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INFORMAL REPORT

IN SITU VITRIFICATION ENGINEERING-SCALE TEST ES-INEL-4 SAMPLING AND ANALYSIS PLAN

B. L. Charboneau
K. A. Kearney
R. N. Currie
C. E. Bigelow
R. K. Farnsworth

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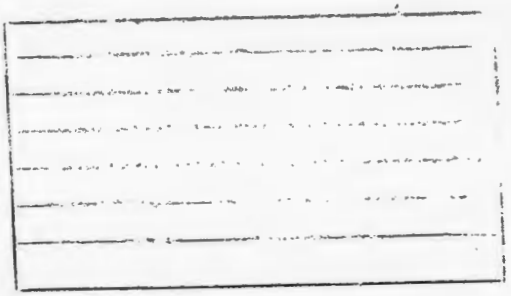

Idaho National Engineering Laboratory

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EG&G Idaho

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Revision 0

In Situ Vitrification Engineering-Scale Test ES-INEL-4 Sampling and Analysis Plan

B. L. Charboneau
K. A. Kearney
R. N. Currie
C. E. Bigelow*
R. K. Farnsworth*

September 1989

Idaho National Engineering Laboratory
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

* Battelle, Pacific Northwest Laboratory

Prepared for the
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In Situ Vitrification
Engineering-Scale Test ES-INEL-4
Sampling and Analysis Plan

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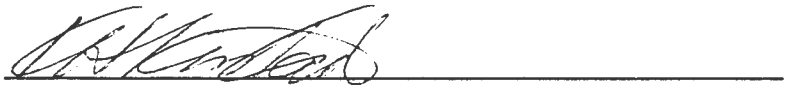
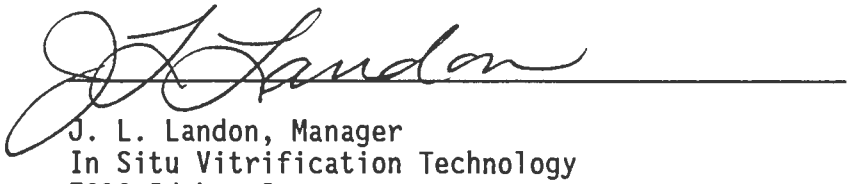


10/17/89

K. H. Kinkade, Manager
Environmental Restoration Program
EG&G Idaho, Inc.

Date

REVIEWED:



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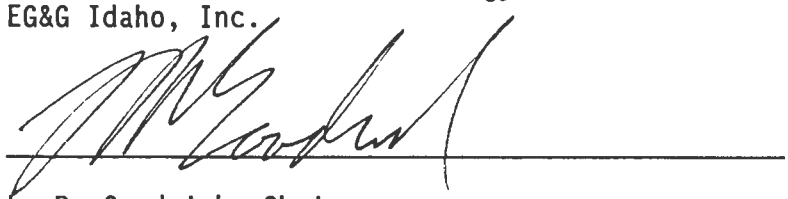
J. L. Landon, Manager
In Situ Vitrification Technology
EG&G Idaho, Inc.

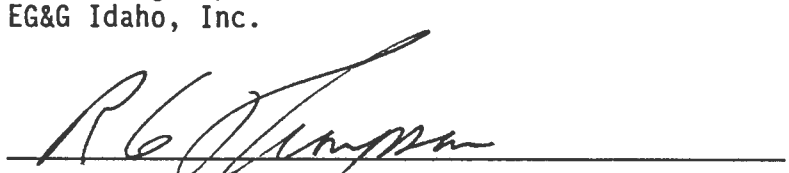
Date



10/17/89

L. D. Goodrich, Chairman
Data Integrity Review Committee
EG&G Idaho, Inc.

Date



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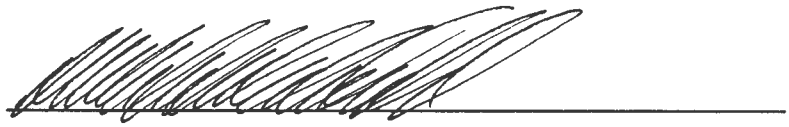
R. G. Thompson, Jr.
Quality
EG&G Idaho, Inc.

Date



10/16/89

W. D. Schofield
Safety
EG&G Idaho, Inc.

Date

10-16-89

C. H. Kindle, PNL Project Manager
Process Development Section
Battelle

Date

List of Effected Pages

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No revisions have been made.

ACRONYMS

ARDC	Administrative Record and Document Control
CLP	Contract Laboratory Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chain-Of-Custody
DCQAP	Data Collection Quality Assurance Plan
DIRC	Data Integrity Review Committee
DOE	Department Of Energy
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
EP-TOX	Extraction Procedure Toxicity Leach Test
ERP	Environmental Restoration Program
ICP	Inductively-Coupled Plasma Spectroscopy
INEL	Idaho National Engineering Laboratory
ISV	In Situ Vitrification
PNL	Pacific Northwest Laboratory
QA	Quality Assurance
QC	Quality Control
RFP	Rocky Flats Plant
RI/FS	Remedial Investigation/Feasibility Study
RWMC	Radioactive Waste Management Complex
SAP	Sampling And Analysis Plan
SDA	Subsurface Disposal Area
TCLP	Toxic Characteristics Leach Procedure
TRU	Transuranic
VOCs	Volatile Organic Compounds

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1. INTRODUCTION

The Environmental Restoration Program (ERP) at the Idaho National Engineering Laboratory (INEL) anticipates conducting a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS) for the U.S. Department of Energy Idaho Operations Office (DOE-ID). A treatability study on the in situ vitrification (ISV) technology is being conducted for this feasibility study. The scope of this treatability study includes the remediation of mixed-low-level waste and mixed-transuranic (TRU) waste[a] buried at the Subsurface Disposal Area (SDA) located at the Radioactive Waste Management Complex (RWMC). The information obtained during this study will also be available to those who are investigating the remediation of other areas. As part of this treatability study an engineering scale ISV test will be conducted.

This SAP describes the objectives of engineering scale ISV test ES-INEL-4, and the methods and procedures to be used to obtain the samples/data and to conduct analyses, and the procedures by which the appropriate level of data quality is ensured. This test will examine ISV product quality for a melt containing soil from the INEL RWMC, heavy metals, hazardous volatile organics, paper, wood, and ordinary metals. The soil and basalt rock surrounding the melt will be analyzed for the presence of hazardous materials which might have migrated from the melt zone.

This SAP was prepared in accordance with ERP Program Directive 5.2, Preparation of Sampling and Analysis Plans. When further guidance was

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a. TRU waste as defined in DOE Order 5820.2, is radioactive material that, without regard to source or form, is contaminated with alpha-emitting rotundities with an atomic number greater than 92, half-lives greater than 20 years, and concentrations greater than 100 nCi/g.

needed, the following references were consulted in sequence order until sufficient information was obtained:

1. Buried Waste Program (ERP) Data Collection Quality Assurance Plan (DCQAP), Rev. 1, EGG-WM-8220, December 1988.

2. RCRA Facility Investigation (RFI) Work Plan, Rev. 1, EGG-WM-8219, December 1988.

3. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, OSWER Directive 9355.2-01, EPA 540/G-89/004, October 1988.

4. Data Quality Objectives For Remedial Response Activities: Development Process, EPA 540/G-87-003, March 1987.

2. PROJECT DESCRIPTION

2.1 Background Information

In situ vitrification is a thermal treatment process that converts contaminated soil and waste to a chemically inert stable glass and crystalline product. The process was originally developed by Battelle at Pacific Northwest Laboratory (PNL) for the DOE, with emphasis on the in place stabilization of TRU contaminated soils.[5] EG&G Idaho with Battelle is working on continued development of the process for application to buried waste at the INEL. Part of this continued development is the process of electrode feeding.

The process is initiated by placing a square array of four electrodes [graphite with or without a molybdenum (Mo) core] into the ground surface above the desired treatment area as shown in Figure 2-1. Because dry soil is a poor electrical conductor, a conductive mixture of flaked graphite and glass frit is placed between the electrodes to act as a starter path. An electrical potential is applied to the electrodes to establish an electrical current in the starter path. The resultant power heats the starter path and surrounding soil initially to 3600^{o}F, well above soil melting temperatures of 2000 to 2550^{o}F. The graphite starter path is eventually consumed by oxidation, and the current is transferred to the molten soil, the operating temperature being between 2650 and 3600^{o}F. As the molten zone grows downward, the electrodes are lowered into the molten zone to distribute the power (heat) and induce downward growth. Radionuclides and nonvolatile hazardous elements, such as heavy metals, present in the soil/waste are incorporated into the vitrified mass. Organic components present in the soil/waste are destroyed through pyrolysis by the high temperature of the process. The by-products of pyrolysis rise to the surface of the molten zone, where they burn in the presence of air. A hood placed over the area being vitrified directs the gaseous effluents to an off gas treatment system.

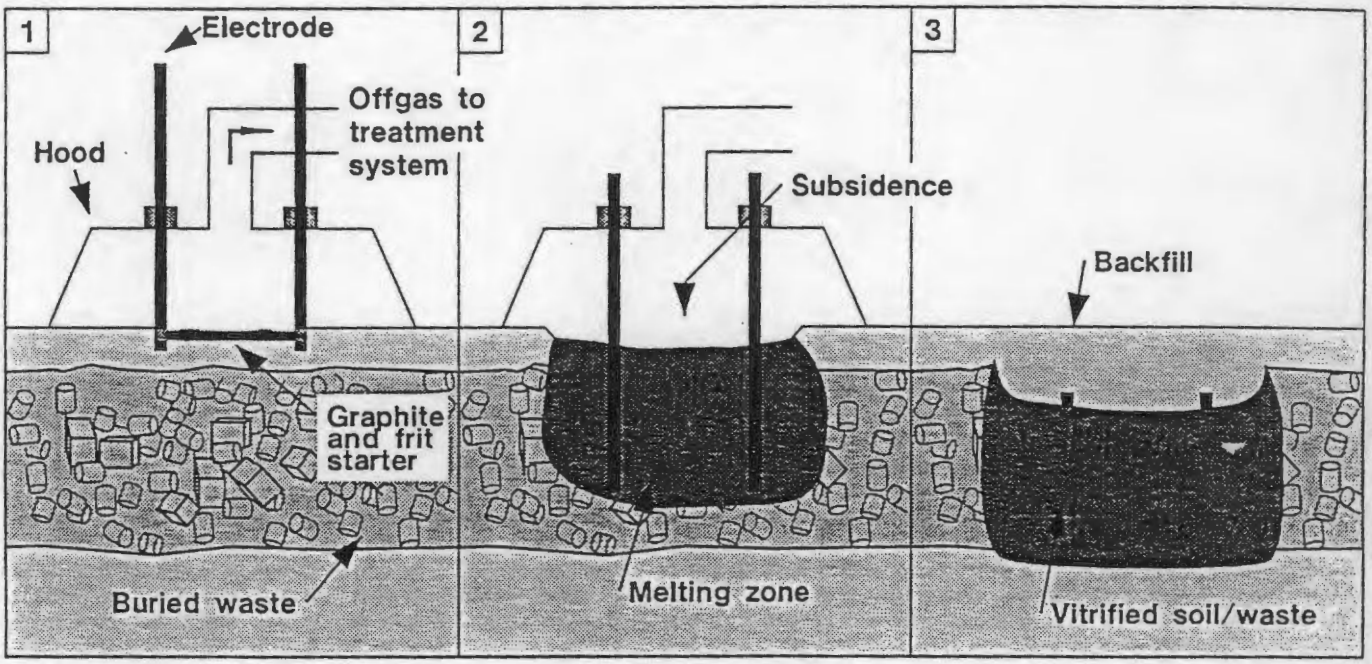


Figure 2-1. In situ vitrification process sequence.

