 MG/M3 (OIL MIST)
Other Recommended Limit: NONE RECOMMENDED

---

Proprietary: NO
Ingredient: 1,2,4-TRIMETHYLBENZENE (SARA 313)
Ingredient Sequence Number: 02
Percent: 2.0
Ingredient Action Code: A
NIOSH (RTECS) Number: DC3325000
CAS Number: 95-63-6
OSHA PEL: 25 PPM
ACGIH TLV: 25 PPM; 9596
Other Recommended Limit: NONE RECOMMENDED

---

Proprietary: NO
Ingredient: STODDARD SOLVENT
Ingredient Sequence Number: 03
ercent: UNKNOWN
ngredient Action Code: A
NIOSH (RTECS) Number: WJ8925000
CAS Number: 8052-41-3
OSHA PEL: 500 PPM
ACGIH TLV: 100 PPM; 9596
Other Recommended Limit: NONE RECOMMENDED

## Physical/Chemical Characteristics

Appearance And Odor: CLEAR, COLORLESS LIQUID - HYDROCARBON ODOR
Boiling Point: 315F - 397F
Melting Point: -4F,-20C
Vapor Pressure (MM Hg/70 F): 6 @ 68F
Vapor Density (Air=1): 3.90
Specific Gravity: 0.79
Decomposition Temperature: UNKNOWN
Evaporation Rate And Ref: <0.1 (N-BUTYL ACETATE=1)
Solubility In Water: <0.01% @ 77F
Viscosity: UNKNOWN
Radioactivity: NOT RELEVANT
Corrosion Rate (IPY): UNKNOWN
Autoignition Temperature: 490F

## Fire and Explosion Hazard Data

Flash Point: 104F,40C
lash Point Method: TCC
ower Explosive Limit: 2.3
Upper Explosive Limit: 14.4
Extinguishing Media: USE CARBON DIOXIDE, SAND, WATER SPRAY, FOAM/DRY CHEMICAL. WATER SPRAY MAY BE USED TO KEEP FIRE EXPOSED CONTAINERS COOL.
Special Fire Fighting Proc: WEAR PROTECTIVE CLOTHING AND NIOSH-APPROVED SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.
Unusual Fire And Expl Hazrds: VAPOR IS HEAVIER THAN AIR AND CAN TRAVEL CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK. CONTAINERS MAY RUPTURE DUE TO VAPOR PRESSURE BUILDUP.

## Reactivity Data

Stability: YES
Cond To Avoid (Stability): HEAT, OPEN FLAMES
Materials To Avoid: STRONG OXIDIZING AGENTS, MOLTEN SULFUR, HALOGENS
Hazardous Decomp Products: CARBON MONOXIDE, CARBON DIOXIDE MAY BE FORMED.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

## Health Hazard Data

LD50-LC50 Mixture: TLV 100 PPM FOR STODDARD SOLVENT
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: TARGET ORGANS:EYE, SKIN, CNS, RESPIRATORY & GI TRACTS. ACUTE- EYE:MAY CAUSE MILD IRRITATION. SKIN:REPEATED/PROLONGED CONTACT MAY CAUSE DRYING. INHALE:IRRITATION, CNS EFFECTS. ORAL:MINIMAL TOXICITY, BUT ASPIRATION HAZARD DURING INGESTION OR VOMITING. CHRONIC-

UNKNOWN
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NONE
Signs/Symptoms Of Overexp: IRRITATION, TEARING, REDNESS, DRYING AND CRACKING OF SKIN, NAUSEA, VOMITING, COUGHING, HEADACHE, DIZZINESS, DROWSINESS, WEAKNESS, FATIGUE, UNCONSCIOUSNESS
Med Cond Aggravated By Exp: PERSONS WITH PRE-EXISTING SKIN DISORDERS, EYE PROBLEMS, OR IMPAIRED CNS OR RESPIRATORY FUNCTION MAY BE MORE SUSCEPTIBLE TO THE EFFECTS OF THIS PRODUCT.
MOVE TO FRESH AIR. PROVIDE CPR/OXYGEN IF NEEDED. EYES:FLUSH WITH WATER FOR 15 MINUTES. HOLD EYELIDS OPEN. SKIN:WASH WITH SOAP & WATER. ORAL:DO NOT INDUCE VOMITING. IF PERSON IS DROWSY/UNCONSCIOUS, PLACE ON LEFT SIDE WITH HEAD DOWN. GET MEDICAL ATTENTION. IF POSSIBLE, DO NOT LEAVE INDIVIDUAL UNATTENDED.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: REMOVE IGNITION SOURCES. VENTILATE AREA. ABSORB SPILL WITH NON-FLAMMABLE MATERIAL SUCH AS VERMICULITE OR SAND. PLACE IN A CONTAINER FOR CHEMICAL WASTE. CLEAN SURFACE THOROUGHLY TO REMOVE RESIDUAL CONTAMINATION. DO NOT FLUSH TO SEWERS OR WATERWAYS.
Neutralizing Agent: NOT RELEVANT
Waste Disposal Method: DISCHARGE, TREATMENT OR DISPOSAL IS SUBJECT TO FEDERAL, STATE OR LOCAL REGULATIONS. REUSING OR INCINERATION IS RECOMMENDED.
Precautions-Handling/Storing: STORE IN COOL, VENTILATED AREA, AWAY FROM IGNITION SOURCES & INCOMPATIBLES. KEEP CONTAINER TIGHTLY CLOSED.
Other Precautions: WARNING! FLAMMABLE. KEEP OUT OF REACH OF CHILDREN. AVOID EYE CONTACT. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. EMPTY CONTAINER RETAINS RESIDUE. FOLLOW LABEL INSTRUCTIONS. AVOID REPEATED SKIN CONTACT.