The development of ISV began in 1980, and since that time numerous experimental tests under a variety of conditions and with a variety of waste types have been conducted.[5] Table 2-1 describes the different scales of tests that have been used during its development. The large scale ISV demonstrations have culminated in a large scale ISV demonstration on a radioactively contaminated soil site at the PNL during June 1987. Development of the ISV technology is being expanded to facilitate its application to the SDA. The major modification currently identified is a technique to allow the electrodes to be lowered into the ground as the process proceeds downward rather than requiring the electrode to be placed into the waste area prior to the process being initiated.

TABLE 2-1. TESTING UNITS FOR DEVELOPING ISV TECHNOLOGY

Equipment Size	Electrode Separation (ft)	Vitrified Mass per Setting	Completed As of 9/30/88
Bench-Scale	0.36	2 to 22 lbs	12
Engineering-Scale	0.7 to 1.2	0.05 to 1 ton	26
Intermediate-Scale	3.0 to 4.9	10 to 50 ton	16
Large-Scale	11.5 to 18.0	400 to 800 ton	5

This task will consist of one engineering scale ISV test, ES-INEL-4, which is the fourth engineering scale ISV test ERP has conducted. The first three tests were of a preliminary scope nature in which the data gathered will be verified later under more stringent conditions. The first two engineering scale ISV tests were conducted to evaluate the feasibility of vitrifying waste containing metallic objects.[6] The third test was conducted to evaluate the feasibility of electrode feeding. The results from engineering scale Test 4 will be used to directly support the INEL evaluation of the ISV technology and the preparation for a full scale demonstration at the SDA.

2.2 Objectives of the Sampling/Data Collection Effort

The primary objective of the overall ISV Treatability Study is to generate data of sufficient quality and quantity to evaluate the ISV technology as a viable remediation alternative for all or part of the SDA. The ES-INEL-4 ISV Test represents one of several engineering-, intermediate-, and large-scale tests which have been or will be conducted. The ES-INEL-4 Test will obtain preliminary data for the objectives listed below which will be confirmed during further Laboratory testing. This test will serve as a basis for designing a laboratory test series to fully meet these objectives.

1. Calculate what the destruction and removal efficiency of hazardous volatile organics would be if the ISV process were applied at the SDA.

2. Calculate the percentages of heavy metals which would be incorporated into the melt, deposited in the surrounding soil, and fluidized into the off gas if the ISV process were applied at the SDA.

3. Calculate what the leachability of heavy metals would be in the vitrified product if the ISV process were applied at the SDA.

4. Calculate the volume reduction the contaminated soil/waste would under go if the ISV process were applied at the SDA.

5. Calculate what the effectiveness of silicon carbide coatings would be on preventing electrode oxidation if the ISV process were applied at the SDA.

2.3 Data Quality Objectives (DQOs)

The following data quality objectives (DQO's) have been established to ensure that the data collected are sufficient and of adequate quality for their intended uses. Data collected and analyzed in conformance with the stated DQO's can be used in assessing the uncertainty associated with decisions related to remedial response. Refer to Section 10 for ISV accuracy and precision requirements.

1. Data Users: ISV Engineering Scale primary data user is the Environmental Restoration Program, In Situ Vitrification Project. The ERP is responsible for collecting data resulting from several promising, diverse remedial tests and demonstrations, of which ISV Engineering-scale test ES-INEL-4 is included. Decisions resulting from ERP data will be used by the DOE, State of Idaho and the EPA to recommend remedial action(s) at the SDA.

2. Available Information: The Battelle Institute at Pacific Northwest Laboratory has developed and conducted numerous engineering-, intermediate-, and large-scale ISV tests. Data and reports on those tests have been reviewed and used as input in the development of EG&G Idaho tests and establishing sampling strategy.

3. Sample Objectives: Program and ISV Project objectives are discussed in Section 2.2. The primary engineering scale test objectives are:

   a. Calculate the destruction and removal efficiency of hazardous volatile organics. With analysis of pre- and post-test samples the efficiency of hazardous material destruction will be estimated by:

      1. Determining the percent migration of the volatile organics, by:

1. Determine the percent migration of volatile organics.

$$PM = \frac{\sum_{n=1}^{4} (MB_{Post,n})(XB_{Post,n} - XB_{Pre}) + \sum_{m=1}^{5} (MS_{Post,m})(XS_{Post,m} - XS_{Pre})}{(X_C)(M_C) + (XS_{Pre})(MS_{VIT}) + (XB_{Pre})(MB_{VIT})} \times 100,$$

where PM = percent migration,

$MB_{Post,n}$ = post-test mass of a section of basalt identified by basalt sample n,

$XB_{Post,n}$ = post-test volatile organic concentration of material in basalt sample n,

XB_{Pre} = pre-test volatile organic concentration of material in basalt,

$MS_{Post,m}$ = post-test mass of portion of soil identified by soil sample m,

$XS_{Post,m}$ = post-test volatile organic concentration of material in soil sample m,

XS_{Pre} = pre-test volatile organic concentration of material in soil,

X_C = volatile organic concentration of cemented sludge/grease mixture,

M_C = mass of cemented sludge/grease mixture added to test,

MS_{VIT} = mass of vitrified soil, and

MB_{VIT} = mass of vitrified basalt.

2. Determine the percentage of volatile organics that are volatilized to the system off gas.

$$PV = \frac{MV_{IB} + MV_{CS} + MV_{OGS} + MV_{OG}}{(X_c)(M_c) + (XS_{pre})(MS_{VIT}) + (XB_{pre})(MB_{VIT})} \times 100,$$

where $MV_{IB} = (V_{IB}/V_{IS})\ [(MI_{post})(XI_{post}) - (MI_{pre})(XI_{pre})]$,

$MV_{CS} = (A_c/A_{cs})\ [(MCS_{post})(XCS_{post}) - (MCS_{pre})(XCS_{pre})]$,

$MV_{OGS} = (A_{OG}/A_{OGS})\ [(MOGS_{post})(XCS_{post}) - (MOGS_{pre})(XOGS_{pre})]$, and

$MV_{OG} = (V_{OG}/V_{OGS})\ [(XSF_{post})(MSF_{post}) - (XSF_{pre})(MSF_{pre}) + (XSR_{post})(MSR_{post}) - (XSR_{pre})(MSR_{pre})]$

In the above equations,

PV = percent volatilized,

MV_{IB} = mass of volatile organic entrained on the insulation blanket,

MV_{CS} = mass of volatile organic entrained on the ISV container surface,

MV_{OGS} = mass of volatile organic entrained on the ISV off-gas line in front of the sampling system,

MV_{OG} = mass of volatile organic sent to the ISV system off-gas,

X_c = volatile organic concentration of cemented sludge/grease mixture,

M_c = mass of cemented sludge/grease mixture in test,

XS_{pre} = pre-test volatile organic concentration of soil,

MS_{VIT} = mass of vitrified soil,

XB_{pre} = pre-test volatile organic concentration of basalt,

MB_{VIT} = mass of vitrified basalt,

V_{IB} = volume of total insulation blanket,

V_{IS} = volume of insulation blanket sample,

MI_{post} = post-test mass of insulation blanket sample,

XI_{post} = post-test volatile organic concentration of insulation blanket sample,

MI_{pre} = pre-test mass of insulation blanket sample,

XI_{pre} = pre-test volatile organic concentration of insulation blanket sample,

A_c = exposed surface area of ISV system container,

A_{cs} = surface area of ISV container smear,

MCS_{post} = post-test mass of ISV container smear,

XCS_{post} = post-test volatile organic concentration of ISV container smear,

MCS_{pre} = pre-test mass of ISV container smear,

XCS_{pre} = pre-test volatile organic concentration of ISV container smear,

A_{OG} = surface area of ISV off-gas line, up to sampler,

A_{OGS} = surface area of off-gas line smear,

$MOGS_{post}$ = post-test mass of off-gas smear,

$XOGS_{post}$ = post-test volatile organic concentration of off-gas smear,

$MOGS_{pre}$ = pre-test mass of off-gas smear,

$XOGS_{pre}$ = pre-test volatile organic concentration of off-gas smear,

V_{OG} = volumetric flow rate of the system off-gas,

V_{OGS} = volumetric flow rate of the off-gas sample stream,

XSF_{post} = post-test volatile organic concentration of the sorbent pre-filter,

MSF_{post} = post-test mass of the sorbent pre-filter,

XSF_{pre} = pre-test volatile organic concentration of the sorbent pre-filter,

MSF_{pre} = pre-test mass of the sorbent pre-filter,

XSR_{post} = post-test volatile organic concentration of the sorbent resin tube,

MSR_{post} = post-test mass of the sorbent resin tube,

XSR_{pre} = pre-test volatile organic concentration of the sorbent resin tube, and

MSR_{pre} = pre-test mass of the sorbent resin tube.

3. Percent of volatile organics destroyed in test.

PD = 100 - PV - PM,

PD = percent destroyed,

PV = percent volatilized, and

PM = percent migrated.

b. Calculate the percentages of heavy metals which have been incorporated into the melt, deposited in the surrounding soil, and fluidized into the off gas.

1. Percent of heavy metal incorporated in melt.

$$PIM = \frac{(XG)(MG) + (XM)(MM)}{MC + (XSM_{pre})(MS_{VIT}) + (XM_c)(M_c) + (XBM_{pre})(MB_{VIT})} \times 100,$$

where PIM = percent in melt,

XG = heavy metal concentration in glass,

MG = mass of glass,

XM = heavy metal concentration in metal,

MM = mass of metal,

MC = mass of heavy metal added to test,

XSM_{pre} = pre-test heavy metal concentration of soil,

MS_{VIT} = mass of soil that was vitrified,

XM_c = heavy metal concentration in the cemented sludge/grease mixture,

M_c = mass of the cemented sludge/grease mixture,

XBM_{pre} = pre-test heavy metal concentration of basalt, and

MB_{VIT} = mass of vitrified basalt.

2. The mass of heavy metal that is off-gassed from the melt.

$$PVM = \frac{MHM_{IB} + MHM_{CS} + MHM_{OGS} + MHM_{OG}}{MC + (XM_c)(M_c) + (XSM_{pre})(MS_{VIT}) + (XBM_{pre})(MB_{VIT})} \times 100$$

where $MHM_{IB} = (V_{IB}/V_{IS})\ [(MI_{post})(XIM_{post}) - (MI_{pre})(XIM_{pre})]$,

$MHM_{CS} = (A_c/A_{cs})\ [(MCS_{post})(XCSM_{post}) - (MCS_{pre})(XCSM_{pre})]$,

$MHM_{OGS} = (A_{OG}/A_{OGS})\ [(MOGS_{post})(XOGSM_{post}) - (MOGS_{pre})(XOGSM_{pre})]$, and

$MHM_{OG} = (V_{OG}/V_{OGS})\ [(MF_{post})(XF_{post}) - (MF_{pre})(XF_{pre})$
$+ (MSOL_{post})(XSOL_{post}) - (MSOL_{pre})(XSOL_{pre})]$.

In the above equations,

PVM = percent volatilized,

MHM_{IB} = mass of heavy metal entrained on the insulation blanket,

MHM_{CS} = mass of heavy metal entrained on the ISV container surface,

MHM_{OGS} = mass of heavy metal entrained on the ISV off-gas line in front of the ISV sampling system,

MHM_{OG} = mass of heavy metal sent to the ISV system off-gas,

MC = mass of heavy metal added to test,

XM_c = concentration of heavy metal in cemented sludge/grease mixture.

M_c = mass of cemented sludge/grease mixture in test,

XSM_{pre} = pre-test heavy metal concentration of soil,

MS_{VIT} = mass of vitrified soil,

XBM_{pre} = pre-test heavy metal concentration of basalt,

MB_{VIT} = mass of vitrified basalt,

V_{IB} = volume of total insulation blanket,

V_{IS} = volume of insulation blanket sample,

MI_{post} = post-test mass of insulation blanket sample,

XIM_{post} = post-test heavy metal concentration of insulation blanket sample,

MI_{pre} = pre-test mass of insulation blanket sample,

XIM_{pre} = pre-test heavy metal concentration of insulation blanket sample,

A_c = exposed surface area of ISV system container,

A_{cs} = surface area of ISV container smear,

MCS_{post} = post-test mass of ISV container smear,

$XCSM_{post}$ = post-test heavy metal concentration of ISV container smear,

A_{OG} = surface area of ISV off-gas line, up to sampler,

A_{OGS} = surface area of off-gas line smear,

$MOGS_{post}$ = post-test mass of off-gas smear,

$XOGSM_{post}$ = post-test heavy metal concentration of off-gas smear,

$MOGS_{pre}$ = pre-test mass of off-gas smear,

$XOGSM_{pre}$ = pre-test heavy metal concentration of off-gas smear,

V_{OG} = volumetric flow rate of the system off-gas,

V_{OGS} = volumetric flow rate of the off-gas sample stream,

XF_{post} = post-test heavy metal concentration of the glass fiber filter,

MF_{post} = post-test mass of the glass fiber filter,

XF_{pre} = pre-test heavy metal concentration of the glass fiber filter,

MF_{pre} = pre-test mass of the glass fiber filter,

$XSOL_{post}$ = post-test heavy metal concentration of the impinger solutions,

$MSOL_{post}$ = post-test mass of the impinger solutions,

$XSOL_{pre}$ = pre-test heavy metal concentration of the impinger solutions, and

$MSOL_{pre}$ = pre-test mass of the impinger solutions.

3. Percent heavy metals migration during test.

$$PM = \frac{\sum_{n=1}^{4} (MB_{post,n})(XB_{post,n} - XB_{pre}) + \sum_{m=1}^{5} (MS_{post,m})(XS_{post,m} - XS_{pre})}{MC + (X_c)(M_c) + (XS_{pre})(MS_{VIT}) + (XB_{pre})(MB_{VIT})} \times 100,$$

where PMM = percent heavy metal migration from test,

$MB_{post,n}$ = post-test mass of basalt represented by basalt sample n,

$XB_{post,n}$ = post-test heavy metal concentration of basalt sample n,

XB_{pre} = pre-test heavy metal concentration of basalt,

$MS_{post,m}$ = post-test mass of soil represented by soil sample m,

$XS_{post,m}$ = post-test heavy metal concentration of soil sample m,

XS_{pre} = pre-test heavy metal concentration of soil,

MC = mass of heavy metal added to test,

X_c = concentration of heavy metal in the cemented sludge/grease mixture,

M_c = mass of cemented sludge/grease mixture in test,

MS_{VIT} = mass of soil vitrified during test, and

MB_{VIT} = mass of basalt vitrified during test.

As a check,
PIM + PVM + PMM = 100.

c. Perform EPA approved leachability tests to determine the leachability of the heavy metals incorporated into the vitrified block. Multiple samples will be collected from the glass and metal phases of the vitrified block to determine the degree the phase homogeneity. Data will assist in the design strategy of future tests.

d. Determine the qualitative volume reduction that the soil/simulated waste under goes during the vitrification process by:

$$VR = \frac{V_{pre} - V_{post}}{V_{pre}} \times 100$$

Where V_{pre} = The initial volume of the test matrix to be vitrified

V_{post} = The final volume of the test matrix after vitrification.

VR = is the percent of volume reduction after the test,

e. Determine the resistance to electrode oxidation provided by silicon carbide coating by measuring the length of time before electrode oxidation is observed. Silicon carbide coatings have the potential of significantly reducing the cost of the electrodes by allowing solid graphite electrodes to be used instead of molybdenum core graphite electrodes. The silicon carbide coating will be applied using two different techniques: chemical vapor deposition and brush application.

4. Data Uses: ISV engineering-scale data uses fall under two broad categories:

- o Evaluation of ISV technology: ISV engineering scale data will be used to evaluate the process, and develop data to be used in future ISV tests. Data may also be used to develop cost estimates for intermediate, large scale, and production tests.
- o Engineering design of alternatives: Data collected will be used to establish a preliminary baseline database for developing ISV technology. The data will supplement data collected by Battelle from past tests.

5. Data Types: Primary data types include:

- o Chemical characteristics (i.e. background and post-test concentrations of hazardous material) of sample matrices included in destruction efficiency calculations.
- o Physical characteristics, e.g., temperature of melt, durability of product, and volume reduction.
- o Effectiveness of silicon carbide coating measured as the length of time before electrode oxidation is observed.

6. Data Quality Needs: The unique nature of the sampling effort associated with ISV testing makes it difficult to correlate data quality needs with established EPA analytical levels. A broad generalization would place ISV engineering scale test field data quality at Analytical Level 2. Analytical Laboratory analysis will however, require Analytical level 3. The detection limits for the volatile organics Carbon Tetrachloride, Tetrachlorethene, 1,1,1-Trichloroethane, and Trichloroethene is 5 μg/Kg. The estimated detection limits for the specific element and analysis given in RCRA SW-846 methods will be used. These are listed in Tables 5-1 and 5-2.

7. Data Quantity Needs: The number of samples collected for the engineering scale test must balance cost with the intended use of the data. The review and application of data gleaned from past ISV studies has provided the basis for the data quantity needs for several of the sampling tasks included in this SAP. These tests include:

   - o Analysis of volatile organic compounds,
   - o Analysis of heavy metals,
   - o Thermocouple measurements.

8. Evaluation of Sampling/Analysis Options: Stated sampling procedures were determined to best meet stated project objectives.

9. Precision, Accuracy, Representativeness, Comparability and Completeness (PARCC) requirements are specified in Section 10.

A final data package to DIRC will include the following:

- o Sampling and Analysis Plan,
- o Statement of Work for analytical laboratory,
- o All chain-of-custody forms,
- o Completed analytical summary forms and raw data,
- o All logbooks (including unused ones),
- o QC data,
- o Calibration data for test instruments.

2.4 Analysis of Existing Data

The relationship between the glass composition and leaching characteristics is only understood at a qualitative level. It is known that the non-hazardous constituents in the glass will effect the leachability of the hazardous constituents, however this relationship has not been quantified.

Bench scale ISV tests were conducted to investigate the use of chemical additives to the melt. The chemical additives were being evaluated on their ability to reduce the viscosity of the melt and increase the solubility of the ordinary metals. The second bench scale test contained sodium tetraborate and several heavy metal constituents (arsenic, barium, cadmium, chromium, and silver) at about the 0.2 wt% concentration level each. Since the primary purpose of this test was to evaluate the chemical additives, only a limited amount of data was collected with respect to the heavy metal constituents.

The glass phase was analyzed for arsenic, barium, cadmium and chromium. Significant increases in the concentration over background levels of barium and chromium were found in the glass, 0.74 and 0.80 wt% respectively. The increase in arsenic was detected to be less than 0.15 wt%. Cadmium was below the detection limit and analysis was not performed on silver. Soil samples surrounding the melt did not show any significant increases in any of the heavy metals. The off gas data was insufficient as to how much of the heavy metal was volatilized. However, the other data implies that all of the cadmium and a significant amount of the arsenic was either reduced into the metallic form or volatilized into the off gas system.

The glass phase of the vitrified block was tested using EP-TOX and TCLP leach procedures and both procedures indicated that the material does not exhibit EP Toxicity characteristics as defined by the Code of Federal Regulations 40:261.24. A TCLP leach test was also performed on the metal phase which indicated the similar results.