## Control Measures

Respiratory Protection: IF ENGINEERING CONTROLS ARE INADEQUATE, A NIOSH-APPROVED AIR-SUPPLIED RESPIRATOR SHOULD BE WORN.
Ventilation: MECHANICAL (GENERAL AND/OR LOCAL EXHAUST, EXPLOSION-PROOF) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).
Protective Gloves: RUBBER
Eye Protection: SAFETY GLASSES WITH SIDE SHIELD/GOGGLES
Other Protective Equipment: EYE BATH, WASHING FACILITIES, SAFETY SHOWER
Work Hygienic Practices: OBSERVE GOOD INDUSTRIAL HYGIENE PRACTICES AND RECOMMENDED PROCEDURES. WASH AFTER HANDLING AND BEFORE EATING OR DRINKING.
Suppl. Safety & Health Data: FORMULA CHANGED. FOR PREVIOUS FORMULATION, SEE PNI A, SAME NSN.

## Transportation Data

Transportation Action Code: A
Trans Data Review Date: 98113
DOT PSN Code: LKZ
DOT Proper Shipping Name: PETROLEUM DISTILLATES, N.O.S. OR PETROLEUM PRODUCTS, N.O.S.
DOT Class: 3
DOT ID Number: UN1268
DOT Pack Group: III
DOT Label: FLAMMABLE LIQUID
DOT/DoD Exemption Number: NOT RELEVANT
IMO PSN Code: LMH

IMO Proper Shipping Name: PETROLEUM DISTILLATES, N.O.S. o
IMO Regulations Page Number: 3375
IMO UN Number: 1268
IMO UN Class: 3.3
IMO Subsidiary Risk Label: -
IATA PSN Code: TJB
IATA UN ID Number: 1268
IATA Proper Shipping Name: PETROLEUM DISTILLATES, N.O.S.
IATA UN Class: 3
IATA Label: FLAMMABLE LIQUID
AFI PSN Code: TJB
AFI Prop. Shipping Name: PETROLEUM DISTILLATES, N.O.S.
AFI Class: 3
AFI ID Number: UN1268
AFI Pack Group: III
AFI Special Prov: P5
AFI Basic Pac Ref: A7.3
N.O.S. Shipping Name: STODDARD SOLVENT
Additional Trans Data: PROPER SHIPPING NAME, HAZARD CLASS PER CTDF. UP TO 220 LITERS ARE ALLOWED BY AIR CARGO.

==========

Disposal Data

==========

==========

Label Data

==========

Label Required: YES
Technical Review Date: 23APR98
Label Date: 18OCT94
MFR Label Number: UNKNOWN
Label Status: M
Common Name: VARSOL 18 SOLVENT
Signal Word: WARNING!
Acute Health Hazard-Moderate: X
Contact Hazard-Slight: X
Fire Hazard-Moderate: X
Reactivity Hazard-None: X
Special Hazard Precautions: TARGET ORGANS:EYE, SKIN, CNS, RESPIRATORY & GI TRACTS. ACUTE- EYE:MAY CAUSE MILD IRRITATION. SKIN:REPEATED/PROLONGED CONTACT MAY CAUSE DRYING. INHALE:IRRITATION, CNS DEPRESSION. ORAL:LARGE AMOUNTS MAY INJURE. ASPIRATION HAZARD. CHRONIC- UNKNOWN. STORE IN VENTILATED AREA, AWAY FROM FLAMES & INCOMPATIBLES. ABSORB SPILL WITH NON-FLAMMABLE MATERIAL. PLACE IN A CONTAINER FOR DISPOSAL. FIRST AID- CALL PHYSICIAN IF SYMPTOMS PERSIST. INHALED:MOVE TO FRESH AIR. PROVIDE CPR/ OXYGEN IF NEEDED. EYES:FLUSH WITH WATER FOR 15 MINUTES. HOLD EYELIDS OPEN. SKIN:WASH WITH SOAP & WATER. ORAL:DO NOT INDUCE VOMITING. GET MEDICAL ATTENTION.
Protect Eye: Y
Label Name: EXXON CHEMICAL AMERICAS
Label P.O. Box: 3272
Label City: HOUSTON
Label State: TX
Label Zip Code: 77001
Label Country: US
Label Emergency Number: 800-726-2015/800-424-9300(CHEMTREC)
Year Procured: 1998

# VINYL CHLORIDE

VCM

| Common Synonyms | Gas | Colorless | Sweet odor |
|---|---|---|---|
| Chloroethylene<br>VCL<br>Vinyl C Monomer<br>VCM | Liquid floats and boils on water. Flammable, irritating visible vapor cloud is produced. | | |

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Evacuate area in case of large discharge.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
POISONOUS GAS IS PRODUCED IN FIRE.
Flashback along vapor trail may occur.
May explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Cool exposed containers and protect men effecting shutoff with water.
Stop flow of gas if possible.
Let fire burn.
Extinguish small fires with dry chemical.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose, and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will cause frostbite.
Flush affected areas with plenty of water.
DO NOT RUB AFFECTED AREAS.

**Water Pollution**

Not harmful to aquatic life.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability
Evacuate area

## 2. LABEL

2.1 Category: Flammable gas
2.2 Class: 2

## 3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Vinyl halides
3.2 Formula: $CH_2$=CHCl
3.3 IMO/UN Designation: 2.0/1086
3.4 DOT ID No.: 1086
3.5 CAS Registry No.: 75-01-4

## 4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquefied compressed gas
4.2 Color: Colorless
4.3 Odor: Pleasant, sweet

## 5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Rubber gloves and shoes; gas-tight goggles; organic vapor canister or self-contained breathing apparatus.
5.2 Symptoms Following Exposure: INHALATION: high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite; phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate.
5.3 Treatment of Exposure: INHALATION: remove patient to fresh air and keep him quiet and warm; call a doctor; give artificial respiration if breathing stops. EYES AND SKIN: flush with plenty of water for at least 15 min.; for eyes, get medical attention; remove contaminated clothing.
5.4 Threshold Limit Value: 5 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 5 min.
5.6 Toxicity by Ingestion: Not pertinent
5.7 Late Toxicity: Chronic exposure may cause liver damage.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin. May cause frostbite.
5.10 Odor Threshold: 260 ppm
5.11 IDLH Value: Data not available

## 6. FIRE HAZARDS

6.1 Flash Point: —110°F C.C.
6.2 Flammable Limits in Air: 4%-22%
6.3 Fire Extinguishing Agents: For small fires use dry chemical or carbon dioxide. For large fires stop flow of gas. Cool exposed containers with water.
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Forms highly toxic combustion products such as hydrogen chloride, phosgene, and carbon monoxide.
6.6 Behavior in Fire: Container may explode in fire. Gas is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 882°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4.3 mm/min.

(Continued)

## 7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Polymerizes in presence of air, sunlight, or heat unless stabilized by inhibitors.
7.6 Inhibitor of Polymerization: Not normally used except when high temperatures are expected. Then 40-100 ppm of phenol used.
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 35

## 8. WATER POLLUTION

8.1 Aquatic Toxicity: None
8.2 Waterfowl Toxicity: None
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

## 9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial or technical 99+%
9.2 Storage Temperature: Under pressure; ambient At atm. pressure; low
9.3 Inert Atmosphere: No requirement
9.4 Venting: Under pressure; safety relief At atm. pressure; pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-B-C-D-E-F-G-Z

## 11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable gas
11.2 NAS Hazard Rating for Bulk Water Transportation:

| Category | Rating |
|---|---|
| Fire | 4 |
| Health | |
| Vapor Irritant | 2 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 0 |
| Aquatic Toxicity | 0 |
| Aesthetic Effect | 0 |
| Reactivity | |
| Other Chemicals | 2 |
| Water | 0 |
| Self Reaction | 2 |

11.3 NFPA Hazard Classification:

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

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Gas
12.2 Molecular Weight: 62.50
12.3 Boiling Point at 1 atm: 7.2°F = 13.8°C = 259.4°K
12.4 Freezing Point: —244.8°F = —153.8°C = —119.4°K
12.5 Critical Temperature: 317.1°F = 158.4°C = 431.6°K
12.6 Critical Pressure: 775 psia = 52.7 atm = 5.34 MN/m²
12.7 Specific Gravity: 0.969 at —13°C (liquid)
12.8 Liquid Surface Tension: 16.0 dynes/cm = 0.0160 N/m at 25°C
12.9 Liquid Water Interfacial Tension: (est.) 30 dynes/cm = 0.03 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 2.2
12.11 Ratio of Specific Heats of Vapor (Gas): 1.106
12.12 Latent Heat of Vaporization: 160 Btu/lb = 88 cal/g = 3.7 X 10⁵ J/kg
12.13 Heat of Combustion: —8136 Btu/lb = —4520 cal/g = —189.1 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: —728 Btu/lb = —405 cal/g = 16.9 X 10⁵ J/kg
12.25 Heat of Fusion: 16.14 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 75 psia

## 6. FIRE HAZARDS (Continued)

6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: 8.490 (Est.)
6.12 Flame Temperature: Data not available