3. PROJECT ORGANIZATION AND RESPONSIBILITY

3.1 Organization

The ISV treatability study is being conducted by the ERP ISV project group which is described in Section 2.5 of the Draft - In Situ Vitrification Treatability Study Work Plan, EGG-WM-8436. Note, the internal structure of the organization has not changed since the draft of the work plan but the project has been made into a unit with J. L. Landon as Unit Manager. Landon reports to the Group Manager of the Environmental Restoration Program. The engineering scale ISV Test 4 task specific organization is shown in Figure 3-1, Section 3.3.

The actual operations involved with performing this test will be performed by Battelle at the PNL located in Richland Washington. In a cooperative effort between DOE-Idaho Operations Office and DOE-Richland Operations Office, funds were transferred to Battelle as a DOE FIN Plan Transfer.

3.2 Responsibility

This section delineates the responsibilities and qualifications of the personnel directly involved in the test or approval of the test documentation.

Environmental Restoration Program Manager is ultimately responsible for all activities performed by the Environmental Restoration Program Group. He is also directly responsible for approving all ERP sampling and analysis plans (Program Directive 5.2).

ISV Task Project Manager, J. L. Landon, is responsible for directing the preparation of the "... SAP, ensuring the document is in conformance with the DCQAP, and ensuring appropriate review and approval has been received before the task is begun."(Program Directive 5.2). Responsibilities also include ensuring all appropriate EPA, State, and Company regulations and requirements

are met and the INEL COCA is complied with during the ISV activities. Specifically she will manage the budget, review and approve project documents like the Sampling and Analysis Plan (SAP). In addition, she is responsible for reporting to ERP management project status and arranging the necessary personnel and subcontracts to meet schedules and assure required data quality is obtained.

Laboratory Tests Work Package Manager, B. L. Charboneau, is responsible for performing, coordinating, and monitoring all work related to laboratory scale in situ vitrification experiments performed for the ERP. Qualifications: Masters degree in Chemical Engineering, six years of experience including three years of experience in research and development of waste treatment systems.

PNL Project Manager, C. H. Kindle, is responsible for performing, coordinating, and monitoring all ISV related activities performed by PNL in support of the ERP. Kindle is responsible for ensuring all workers are qualified to perform their tasks and can designate alternate PNL workers as necessary. Qualifications: 3 years of experience with nuclear waste technology research and development and 10 years of experience as a project manager at PNL.

Operations Supervisors, J. L. Buelt, T. M. Brouns, R. K. Farnsworth, C. H. Kindle, S. S. Koegler, M. E. Peterson, C. L. Timmerman, B. E. Campbell and J. G. Carter. Operations Supervisor is responsible for preparing and operating the ISV test equipment as well as recording all data during the test. All Operations Supervisors have been trained in the safe and proper operation of the ISV equipment by the group who designed and built the ISV equipment.

ISV Operators, J. T. Jeffs, T. D. Powell, B. L. Sasser, I. C. Nelson, M. Longacker, C. R. Hymas and C. E. Bigelow. ISV Operators are responsible for preparing and operating the ISV test equipment as well as recording all data during the test. All ISV operators have been trained in the safe and proper operation of the ISV equipment by the group who designed and built the ISV equipment

Data Collection Supervisor, PNL Project Manager will designated one of the Shift Operations Supervisor as Sampling Leader. The Data Collection Supervisor is responsible for ensuring: the samples are obtained following the sampling procedures, the chain-of-custody are completed, the custody seals are used, the samples are shipped in accordance with Department of Transportation regulation, and the field logbooks are properly filled out. In addition, the Data Collection Supervisor will coordinate with an ERP audited analytical laboratory Manager to obtain the results and correct any discrepancies noted in the data obtained.

PNL Quality Assurance Officer, L. E. Thompson or J. W. Smith will monitor post test soil samples being obtained. Qualifications: PNL Quality Assurance Engineer.

ERP QA Officer, R. G. Thompson, is responsible for reviewing the SAP, reviewing the SOW, auditing the field and laboratory activities and reporting to ERP management the results of the audits. In addition, the ERP QA Officer will ensure that the Data Quality Objectives are met and that the quality of the data is verified. The QA Officer is assigned by the Engineering Department and has the independence to report to the ERP Manager and/or the Quality Engineering Unit Manager.

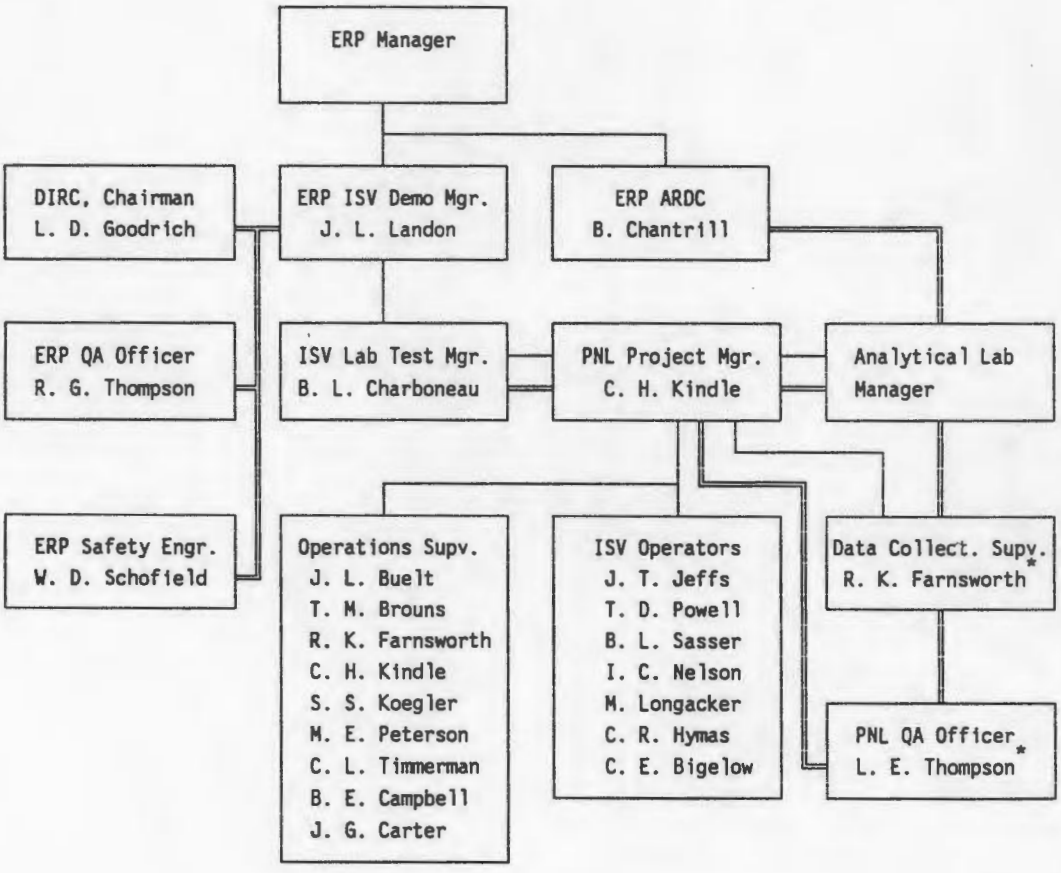
Data Integrity Review Committee (DIRC) is responsible for reviewing the data, SAP and SOWs, and any supporting data needed to decide if the data meets the Data Quality Objectives and reviews uncertainty values of the data. The DIRC Chairman will report to the Treatability Studies and ERP managers the results of the data review. The DIRC members' qualifications are stated in the ERP Project Directive discussing the DIRC's charter.

ERP Administrative Records and Document Control (ARDC) Manager, Bonnie Chantrill, is responsible for the storage and retrieval of the ISV logbooks, data, and other pertinent information collected during the ISV activity once the information is transmitted to her by the Treatability Studies Manager.

The information will be assembled into a data package for data qualification by DIRC. In addition, she is responsible for issuing the logbooks, custody seals, chain-of-custody forms, and all other controlled documents to the data collection supervisor.

3.3 Illustrations

Figure 3-1 shows the engineering scale ISV Test 4 task specific organization.



* PNL Project Manager may designated alternate.
— Indicates project authority
═ Indicates project interface

Figure 3-1. Engineering scale ISV Test 4 organization chart.

4. SAMPLING AND ANALYSIS STRATEGY

The goal of the five objectives list in Section 2.2 is to estimate specific soil/waste/electrode behavior associated with applying ISV to soil/waste buried at the SDA. The engineering scale ISV system utilizes smaller electrodes, a smaller electrode separation and less total power to melt the soil/simulated waste using the same technique to produce similar melt temperatures as the full scale system.

The first two objectives are concerned with the chemical and physical behavior of heavy metals and hazardous volatile organics during the ISV process. More specifically their behavior as the melt front and associated temperature gradient approaches the materials buried in the soil. The transport phenomena which control the movement of these hazardous materials should be the same for laboratory setup as it is in the large scale system.

The third and fourth objectives deal with the intensive chemical and physical properties of the glass which should be independent of scale as long as the constituents are the same. Three factors which may influence the representativeness of the engineering scale to the large scale system as it pertains to the leachability of the vitrified product are:

Effects that may be introduced by the longer melt time required on the larger scale.

The amount of mixing which occurs during the melt.

The length of time for each size melt to solidify and the amount of phase layering which may occur during cooling.

Factors which may influence the representativeness of the engineering scale system will be investigated further with the design of the future test series.

Two similar analytical leach test procedures, EP-TOX and TCLP, will be used. The EP-TOX is the current legally required procedure and the TCLP is a new procedure which is being considered to replace EP-TOX. Sample preparation as it relates to particle size is the main difference between the procedures, however this can be a significant factor in leachability. Therefore both procedures will be used. It is important to note, we have choosen only one of the many proposed forms of the TCLP procedure.

The fifth objective is related to effectiveness of applying silicon carbide coatings to the electrodes using a chemical vapor deposition technique and brush. The highly oxidizing atmosphere (HOA) which exist at the surface of the melt should be the same regardless of the size of the melt. There are two main factors which will influence this objective. The first is the rate at which the electrodes are lowered into the melt thus changing on the electrode surface exposed to this highly oxidizing atmosphere. Estimates will be made as to the amount of time the coating is exposed to the HOA. The second is the amount of time and frequency the electrode surface is lowered below the surface and then exposed to this HOA. The main concern here is that the coating is far less resistent to the melt itself then it is to this HOA at the surface of melt. Fortunately, the melt is less oxidative to the graphite below the surface then it is at the surface. A comparison will be made between the length of time required to observe oxidation on the electrode with the different types of coatings.