VCM

# VINYL CHLORIDE

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| 0 | 61.000 | —30 | .259 | | N | —10 | .287 |
| 5 | 60.710 | —20 | .265 | | O | —5 | .281 |
| | | —10 | .272 | | T | 0 | .276 |
| | | 0 | .279 | | | 5 | .271 |
| | | | | | P | | |
| | | | | | E | | |
| | | | | | R | | |
| | | | | | T | | |
| | | | | | I | | |
| | | | | | N | | |
| | | | | | E | | |
| | | | | | N | | |
| | | | | | T | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | .600 | —50 | 3.384 | —50 | .04810 | 0 | .185 |
| | | —40 | 4.501 | —40 | .06245 | 25 | .192 |
| | | —30 | 5.908 | —30 | .08005 | 50 | .198 |
| | | —20 | 7.658 | —20 | .10140 | 75 | .205 |
| | | —10 | 9.814 | —10 | .12710 | 100 | .211 |
| | | 0 | 12.440 | 0 | .15760 | 125 | .217 |
| | | 10 | 15.610 | 10 | .19360 | 150 | .224 |
| | | 20 | 19.410 | 20 | .23560 | 175 | .230 |
| | | 30 | 23.920 | 30 | .28440 | 200 | .235 |
| | | 40 | 29.220 | 40 | .34050 | 225 | .241 |
| | | 50 | 35.430 | 50 | .40470 | 250 | .247 |
| | | 60 | 42.630 | 60 | .47760 | 275 | .252 |
| | | 70 | 50.940 | 70 | .56000 | 300 | .257 |
| | | 80 | 60.480 | 80 | .65250 | 325 | .263 |
| | | 90 | 71.349 | 90 | .75570 | 350 | .268 |
| | | 100 | 83.669 | 100 | .87050 | 375 | .273 |
| | | 110 | 97.580 | 110 | .99740 | 400 | .277 |
| | | 120 | 113.200 | 120 | 1.13700 | 425 | .282 |
| | | | | | | 450 | .286 |
| | | | | | | 475 | .291 |
| | | | | | | 500 | .295 |
| | | | | | | 525 | .299 |
| | | | | | | 550 | .303 |
| | | | | | | 575 | .307 |
| | | | | | | 600 | .311 |

Please reduce your browser font size for better viewing and printing.

**MSDS** Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

# XYLENES

**MSDS Number: X2000 — *Effective Date: 09/08/97***

## 1. Product Identification

**Synonyms:** Dimethyl benzene, xylol, methyltoluene
**CAS No.:** 1330-20-7
**Molecular Weight:** 106.17
**Chemical Formula:** C6H4(CH3)2
**Product Codes:**
J.T. Baker: 5377, 5810, 5813, 9483, 9489, 9490, 9493, 9494, 9499, 9516, X516
Mallinckrodt: 8664, 8668, 8671, 8672, 8685, 8802

## 2. Composition/Information on Ingredients

| Ingredient | CAS No | Percent | Hazardous |
|---|---|---|---|
| m-Xylene | 108-38-3 | 40 - 65% | No |
| o-Xylene | 95-47-6 | 15 - 20% | No |
| p-Xylene | 106-42-3 | < 20% | No |
| Ethyl Benzene | 100-41-4 | 15 - 25% | Yes |

## 3. Hazards Identification

**Emergency Overview**

**DANGER! HARMFUL OR FATAL IF SWALLOWED. VAPOR HARMFUL. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE EYE IRRITATION. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CHRONIC EXPOSURE CAN CAUSE ADVERSE LIVER, KIDNEY, AND BLOOD EFFECTS. FLAMMABLE**

**LIQUID AND VAPOR.**

**J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)**

---

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS
Storage Color Code: Red (Flammable)

---

**Potential Health Effects**

---

**Inhalation:**
Inhalation of vapors may be irritating to the nose and throat. Inhalation of high concentrations may result in nausea, vomiting, headache, ringing in the ears, and severe breathing difficulties which may be delayed in onset. Substernal pain, cough, and hoarseness are also reported. High vapor concentrations are anesthetic and central nervous system depressants.
**Ingestion:**
Ingestion causes burning sensation in mouth and stomach, nausea, vomiting and salivation. Minute amounts aspirated into the lungs can produce a severe hemorrhagic pneumonitis with severe pulmonary injury or death.
**Skin Contact:**
Skin contact results in loss of natural oils and often results in a characteristic dermatitis. May be absorbed through the skin.
**Eye Contact:**
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
**Chronic Exposure:**
Chronic inhalation can cause headache, loss of appetite, nervousness and pale skin. Repeated or prolonged skin contact may cause a skin rash. Repeated exposure of the eyes to high concentrations of vapor may cause reversible eye damage. Repeated exposure can damage bone marrow, causing low blood cell count. May damage the liver and kidneys.
**Aggravation of Pre-existing Conditions:**
Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney, blood, or respiratory function may be more susceptible to the effects of the substance.

---

# 4. First Aid Measures

**Inhalation:**
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.
**Ingestion:**
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
**Skin Contact:**
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

**Eye Contact:**
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

## 5. Fire Fighting Measures

**Fire:**
Flash point: 29C (84F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 1.0; uel: 7.0
**Explosion:**
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. Sensitive to static discharge.
**Fire Extinguishing Media:**
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
**Special Information:**
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Vapors can flow along surfaces to distant ignition source and flash back.