The organics will be included in the sludge/grease mixture. There will be two different sludge/grease mixtures, the compositions of which are listed in the PNL Plan. The sludge/grease mixtures are based upon to common sludge mixtures (sludge series 743 and 744) found in Pit 9 as documented in Reference 8. The volatile hazardous organics in sludges include carbon Tetrachloride, tetrachlorethene, 1,1,1-trichloroethane, and trichloroethene. To account for the random nature in which the wastes were disposed the sludge/grease wt% will be increased from the 0.4 wt% (estimated from Reference 8) to 5.0 wt%. The two batches of the sludge/grease mixtures will be placed in separate glass jars and placed in the test container surrounded by clean soil. The glass jars will prevent the test soil from being contaminated prior to the test. Then as the melt front approaches during the test, the glass jars

will fracture due to the temperature gradient. This will release the chemicals in front of the melt. This will allow data to be gathered as to whether the melt front will push the organics and heavy metals into the surrounding soil, or draw them up into the melt as it progresses.

Test ES-INEL-4 will contain 11.6 wt% metals, 1.0 wt% paper and wood, and various hazardous heavy metal constituents in a 41-cm (16-in.) thick layer, 10-cm (4-in.) below the surface. The metals and paper will be evenly distributed throughout the prepared test soil while the heavy metal constituents will be in individual paper envelopes that are placed between the electrodes. In addition, an approximately 20-cm (8-in.) thick piece of basalt rock will be buried 10-cm (4-in) below the metals/soil layer, to evaluate hazardous constituent migration through a basalt layer.

It is estimated in Reference 7, that there is about 7,000 Kg of Lead in Pit 9 or 0.023 wt% of the waste and soil in the Pit. The amount of lead in this test will represent about 9 times this much lead or 0.2 wt%. This is to account for the non-homogenous waste distribution within the Pit. It is also documented in Reference 7, that the other heavy metals (arsenic, barium, cadmium, mercury, selenium, and silver) are probably present within the SDA pits and trenches as chemical components of common items which make up the waste. However, no estimate is made as to their quantities in the waste. For this test, the other heavy metals will be added in quantities equal to one-tenth of that of lead or 0.02 wt%.

Post-test analysis of ES-INEL-4 will quantify the fraction of heavy metal and volatile hazardous organic constituents released to the off gas treatment system, and the extent of migration of inorganic or organic contaminates to the surrounding soil. Standard leach tests per Toxic Characteristics Leach Procedure (TCLP) and EP-TOX leach testing will be conducted on samples of the vitrified glass and the metal layer which will form at the bottom of the block.

5. SAMPLING PROCEDURES

5.1 Sample Collection

5.1.1 Temperature Measurements

To monitor the melt progress of the test Type K thermocouples will be installed starting 10-cm (4-in.) below the soil surface and at 10-cm (4-in.) intervals. A high temperature, type C thermocouple, located in the center line between the electrodes and at a depth of 16 inches, will be used to hourly monitor actual melt temperatures during the test. A string of type K thermocouples, at 10-cm (4-in.) intervals, will be installed at the same depth as the type C thermocouple. Run time is projected to be 24 hrs for ES-INEL-4. A test pit sketch in the PNL plan shows the exact location of the thermocouples. A chart recorder will be used to status and record all preplaced thermocouples at least once every five minutes during the test.

5.1.2 Off Gas Sampling

An off gas treatment system will be utilized for the testing. The 21 SCFM flow rate is sufficient to provide excess oxygen for combustion of pyrolyzed gasses that will be released during processing. Use of a 21 SCFM off gas flow rate requires that the engineering-scale tests have a plenum height of 61-cm (24-in.) to simulate the resistance time in the large scale ISV system. The off gas vacuum for the hood shall always be above 0.10 in. H_2O vacuum.

Off gas from the vitrification zone will be sampled continuously during the Test. A fraction of the total off gas flow (~13 LPM) will be drawn ostentatiously through a stainless steel sample tube connected to a sampling train. The train is designed to capture heavy metal particulates and organics which may volatilize during ISV processing. A Modified Method 5 (MM5) sampling train will be used for sampling the off gas effluents. The modified system includes a sorbent module which permits trapping of volatile and semi-volatile organic vapors. Further information about the off gas sampling is contained in SW-846 Test method 0010.

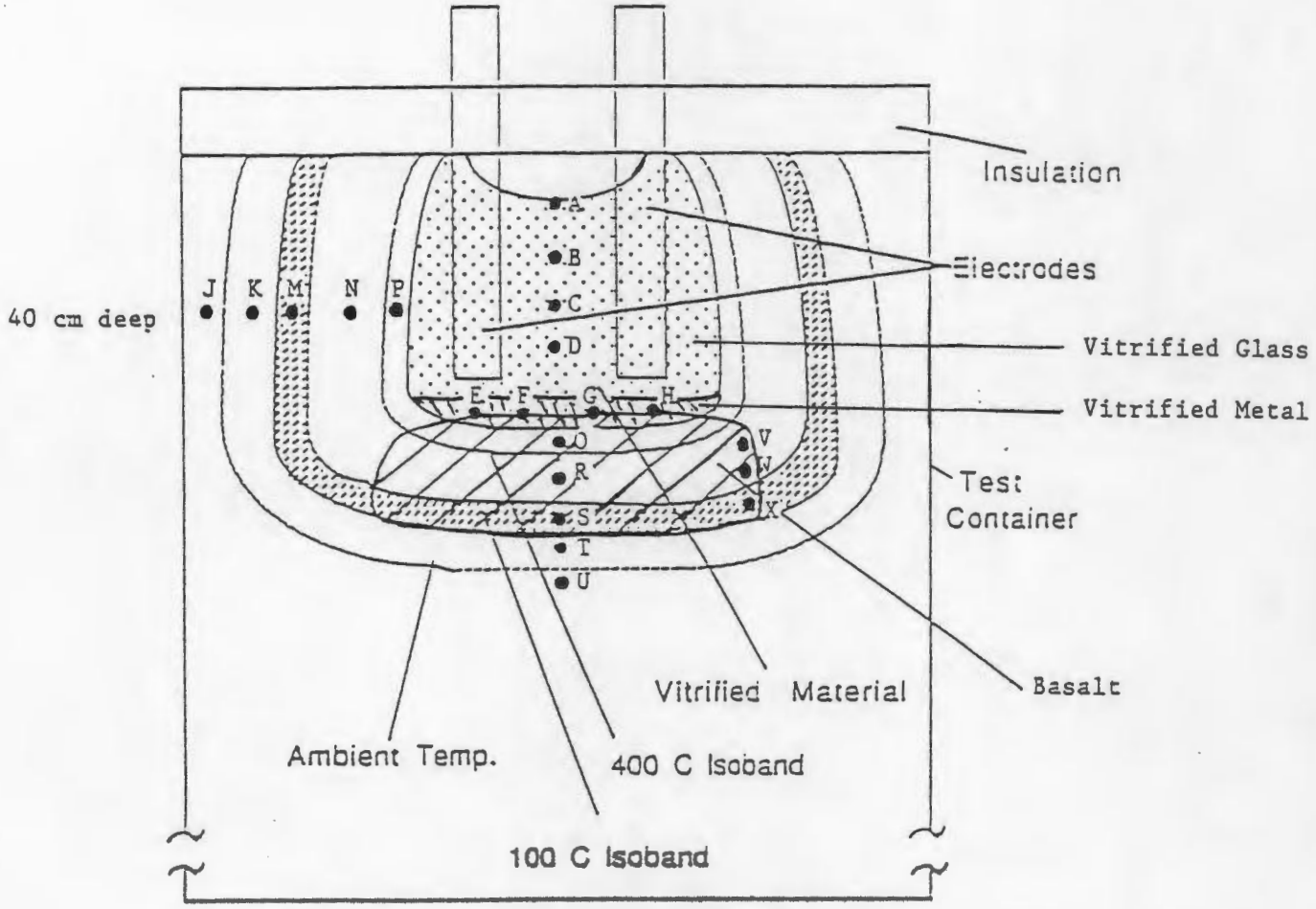
5.1.3 Pre-Test Sampling

The pre-test soil samples will be obtained from the same locations designated for the post test sampling, however they will be collected as the test pit is built, shown in Figure 5-1. The soil will be pre-test sampled to determine the background levels of the organics and heavy metals. It will also be tested to determine the soil composition so as to further define the actual test conditions.

The sludge/grease mixture will also have pre-test samples taken to determine the organics and heavy metals to verify their correct preparation. The sludge/grease mixtures will be analyzed separately for their hazardous constituents, if any.

5.1.4 Post Test Samples

After ES-INEL-4 is completed, samples of the vitrified material, the soil adjacent to the vitrified zone, and soil out to two inches beyond the ambient temperature isotherm will be obtained and packaged. To minimize soil disturbance, the soil shall be removed in layers until the bottom of the vitrified block is exposed. The block will then be removed, and the soil underneath the block will be removed and sampled layer by layer based on thermocouple readings. Special care must be taken during soil sampling to prevent cross contamination. Figure 5-1 shows the approximate locations of the surrounding soil samples to be taken. The specific samples to be collected are listed per test in Table 5-2. Samples of the lid blanket insulation and smears of the Engineering-scale container lid will also be obtained and archives. The samples will then be sealed, packaged, identified, and sent to the ERP audited Analytical Laboratory for analysis.



Sample locations shown as: •

Samples consist of a composite within the "band" of soil as indicated by the sample location. The soil sample below the ambient temperature band extends to 2" below the band.

Figure 5-1. Sampling locations.

Table 5-1. Pre-test samples.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Soil	5	IA001A89EA IA002A89EJ IA003A89ED IA004A89ET IA005A89EU	Archives	N/A	200g	N/A	N/A	N/A
Soil	3	IA006A89EA IA007A89ED IA007B89ED	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	25g	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Soil	3	IA008A89EA IA009A89ED IA009B89ED	AA,Cold-Vap	Mercury	25g	3050	7471	0.2 µg/L
Soil	3	IA010A89EA IA011A89ED IA011B89ED	GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	25g	(2) 5030	(2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg
Soil	2		EP-TOX		200g	1310		
		IF012A89EZ IF012B89EZ	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Silver, Selnium		3010 7470	6010 7470	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 7 µg/L 75 µg/L 7 µg/L
Soil	2		TCLP		200g	TCLP(3)		
		IF013A89EZ IF013B89EZ	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Silver, Selnium		3010 7470	6010 7470	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 7 µg/L 75 µg/L 7 µg/L

Table 5-1. Pre-test samples.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Soil	2	IF014A89EZ	TCLP-ZHE		200g	TCLP(3)		5 µg/Kg
		IF014B89EZ	GC/MS	Ethyl Ether,		(2)	(2)	5 µg/Kg
				Carbon-Tetrachloride,		8240	8240	5 µg/Kg
				Tetrachlorethene,				5 µg/Kg
				Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				
Basalt Rock	6	IA015A89EV	Archives		200g	N/A	N/A	N/A
		IA015B89EV						
		IA016A89EW						
		IA016B89EW						
		IA017A89EX						
		IA017B89EX						
Basalt Rock	3	IA018A89EV	ICP (1)	Arsenic,	25g	3050	6010	53 µg/L
		IA019A89EX		Barium,				2 µg/L
		IA019B89EX		Cadmium,				4 µg/L
				Chromium,				7 µg/L
				Lead,				42 µg/L
				Selenium,				75 µg/L
				Silver				7 µg/L
Basalt Rock	3	IA020A89EV	AA,Cold-Vap	Mercury	25g	3050	7471	0.2 µg/L
		IA021A89EX						
		IA021B89EX						
Basalt Rock	3	IA022A89EV	GC/MS	Ethyl Ether,	25g	(2)	(2)	5 µg/Kg
		IA023A89EX		Carbon-Tetrachloride,		5030	8240	5 µg/Kg
		IA023B89EX		Tetrachlorethene,				5 µg/Kg
				Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				5 µg/Kg
Basalt Rock	2		EP-TOX		200g	1310		
		IF024A89EZ	ICP (1)	Arsenic,		3010	6010	53 µg/L
		IF024B89EZ		Barium,				2 µg/L
				Cadmium,				4 µg/L
				Chromium,				7 µg/L
				Lead,				42 µg/L
				Mercury,		7470	7470	7 µg/L
				Silver,				75 µg/L
				Selnium				7 µg/L

Table 5-1. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Basalt Rock	2		TCLP		200g	TCLP(3)		
		IF025A89EZ	ICP (1)	Arsenic,		3010	6010	53 µg/L
		IF025B89EZ		Barium,				2 µg/L
				Cadmium,				4 µg/L
				Chromium,				7 µg/L
				Lead,				42 µg/L
				Mercury,		7470	7470	7 µg/L
				Silver,				75 µg/L
				Selnium				7 µg/L
Basalt Rock	2	IF026A89EZ	TCLP-ZHE		200g	TCLP(3)		5 µg/Kg
		IF026B89EZ	GC/MS	Ethyl Ether,		(2)	(2)	5 µg/Kg
				Carbon-Tetrachloride,		8240	8240	5 µg/Kg
				Tetrachlorethene,				5 µg/Kg
				Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				
Sludge/Grease Mixture	2	IF027A89EZ	Archives	N/A	200g	N/A	N/A	N/A
		IF027B89EZ						
Sludge/Grease Mixture	2	IF028A89EZ	GC/MS	Ethyl Ether,	25g	(2)	(2)	5 µg/Kg
		IF028B89EZ		Carbon-Tetrachloride,		5030	8240	5 µg/Kg
				Tetrachlorethene,				5 µg/Kg
				Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				5 µg/Kg
Sludge/Grease Mixture	2	IF029A89EZ	ICP (1)	Arsenic,	25g	3050#	6010	53 µg/L
		IF029B89EZ		Barium,				2 µg/L
				Cadmium,				4 µg/L
				Chromium,				7 µg/L
				Lead,				42 µg/L
				Selenium,				75 µg/L
				Silver				7 µg/L
Sludge/Grease Mixture	2	IF030A89EZ	AA,Cold-Vap	Mercury	25g	3050	7471	0.2 µg/L
		IF030B89EZ						
Sludge/Grease Mixture	2		EP-TOX		200g	I310		
		IF031A89EZ	ICP (1)	Arsenic,		3010	6010	53 µg/L
		IF031B89EZ		Barium,				2 µg/L
				Cadmium,				4 µg/L
				Chromium,				7 µg/L
				Lead,				42 µg/L
				Mercury,		7470	7470	7 µg/L
				Silver,				75 µg/L
				Selnium				7 µg/L

Table 5-1. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Sludge/Grease Mixture	2	IF032A89EZ IF032B89EZ	TCLP ICP (1)	Arsenic,	200g	TCLP(3) 3010	6010	53 µg/L
				Barium,				2 µg/L
				Cadmium,				4 µg/L
				Chromium,				7 µg/L
				Lead,				42 µg/L
				Mercury,		7470	7470	7 µg/L
				Silver,				75 µg/L
				Selnium				7 µg/L
Cover Blanket Insulation	1	IE033A89EZ	Archives	N/A	20 in^2	N/A	N/A	N/A
Cover Blanket Insulation	1	IE034A89EZ	ICP (1)	Arsenic,	4 in^2	3050	6010	53 µg/L
				Barium,				2 µg/L
				Cadmium,				4 µg/L
				Chromium,				7 µg/L
				Lead,				42 µg/L
				Selenium,				75 µg/L
				Silver				7 µg/L
Cover Blanket Insulation	1	IE035A89EZ	AA,Cold-Vap	Mercury	4 in^2	3050	7471	0.2 µg/L
Cover Blanket Insulation	1	IE036A89EZ	GC/MS	Ethyl Ether,	4 in^2	(2)	(2)	5 µg/Kg
				Carbon-Tetrachloride,		5030	8240	5 µg/Kg
				Tetrachlorethene,				5 µg/Kg
				Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				5 µg/Kg
Offgas Lid Smears	2	IE037A89EZ IJ038A89EZ	ICP (1)	Arsenic,	100 cm^2	3050	6010	53 µg/L
				Barium,				2 µg/L
				Cadmium,				4 µg/L
				Chromium,				7 µg/L
				Lead,				42 µg/L
				Selenium,				75 µg/L
				Silver				7 µg/L
Offgas Lid Smears	2	IE039A89EZ IE040A89EZ	AA,Cold-Vap	Mercury	100 cm^2	3050	7471	0.2 µg/L
Offgas Lid Smears	2	IE041A89EZ IE042A89EZ	GC/MS	Ethyl Ether,	100 cm^2	(2)	(2)	5 µg/Kg
				Carbon-Tetrachloride,		5030	8240	5 µg/Kg
				Tetrachlorethene,				5 µg/Kg
				Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				5 µg/Kg

Table 5-1. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Offgas Line Smears	1	6E043A89EZ IE044A89EZ	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	33 cm^2	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Offgas Line Smears	1	IE045A89EZ IE046A89EZ	AA,Cold-Vap	Mercury	33 cm^2	3050	7471	0.2 µg/L
Offgas Line Smears	1	IE047A89EZ	GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	33 cm^2	(2) 5030	(2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg
Sorbent Resin	1	IE048A89EZ	GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	One Tube	(2) 5030	(2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg
Sorbent Resin Pre-Filter	1	IE049A89EZ	GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	One Filter	(2) 5030	(2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg
Impinger Pre-Filter	1	IE050A89EZ	Archives	N\A	One Filter	N/A	N\A	N/A
Impinger Pre-Filter	1	IE051A89EZ	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	1/2 Filter	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Impinger Pre-Filter	1	IE052A89EZ	AA,Cold-Vap	Mercury	1/2 Filter	3050	7471	0.2 µg/L

Table 5-1. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Impinger Solutions 1,2,3 (5)	2	ID053A89EZ ID053B89EZ	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	25ml		6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Impinger Solutions 1,2,3 (5)	2	ID054A89EZ ID054B89EZ	AA,Cold-Vap	Mercury	25ml	7470	7470	2 µg/L
Contaminated Soil	2		EP-TOX		200g	1310		
		IF055A89EZ IF055B89EZ	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Silver, Selnium		3010 7470	6010 7470	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 7 µg/L 75 µg/L 7 µg/L
Contaminated Soil	2		TCLP		200g	TCLP(3)		
		IF056A89EZ IF056B89EZ	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Silver, Selnium		3010 7470	6010 7470	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 7 µg/L 75 µg/L 7 µg/L
Sludge/Grease Mixture	2	IF057A89EZ IF057B89EZ	TCLP-ZHE GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	200g	TCLP(3) (2) 824C	 (2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg

(1) Report all detectable Constituents.
(2) Reference CFR 40 Ch. 1 Pt. 264, Appendix 9.
(3) Reference CFR 40 Ch. 1 Pt. 268, Appendix 1.
(4) Reference CFR 40 Ch. 1 Pt. 268, Appendix 1 with proposed rule change announced May 24, 1988.
(5) Impinger 1 - empty, 2 - 0.1 N HNO_3, 3 - 1.5% $KMNO_4$/10%H_2SO_4.

Table 5-2. Post test samples.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Vitrified Block/Glass Phase	4	IC058A89EA IC059A89EB IC060A89EC IC061A89ED	Archives	N/A	200g	N/A	N/A	N/A
Vitrified Block/Glass Phase	5	IC062A89EA IC063A89EB IC063B89EB IC064A89EC IC065A89ED	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	25g	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Vitrified Block/Glass Phase	5	IC066A89EA IC067A89EB IC067B89EB IC068A89EC IC069A89ED	AA,Cold-Vap	Mercury	25g	3050	7471	0.2 µg/L
Vitrified Block/Glass Phase	5	IC070A89EA IC071A89EB IC071B89EB IC072A89EC IC073A89ED	EP-TOX ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Silver, Selnium	200g	1310 3010 7470	 6010 7470	 53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 7 µg/L 75 µg/L 7 µg/L
Vitrified Block/Glass Phase	5	IC074A89EA IC075A89EB IC075B89EB IC076A89EC IC077A89ED	TCLP ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Silver, Selnium	200g	TCLP(3) 3010 7470	 6010 7470	 53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 7 µg/L 75 µg/L 7 µg/L
Vitrified Block/Glass Phase	5	IC078A89EA IC079A89EB IC079B89EB IC080A89EC IC081A89ED	TCLP ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Silver, Selnium	200g	TCLP(4) 3010 7470	 6010 7470	 53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 7 µg/L 75 µg/L 7 µg/L