## 6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(tm) solvent adsorbent is recommended for spills of this product.

## 7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty

containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

## 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**
-OSHA Permissible Exposure Limit (PEL):
100 ppm (TWA) xylene
100 ppm (TWA) ethylbenzene
-ACGIH Threshold Limit Value (TLV):
100 ppm (TWA) 150 ppm (STEL) xylene
Carcinogen Category (xylene): A4
100 ppm (TWA) 125 ppm (STEL) ethyl benzene
**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.
**Personal Respirators (NIOSH Approved):**
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
**Eye Protection:**
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

## 9. Physical and Chemical Properties

The following physical data is for xylene.
**Appearance:**
Clear, colorless liquid.
**Odor:**
Characteristic odor.
**Solubility:**
Insoluble in water.
**Specific Gravity:**
0.86 @ 20C/4C
**pH:**
Not applicable.
**% Volatiles by volume @ 21C (70F):**
100

**Boiling Point:**
137 - 140C (279 - 284F)
**Melting Point:**
-25C (-13F)
**Vapor Density (Air=1):**
3.7
**Vapor Pressure (mm Hg):**
8 @ 20C (68F)
**Evaporation Rate (BuAc=1):**
0.7

## 10. Stability and Reactivity

**Stability:**
Stable under ordinary conditions of use and storage.
**Hazardous Decomposition Products:**
Involvement in a fire causes formation of carbon monoxide and unidentified organic components.
**Hazardous Polymerization:**
Will not occur.
**Incompatibilities:**
Strong oxidizing agents and strong acids.
**Conditions to Avoid:**
Heat, flames, ignition sources and incompatibles.

## 11. Toxicological Information

**Toxicological Data:**
Xylene: oral rat LD50: 4300 mg/kg; inhalation rat LC50: 5000 ppm/4H; skin rabbit LD50: > 1700 mg/kg; Irritation eye rabbit: 87 mg mild (Std. Draize); irritation skin rabbit 500 mg/24 moderate (Std. Draize); investigated as a tumorigen, mutagen, reproductive effector. Ethyl benzene: oral rat LD50: 3500 mg/kg; skin rabbit LD50: 17800 uL/kg; investigated as a tumorigen, mutagen, reproductive effector.
**Reproductive Toxicity:**
May cause teratogenic effects.

--------\Cancer Lists\----------

| Ingredient | ---NTP Carcinogen--- Known | Anticipated | IARC Category |
|---|---|---|---|
| m-Xylene (108-38-3) | No | No | 3 |
| o-Xylene (95-47-6) | No | No | 3 |
| p-Xylene (106-42-3) | No | No | 3 |
| Ethyl Benzene (100-41-4) | No | No | None |

## 12. Ecological Information

**Environmental Fate:**
Following data for xylene: When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material is expected to leach into

groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released into water, this material may evaporate to a moderate extent. When released into water, this material may biodegrade to a moderate extent. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of less than 1 day. This material is not expected to significantly bioaccumulate. (mixed xylenes: octanol / water partition coefficient 3.1 - 3.2; bioconcentration factor = 1.3, eels)

**Environmental Toxicity:**

For xylene: This material is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

## 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

## 14. Transport Information

**Domestic (Land, D.O.T.)**

**Proper Shipping Name:** XYLENES
**Hazard Class:** 3
**UN/NA:** UN1307
Packing Group: III
**Information reported for product/size:** 398LB

**International (Water, I.M.O.)**

**Proper Shipping Name:** XYLENES
**Hazard Class:** 3.3
**UN/NA:** UN1307
Packing Group: III
**Information reported for product/size:** 398LB

## 15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

| Ingredient | TSCA | EC | Japan | Australia |
|---|---|---|---|---|
| m-Xylene (108-38-3) | Yes | Yes | Yes | Yes |
| o-Xylene (95-47-6) | Yes | Yes | Yes | Yes |
| p-Xylene (106-42-3) | Yes | Yes | Yes | Yes |
| Ethyl Benzene (100-41-4) | Yes | Yes | Yes | Yes |

--------\Chemical Inventory Status - Part 2\--------

--Canada--

| Ingredient | Korea | DSL | NDSL | Phil. |
|---|---|---|---|---|
| m-Xylene (108-38-3) | Yes | Yes | No | Yes |
| o-Xylene (95-47-6) | Yes | Yes | No | Yes |
| p-Xylene (106-42-3) | Yes | Yes | No | Yes |
| Ethyl Benzene (100-41-4) | Yes | Yes | No | Yes |

--------\Federal, State & International Regulations - Part 1\----------

| Ingredient | -SARA 302- RQ | TPQ | ------SARA 313------ List | Chemical Catg. |
|---|---|---|---|---|
| m-Xylene (108-38-3) | No | No | Yes | No |
| o-Xylene (95-47-6) | No | No | Yes | No |
| p-Xylene (106-42-3) | No | No | Yes | No |
| Ethyl Benzene (100-41-4) | No | No | Yes | No |

--------\Federal, State & International Regulations - Part 2\----------

| Ingredient | CERCLA | -RCRA- 261.33 | -TSCA- 8(d) |
|---|---|---|---|
| m-Xylene (108-38-3) | 1000 | No | No |
| o-Xylene (95-47-6) | 1000 | No | No |
| p-Xylene (106-42-3) | 100 | No | Yes |
| Ethyl Benzene (100-41-4) | 1000 | No | No |

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

**Australian Hazchem Code:** 3[Y]
**Poison Schedule:** No information found.
**WHMIS:**
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

# 16. Other Information

**NFPA Ratings:** Health: **2** Flammability: **3** Reactivity: **0**
**Label Hazard Warning:**
DANGER! HARMFUL OR FATAL IF SWALLOWED. VAPOR HARMFUL. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE EYE IRRITATION. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CHRONIC EXPOSURE CAN CAUSE ADVERSE LIVER, KIDNEY, AND BLOOD EFFECTS. FLAMMABLE LIQUID AND VAPOR.
**Label Precautions:**
Keep away from heat, sparks and flame.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use only with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
**Label First Aid:**
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled,

remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

**Product Use:**
Laboratory Reagent.

**Revision Information:**

**Disclaimer:**
**********

**Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.**
**********

**Prepared by:** Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

# Appendix I

# Air Quality Monitoring

# Air Quality Monitoring

| | | | |
|---|---|---|---|
| **Client:** | Waste Management, Inc. | **Proj. No.:** | 3-4198 |
| **Location:** | Austin, Texas | **Site Geol.:** | Mark R. Riggle |
| **Proj. Mgr.:** | Steve Dischler | **Site H&S Ofcr.:** | Robert Crone |

| Date | Initial | Time | Location | OVA/ OVM | $O_2$ | LEL | Dräger Tubes | | | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

# Appendix J

# Equipment Calibration Log

# Field Equipment Calibration/Maintenance Log

| | | | |
|---|---|---|---|
| **Client:** | Waste Management, Inc. | **Proj. No.:** | 3-4198 |
| **Location:** | Austin, Texas | **Site Geol.:** | Mark R. Riggle |
| **Proj. Mgr.:** | Steve Dischler | **Site H&S Ofcr.:** | Robert Crone |

| Date | Type of Equipment[1] | Equipment ID Number | Procedure[2] | Reference Standards[3] | Initials of Individual | Company | Calibration OK Yes/No |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

[1]Certifications or statements of manufacturer calibration can be obtained from ThermoRetec office files.
[2]Use space below if necessary
[3]Type of calibration gas used and concentration; buffer solutions, etc.

Maintenance Required/Procedures _____

_____

_____

# Appendix K

# Record of Hazardous Waste Activity

# Record of Hazardous Waste Activity

| | | | |
|---|---|---|---|
| **Client:** | Waste Management, Inc. | **Proj. No.:** | 3-4198 |
| **Location:** | Austin, Texas | **Date:** | |
| **Proj. Mgr.:** | Steve Dischler | **Site Geol.:** | Mark R.Riggle |
| **Site H&S Ofcr:** | Robert Crone | | |

| **Name** | **Date** | **Days at the Site In:** | | | **Job Function** |
|---|---|---|---|---|---|
| | | **Level A/B** | **Level C** | **Level D** | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Site Health & Safety Officer** **Date**

# Appendix L

# Injury/Exposure Report

# Injury/Exposure Report

| | | | |
|---|---|---|---|
| **Client:** | | **Proj. No.:** | |
| **Location:** | | **Date:** | |
| **Proj. Mgr.:** | | **Site Eng.:** | |
| **Site Health & Safety Officer:** | | | |
| **Personal Information:** | | | |
| **Name of Injured:** | | | |
| **Address:** | | | |
| **Title/Classification:** | | | **Office:** |
| **SSN:** | **Age:** | **Sex:** | **Yrs. of Svc:** |
| Date of Injury/exposure: | | Time: | |
| **Accident Category:** (motor vehicle, fire, property damage, chemical exposure, other please explain if other) | | | |
| **Severity of Injury/Exposure** (non-disabling, disabling, medical treatment, fatality): | | | |
| **Amount of Damage:** $ | | **Property Damage:** | |
| **Estimated Number of Days Away from Work:** | | | |
| **Nature of Injury/Exposure:** | | | |
| **Classification of Injury/Exposure:** (Please Check) | | | |
| Fractures | Bites | Blisters | Heat Exhaustion |
| Dislocations | Respiratory Allergy | Toxic Respiratory Exposure | Concussion |
| Sprains | Heat Burns | Toxic Ingestion | Faint/dizziness |
| Abrasions | Chemical Burns | Cold Exposure | Toxic Respiratory |
| Lacerations | Radiation Burns | Frostbite | Dermal Allergy |
| Punctures | Bruises | Heatstroke | |
| **Parts of Body Affected:** | | | |
| **Degree of Disability:** | | | |
| **Date Medical Care Was Received:** | | | |
| **Facility Where Medical Care Was Received:** | | | |
| **Injury/Exposure Information** | | | |
| **Causative agent most directly related to injury/exposure (object, substance, material, machinery) equipment, conditions):** | | | |
| **Was weather a factor?** | | | |
| **Unsafe mechanical/physical/environmental conditions at time of exposure injury (be specific):** | | | |