Table 5-2. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Vitrified Block/Metal Phase	4	IH082A89EE IH083A89EF IH084A89EG IH085A89EH	Archives	N/A	200g	N/A	N/A	N/A
Vitrified Block/Metal Phase	5	IH086A89EE IH086B89EE IH087A89EF IH088A89EG IH089A89EH	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	25g	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Vitrified Block/Metal Phase	5	IH090A89EE IH090B89EE IH091A89EF IH092A89EG IH093A89EH	AA,Cold-Vap	Mercury	25g	3050	7471	0.2 µg/L
Vitrified Block/Metal Phase	5	IH094A89EE IH094B89EE IH095A89EF IH096A89EG IH097A89EH	TCLP ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Silver, Selnium	200g	TCLP(4) 3010 7470	 6010 7470	 53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 7 µg/L 75 µg/L 7 µg/L
Soil	8	IB098A89EJ IB099A89EK IB100A89EM IB101A89EN IB102A89EP IB102B89EP IB103A89ET IB104A89EU	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	25g	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Soil	8	IB105A89EJ IB106A89EK IB107A89EM IB108A89EN IB109A89EP IB109B89EP IB110A89ET IB111A89EU	AA,Cold-Vap	Mercury	25g	3050	7471	2 µg/L

Table 5-2. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Soil	8		EP-TOX		200g	1310		
		IB112A89EJ	ICP (1)	Arsenic,		3010	6010	53 µg/L
		IB113A89EK		Barium,				2 µg/L
		IB114A89EM		Cadmium,				4 µg/L
		IB115A89EN		Chromium,				7 µg/L
		IB116A89EP		Lead,				42 µg/L
		IB116B89EP		Mercury,		7470	7470	7 µg/L
		IB117A89ET		Silver,				75 µg/L
		IB118A89EU		Selnium				7 µg/L
Soil	8		TCLP		200g	TCLP(3)		
		IB119A89EJ	ICP (1)	Arsenic,		3010	6010	53 µg/L
		IB120A89EK		Barium,				2 µg/L
		IB121A89EM		Cadmium,				4 µg/L
		IB122A89EN		Chromium,				7 µg/L
		IB123A89EP		Lead,				42 µg/L
		IB123B89EP		Mercury,		7470	7470	7 µg/L
		IB124A89ET		Silver,				75 µg/L
		IB125A89EU		Selnium				7 µg/L
Soil	8	IB126A89EJ	GC/MS	Ethyl Ether,	25g	(2)	(2)	5 µg/Kg
		IB127A89EK		Carbon-Tetrachloride,		5030	8240	5 µg/Kg
		IB128A89EM		Tetrachlorethene,				5 µg/Kg
		IB129A89EN		Trichloroethene,				5 µg/Kg
		IB130A89EP		1,1,1-Trichloroethane				5 µg/Kg
		IB130B89EP						
		IB131A89ET						
		IB132A89EU						
Soil	8	IB133A89EJ	TCLP-ZHE		200g	TCLP(3)		
		IB134A89EK	GC/MS	Ethyl Ether,		(2)	(2)	5 µg/Kg
		IB135A89EM		Carbon-Tetrachloride,		5030	8240	5 µg/Kg
		IB136A89EN		Tetrachlorethene,				5 µg/Kg
		IB137A89EP		Trichloroethene,				5 µg/Kg
		IB137B89EP		1,1,1-Trichloroethane				5 µg/Kg
		IB138A89ET						
		IB139A89EU						
Basalt Rock	4		EP-TOX		200g	1310		
		IB140A89EQ	ICP (1)	Arsenic,		3010	6010	53 µg/L
		IB140B89EQ		Barium,				2 µg/L
		IB141A89ER		Cadmium,				4 µg/L
		IB142A89ES		Chromium,				7 µg/L
				Lead,				42 µg/L
				Mercury,		7470	7470	7 µg/L
				Selenium,				75 µg/L
				Silver,				7 µg/L

Table 5-2. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Basalt Rock	4		TCLP		200g	TCLP(3)		
		IB143A89EQ	ICP (1)	Arsenic,		3010	6010	53 µg/L
		IB143B89EQ		Barium,				2 µg/L
		IB144A89ER		Cadmium,				4 µg/L
		IB145A89ES		Chromium,				7 µg/L
				Lead,				42 µg/L
				Mercury,		7470	7470	7 µg/L
				Silver,				75 µg/L
				Selnium				7 µg/L
Basalt Rock	4	IB146A89EQ	GC/MS	Ethyl Ether,	25g	(2)	(2)	5 µg/Kg
		IB146B89EQ		Carbon-Tetrachloride,		5030	8240	5 µg/Kg
		IB147A89ER		Tetrachlorethene,				5 µg/Kg
		IB148A89ES		Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				5 µg/Kg
Basalt Rock	4	IB149A89EQ	TCLP-ZHE		200g	TCLP(3)		
		IB149B89EQ	GC/MS	Ethyl Ether,		(2)	(2)	5 µg/Kg
		IB150A89ER		Carbon-Tetrachloride,		5030	8240	5 µg/Kg
		IB151A89ES		Tetrachlorethene,				5 µg/Kg
				Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				5 µg/Kg
Basalt Rock	4	IB152A89EQ	ICP (1)	Arsenic,	25g	3050	6010	53 µg/L
		IB152B89EQ		Barium,				2 µg/L
		IB153A89ER		Cadmium,				4 µg/L
		IB154A89ES		Chromium,				7 µg/L
				Lead,				42 µg/L
				Selenium,				75 µg/L
				Silver				7 µg/L
Basalt Rock	4	IB155A89EQ	AA,Cold-Vap	Mercury	25g	3050	7471	2 µg/L
		IB155B89EQ						
		IB156A89ER						
		IB157A89ES						
Sorbent Resin	2	IE158A89EZ	GC/MS	Ethyl Ether,	One Tube	(2)	(2)	5 µg/Kg
		IE159A89EZ		Carbon-Tetrachloride,		5030	8240	5 µg/Kg
				Tetrachlorethene,				5 µg/Kg
				Trichloroethene,				5 µg/Kg
				1,1,1-Trichloroethane				5 µg/Kg

Table 5-2. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Sorbent Resin Pre-Filter	1	IE160A89EZ	GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	One Filter	(2) 5030	(2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg
Impinger Solutions 1,2,3 (5)	2	ID161A89EZ ID161B89EZ	ICP (1)	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	25ml	N/A	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Impinger Solutions 1,2,3 (5)	2	ID162A89EZ ID162B89EZ	AA,Cold-Vap	Mercury	25ml	7470	7470	0.2 µg/L
Impinger Pre-Filter	1	IE163A89EZ	ICP	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	1/2 Filter	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Impinger Pre-Filter	1	IE164A89EZ	AA,Cold-Vap	Mercury	1/2 Filter	3050	7471	2 µg/L
Cover Blanket Insulation	3	ID165A89EZ ID166A89EZ ID167A89EZ	ICP	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	4 in^2	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Cover Blanket Insulation	2	IE168A89EZ IE169A89EZ	AA,Cold-Vap	Mercury	4 in^2	3050	7471	2 µg/L
Cover Blanket Insulation	2	IE170A89EZ IE171A89EZ	GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	4 in^2	(2) 5030	(2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg

Table 5-2. Continued.

SAMPLE MEDIUM	NUMBER OF SAMPLES	SAMPLE NUMBER	ANALYSIS METHOD	CONSTITUENTS	SAMPLE SIZE	METHOD NUMBERS PREPAR.	METHOD NUMBERS ANALYSIS	METHOD DETECTION LIMIT
Offgas Lid Smears	2	IJ172A89EZ IJ173A89EZ	ICP	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	100 cm^2	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Offgas Lid Smears	2	IJ174A89EZ IJ175A89EZ	AA,Cold-Vap	Mercury	100 cm^2	3050	7471	2 µg/L
Offgas Lid Smears	2	IJ176A89EZ IJ177A89EZ	GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	100 cm^2	(2) 5030	(2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg
Offgas Line Smears	1	IJ178A89EZ	ICP	Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	33 cm^2	3050	6010	53 µg/L 2 µg/L 4 µg/L 7 µg/L 42 µg/L 75 µg/L 7 µg/L
Offgas Line Smears	1	IJ179A89EZ	AA,Cold-Vap	Mercury	33 cm^2	3050	7471	2 µg/L
Offgas Lid Smears	2	IJ180A89EZ IJ181A89EZ	GC/MS	Ethyl Ether, Carbon-Tetrachloride, Tetrachlorethene, Trichloroethene, 1,1,1-Trichloroethane	33 cm^2	(2) 5030	(2) 8240	5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg 5 µg/Kg
Electrode With CVD SiC Coating	2	IG182A89EZ IG183A89EZ	Archives	N/A	Whole Electrode	N/A	N/A	N/A
Electrodes With Brushed SiC Coating	2	IG184A89EZ IG185A89EZ	Archives	N/A	Whole Electrode	N/A	N/A	N/A

(1) Report all detectable Constituents
(2) Reference CFR 40 Ch. 1 Pt. 264, Appendix 9.
(3) Reference CFR 40 Ch. 1 Pt. 268, Appendix 1.
(4) Reference CFR 40 Ch. 1 Pt. 268, Appendix 1 with proposed rule change announced May 24, 1988.
(5) Impinger 1 - empty, 2 - 0.1 N HNO_3, 3 - 1.5% $KMNO_4$/10%H_2SO_4.

Appendix C includes Data Summary Forms for each intermediate scale sampling task. Each form includes the following information:

1. Project information: Project name, project manager, and expected sampling date.

2. Sampling media: specifies soil, groundwater, surface water/sediment, air, biological, or other.
3. Data Use:
   a. Site characterization: includes a determination of the level(s) of health and safety protection required at the site.
   b. Risk assessment: data to be used to perform the endangerment assessment or public health evaluation.
   c. Evaluate alternatives: data will be used to evaluate or screen remedial/technological alternatives/
   d. Engineering design: data will be used to perform detailed engineering design of remedy.
   e. Monitoring: data will be used to monitor during remedy implementation or establish baseline conditions for long term monitoring after site remediation.
   f. Other.

4. Sampling task objective.

5. Site information: summarizes information unique to sampling location such as size, soil characteristics, etc.

6. Data types: specifies the appropriate analytical and physical data required to determine the type, degree, extent and migration characteristics of the contaminants and the required site characteristics.

7. Sampling method:
   a. Environmental: refers to media sampling of air, water, soils and the biological environment.
   b. Source: refers to the sampling of the actual contamination source(s).
   c. Biased: refers to sampling which focuses on a specific site area, characteristic, or problem factor based upon site knowledge and/or modeling.
   d. Grid: refers to unbiased sampling which provides a representative estimate of contamination problem over the entire site.
   e. Grab: refers to discrete samples which are representative of a specific location at a specific point in time.
   f. Composite: the mixture of a number of grab samples to represent the average properties of the parameters of concern over the extent of the area sampled.
   g. Non-intrusive: refers to obtaining data using methods and equipment that do not require the physical extraction of sample from the media being sampled.
   h. Intrusive: refers to physically extracting samples from the media being sampled.