| |
|---|
| **Personal factors (improper attitude, lack of knowledge or skill, slow reaction, fatigue):** |
| **Level of personal protective equipment specified in the Site Health & Safety Plan:** |
| **Modification:** |
| **Was injured person/persons using required PPE?** |
| **If not, how did the actual equipment used differ from that specified in the Site Health & Safety Plan?** |
| **What can be done to prevent a recurrence of this type of accident? (modification of equipment, mechanical) changes, additional training, etc.):** |
| **Present a detailed narrative description of the injury/exposure. How did it occur? Why? Objects, equipment, tools used, circumstances, assigned duties, etc. (be specific):** |
| **Witnesses to injury/exposure (names and their eye witness accounts):** |

| **FOR CORPORATE HEALTH & SAFETY USE ONLY** | | |
|---|---|---|
| Temp. Total: | Permanent Total: | Death or Permanent Total: |
| Start Losing Time: | Part of Body: | |
| Return to Work: | Percent Loss or Loss of Use: | |
| Time Charge: | | |
| Name of Hospital: | | |
| Address: | | |
| Name of Physician: | | |
| Address: | | |

**Forward this form to the following:**

- ☐Health and Safety Department - Pittsburgh
- ☐Human Resources Department - Concord
- ☐Health and Safety Coordinator - Local
- ☐Regional Manager - Local
- ☐Operations Manager - Local

# Appendix M

# Near-Accident Report

# Near-Accident Report

| | | | |
|---|---|---|---|
| **Name:** | | **Date:** | |
| **Client:** | | **Proj. No:** | |

I witnessed a near-accident this day at _____

Was appropriate PPE being worn: Yes or No

The following is an account of what happened:

_____
_____
_____
_____
_____

I believe this could have resulted in injury and/or damage to: (Check all that pertain)

☐ Personnel ☐ Property ☐ Equipment

If these circumstances occurred:

_____
_____
_____
_____
_____
_____
_____
_____

I recommend the following actions to prevent this form occurring in the future:

_____
_____
_____
_____
_____
_____

Safety Standard Required ☐ Yes (Complete and Attach Safety Standard Form)
☐ No

**Note: Use additional paper if required**

# Appendix N

# Hot Work Permit

# Hot Work Permit

**Permit Valid for 1 Work Day**

**Proj. Name:** _____ **Job No.:** _____

**Hot Work Description:** _____

**Workers/Welders Conducting Hot Work:** _____

## PERMIT MUST BE COMPLETED IN ITS ENTIRETY BEFORE HOT WORK BEGINS

| | Yes | No |
|---|---|---|
| Has project supervisor been notified of intended hot work? | | |
| Does client representative need to be notified of the intended hot work? | | |
| Will hot work impact the general public, clients, or operation employees? | | |
| Will the intended hot work need to be coordinated with other contractors who may be working on the site to make them aware of any hazards and the scope of work to be performed? | | |
| Have hazardous energy sources been identified, isolated, and locked out - tagged out before the start of the project? | | |
| Will hot work be conducted within a confined space? | | |
| All testing equipment (i.e., CGI, oxygen meter, etc.) and fire fighting equipment (i.e., extinguisher, etc.) have been checked to ensure proper operation and calibration before the start of this project? | | |
| Has a fire watch been designated and on station? | | |
| Coatings on metal surfaces have been tested for ignitability and flame spread? | | |
| Area has been cleared of all flammable materials. | | |
| All fuel sources been identified and protected. | | |
| The area has been restricted with proper barriers and signs. | | |
| The area has been tested to be certain that atmosphere is 0% LEL before starting hot work. | | |
| Flame sensitive areas and equipment (including cylinders and gas delivery lines) exposed to slag and sparks protected by flame resistant blankets or removed from the area? | | |
| All equipment and hoses protected from falling metal structures and debris? | | |
| Escape routes have been identified before starting work? | | |
| Is ventilation equipment needed? Type Needed:_____ | | |

**The Following Protective Equipment Will Be Required:**

| | Yes | No | | Yes | No |
|---|---|---|---|---|---|
| Welding Goggles/Shield Tint | | | Supplied Air Respirator | | |
| Safety Boots | | | Head Protection | | |
| Leather Gloves | | | Safety Harness | | |
| Hearing Protection | | | Welding Leathers — Top | | |
| APR _____ Cartridge | | | Welding Leathers — Bottom | | |

## Hot Work Permit (Continued)

**Permit Valid for 1 Work Day**

**The following procedures will be applicable prior to hot work on tanks or other types of enclosed structures.** (Check all that apply and fill in appropriate information)

_____ Ventilate to 0% LEL  Confined Space Entry Permit _____

_____ Mechanical Ventilation Required  Cold Cut Only
Method Required: _____

_____Inert<_____%Oxygen:  Hot Cut Method Allowed: _____
(Fill In)

_____Inert<_____%Oxygen:  Cold Cut Only Method Required:

**APPROVALS:**  **DATE:**_____

_____
Client Representative

_____
ThermoRetec Site Safety Officer

_____
Fire Watch

_____
Performed Hot Work Employee

**FILE PERMIT IN PROJECT WORK FILE**

# Appendix O

# Drill Rig Inspection Log

# Drilling Safety Audit

**Site:**_____

**Date:**_____

**Subcontractor Audited:**_____

**Auditor:**_____

## General Safety

Safety Officer Designated for Job: ☐Yes ☐No

**Name:**_____

Safety Meeting Performed (Daily) ☐Yes ☐No

## Personal Protective Equipment (PPE)

| | | |
|---|---|---|
| Hard Hats | ☐Yes | ☐No |
| Safety Glasses | ☐Yes | ☐No |
| Steel Toed Boots | ☐Yes | ☐No |
| Hearing Protection | ☐Yes | ☐No |
| Work Gloves | ☐Yes | ☐No |
| Orange Work Vests | ☐Yes | ☐No |
| Traffic Cones and Signs | ☐Yes | ☐No |
| Other _____ | ☐Yes | ☐No |

Disposal of PPE in Proper Waste Containers (If Applicable) ☐Yes ☐No

**Comments:**

_____

_____

_____

_____

## Daily Inspections of Drill Rig:

| | | |
|---|---|---|
| Structural Damage, Loose Bolts | ☐Yes | ☐No |
| Proper Tension in Chain Drives | ☐Yes | ☐No |

| | | |
|---|---|---|
| Loose or Missing Guards, Fluid Leaks | □Yes | □No |
| Damaged Hoses and/or Damaged Pressure Gages and Pressure Relief Valves | □Yes | □No |

**Comments:**

_____

_____

_____

_____

**Check and test all safety devices such as:**

| | | |
|---|---|---|
| Emergency shutdown switches, at least daily | □Yes | □No |
| Check all gages and warning lights and ensure control levers are functioning properly | □Yes | □No |
| First Aid and fire extinguishers on drill rig | □Yes | □No |
| Back up alarm functioning properly | □Yes | □No |

**Comments:**

_____

_____

_____

_____

**Drill Crew Training Requirements:**

| | | |
|---|---|---|
| 40 Hour OSHA Training | □Yes | □No |
| 8 Hour Annual Refresher Training | □Yes | □No |
| Drill Rig Training/Safe Operating Practices | □Yes | □No |
| First Aid/CPR | □Yes | □No |
| Emergency Procedures | □Yes | □No |
| Emergency Phone Numbers Posted | □Yes | □No |
| Site Orientation | □Yes | □No |
| Health and Safety Plan Review | □Yes | □No |

**Comments:**

_____

_____

_____

_____

**Housekeeping:**

| | | |
|---|---|---|
| Suitable storage for tools, materials and supplies | ☐Yes | ☐No |
| Pipes, drill rods, casing, and augers stacked on racks to prevent rolling and sliding | ☐Yes | ☐No |
| Platforms and other work areas free of debris materials and obstructions | ☐Yes | ☐No |

**Hand Tools:**

| | | |
|---|---|---|
| Tools in good condition | ☐Yes | ☐No |
| Broken tools discarded and replaced | ☐Yes | ☐No |
| Right tool used for the right job | ☐Yes | ☐No |

**Comments:**

_____

_____

_____

_____

**Drilling Operations:**

| | | |
|---|---|---|
| Mast or derrick down when moving rig | ☐Yes | ☐No |
| Overhead obstructions identified before mast is raised | ☐Yes | ☐No |
| Drill rig stabilized using leveling jacks or solid cribbing | ☐Yes | ☐No |
| Secure and lock derrick | ☐Yes | ☐No |

**Comments:**

_____

_____

_____

_____

**Overhead and Buried Utilities:**

| | | |
|---|---|---|
| Buried utilities identified and marked | □Yes | □No |
| Safe distance of drill rig from overhead power lines | □Yes | □No |

**Comments:**

_____

_____

_____

_____

**Wire Line Hoists Wire Rope and Hardware:**

| | | |
|---|---|---|
| Inspection for broken wires where reduction in rope diameter, wire diameter, fatigue, corrosion, damage from gear jamming, crushing, bird caging, kinking | □Yes | □No |
| Inspect and lubricate parts daily | □Yes | □No |

**Comments:**

_____

_____

_____

_____

**Auger Operations: What to look for:**

- A system of responsibility between the operator and the tool handler when connecting and disconnecting auger sections and inserting and removing auger fork.
- During connecting and disconnecting auger sections and inserting auger for the tool, handler should position himself away from the auger column while it is rotating.
- When securing the auger to the power coupling, pin should be inserted and tapped into place using a hammer or other similar device.
- Tool hoist should be used to lower second section of auger into place.
- Both operators should be clear of auger as it is being lifted into place.
- Long handled shovel should be used to move dirt away from auger.

**Overall Summery:**