8. Analytical levels:
   a. Level 1 field screening - equipment: identifies the field monitoring equipment to be used and the manufacturers specified detection limits (when known).
   b. Level 2 field analysis - equipment: identifies the field analysis to be used and achievable instrumentation limits.
   c. Level 3 non-CLP laboratory - methods: identifies laboratory method(s) and historically achievable accuracy and precision.
   d. Level 4 CLP laboratory - methods: identifies CLP laboratory method(s) and historically achievable accuracy and precision.
   e. Level 5 non-standard - specifies requirement for non-standard analysis, analytical procedures to be used and required precision and accuracy.

9. Sampling procedures: summarizes procedures and required equipment/hardware.

10. Quality control samples: identifies minimum field and laboratory standards to meet QA requirements specified in Section 10.0.

11. Administrative requirements: summarizes budget estimate, scheduling estimate, and staffing estimate for sampling effort

After the vitrified block has been removed from the soil and allowed to cool for approximately a week, it will be split along a stress cracks that form while the block was cooling, and samples of glass from the block will be removed and analyzed for leachability.

Alternatively, the vitrified block and basalt samples will be obtained through coring. Actual methods will be documented in the sampling logbook.

5.2 Decontamination Procedures

All samples except those of vitrified product and basalt will be collected using disposal sampling spoons or other disposable sampling devices. Each sample will be gathered with a new and clean sampling device.

Vitrified glass phase and basalt samples will be collect with unpainted steel hammers and chisels which have been cleaned, rinsed with distilled water and dried with paper towels. Alternatively, they will be collected through coring. Decontamination of the coring equipment will be documented in the sampling logbook. Rinsates will be collected before pretest sampling and after posttest sampling to verify the decontamination procedure effectiveness.

Vitrified metal phase samples will be collected using a hack saw with a unpainted steel blade. The blade is to be cleaned, rinsed with distilled water and dried with paper towels. The samples will be rinsed with distilled water and dried with paper towels to remove contamination which may have occurred during cutting. Alternatively, samples can be collected through coring as specified above.

6. SAMPLE CONTROL AND DOCUMENT MANAGEMENT

The collection of samples and measurement data will be fully documented in the appropriate field logbooks. All samples to be shipped for laboratory analysis will be labeled, tagged and accompanied by a ERP chain-of-custody (COC) form. Radiological surveys of collected samples will be necessary before they leave the PNL Site. Procedures for the proper documentation of data and sampling collection, for the control and tracking of samples, and for ensuring the integrity of the samples are described in the following sections. Examples of a sample label, sample tag, custody seal, and chain-of-custody are all illustrated in the DCQAP[1].

6.1 Documentation

Documentation of field measurement and sampling activities will include the use of sample labels, sample tags, custody seals, and unique sample identifiers as specified in the ERP DCQAP. Necessary field documentation is detailed below.

6.1.1 Sample Labels

All samples collected for laboratory analysis will be labeled. Gummed and/or taped labels will be affixed to the sample container and to any outer wrapping of the sample. Sample labels will include unique identifier, date and time of sample collection, requested analysis, preservative, and the name of collector.

6.1.2 Sample Tag

All samples collected for laboratory analysis will have affixed (tape, rubber band, wire fastener) to them a ERP sample tag. The sample tag will contain the same information as the sample container label.

6.1.3 Custody Seals

All samples collected for laboratory analysis will require a custody seal. Custody seals are used to detect sample tampering between the time that the sample is collected and opened at the laboratory. Custody seal information includes the date of sample collection and the collectors name.

6.1.4 Unique Identifier

Unique sample identification numbers will be assigned to discrete samples collected. Sample identifiers shown in Table 5-1 and 5-2. The 10-digit numbers has the following form:

Digit	Designation	Significance
1	I	Denotes sample collected for the ISV project
2	A-H,J	Specific ISV sampling task: A: Pre-test soil sampling B: Post-test soil sampling C: Vitrified product/glass phase sampling D: Off gas scrubbing solution E: Stack monitoring and filters F: Simulated Waste G: Electrodes H: Vitrified product/metal phase sampling J: Equipment smears
3-5	xxx	Unique sequential number except for splits; same number is then used.
6	A-Z	Indicator of multiple samples that correspond to unique sample designated in digits 3-5. The first sample is always "A"; all multiples are assigned letters of the alphabet in chronological order.
7,8	89	Calendar year sample is collected.
9	x	Specific testing apparatus scale B: Bench scale E: Engineering scale I: Intermediate scale F: Full scale P: Production scale
10	A-Z	Task specific sample location data (see Figure 5-1). Z: no specific location information is necessary.
	Note	Additional task specific information may be added at the discretion of the Data Collection Supervisor.

6.1.5 Field Logbooks

Logbooks will be used to document all field aspects of the sampling effort. Logbooks are consecutively numbered and bound. All entries will be made in permanent black ink, dated, and signed by the person making the entry. Logbooks are distributed and controlled by the ERP Administrative Records and Document Control Manager. A single log book will be maintained for this ISV sampling effort and it will be the Data Collection Supervisors responsibility to ensure that it is properly maintained.

Information that must be recorded in the logbook pertaining to performing the operational part of the test is described in the PNL Plan. Required information pertaining to sample collection includes the sample date, location, sample description (matrix), narrative and map. Required information pertaining to sample shipping includes sample identification number, date collected, laboratory shipped to, date shipped, COC number, sample shipping classification, shipped by, and QA checked by.

If an error is made in the logbooks, corrections will be made by drawing a single line through the error and entering the correct information. All corrections will be initialed and dated by the individual making the correction.

6.1.6 Sample Analysis Request

The Request for Analysis form will be fully completed by sample team personnel. The information provided on the form must be consistent with information on the COC record to ensure complete sample tracking. The laboratory portion of the form will be completed by the contract analytical laboratory. The Request for Analysis form will accompany the COC record and the sample shipment. A copy of the form will be retained in the field record. The form will include the following information:

- COC control number
- Project name and sample team leader's name
- Laboratory destination and contact
- Data package due date and designated recipients
- Unique sample identification number
- Sample matrix
- Preservative
- Requested analysis and special instructions
- Possible hazards identification
- Sample disposal instructions.

6.1.7 Sample Tracking

An ERP Audited Analytical Laboratory will be used for all chemical analyses. A copy of the Laboratory Quality Assurance Plan for this Laboratory is available from ERP ARDC. This plan describes in detail the steps which will be taken to track the samples.

Upon sample receipt by the laboratory, the Laboratory Custodian will inspect the sample and sample seal condition, reconcile the information of the sample label and seal against that of the COC record, assign a laboratory number, log in the sample in the laboratory logbook, and store the sample in a secured sample storage room or cabinet until assigned to an analyst. The tracking of any extract or digestate produced from a sample is the responsibility of the lab and a copy of the tracking documentation shall be made available with the data.

The Laboratory custodian will inspect the sample for leakage. A leaky container containing a multiphase sample should not be accepted for analysis because the sample may no longer be representative. If the sample is under pressure or releasing gases, it should be treated as a potentially explosive or as possibly containing hazardous gases. Any discrepancies between the information on the sample label and seal, and the information on the COC record and the Sample Analysis Request Sheet will be resolved before the sample is assigned for analysis. This effort may require communications with the sample collector. Results of the inspection will be noted on the Sample Analysis Request Sheet and on the Laboratory Sample Logbook.

Incoming samples will carry the ISV sampling unique identifier. To further identify samples, the laboratory should assign its own identification

numbers; each sample should be marked with the assigned laboratory number. This number is recorded in the Laboratory Sample Logbook along with information describing the sample. The sample information is copied from the Sample Analysis Request Sheet and cross referenced against the information on the sample label. In most cases the Laboratory Manager assigns the sample to an analyst. The Manager shall review the information on the Sample Analysis Request Sheet which includes inspection notes recorded by the Laboratory Custodian. The analyst assigned to analyze the sample shall record in the Laboratory Notebook the identifying information about the sample, the receipt date, analysis date, and other pertinent information. This notebook shall also include the subsequent raw analysis data and calculations, where applicable.

Once the laboratory receives the sample the Laboratory Manager or assignee is responsible for the sample care and custody. The Laboratory Manager or assignee should be prepared to testify that the sample was in his/her possession or secured in the laboratory at all times from receipt until the analysis were completed.

6.2 Sample Handling

To prevent contamination and to ensure sample representativeness, proper sample handling is required. The sections below discuss proper handling procedures. All sample packaging and shipping shall be in accordance with ERP Program Directive 6.1, Draft Date 09/15/89, located in the Appendix B.

6.2.1 Sample Containers

The laboratory will furnish pre-cleaned sample containers of the appropriate size for the analysis to be performed.

6.2.2 Sample Preservation

All samples will be cooled to approximately 4°C per Program Directive 6.1 (Appendix B). All samples being analyzed for volatile organics will be held no longer than 10 days from time collected to time analyzed. All samples being analyzed for heavy metals will not be held for over 26 days from time collected to time analyzed.

6.2.3 Field Radiation Screening

There will be no intentional use of radiologically control materials. The only possible unintentional radiological contamination from the INEL site would have been contained in drums of RWMC soil and all soil drums were radiologically surveyed for a green tag before leaving the INEL site to ensure there was no radiation contamination.

6.2.4 Field Screening For Hazardous Substances

No field screening for hazardous substance will be performed. All vitrified product samples will be assumed contaminated with all hazardous heavy metal used. All other samples will be assumed contaminated with all hazardous materials used in the test.

6.2.5 Transportation Of Samples

The sampling packaging and shipping procedures contained in Appedix B will be following as applicable to PNL. All items listed in the procedures not applicable will be noted in the sampling logbook.

6.2.6 Chain-Of-Custody Procedures

The COC record establishes the documentation necessary to trace the sample possession from collection to analysis. The COC is initiated by the field sample team and accompanies the sample to the laboratory. The COC is signed by the Laboratory Manager or Custodian and returned to the Data Collection Supervisor with the data package.

6.2.7 Special Handling

No special handling procedures other than the ones noted in the above text are required.

7. EQUIPMENT

7.1 Maintenance and Operation

Preventive maintenance will be performed on all equipment following the manufacturer's recommended frequencies and procedures. Where no manufacturer's procedures exist, PNL or the subcontractor will write, review and approve appropriate procedures to be followed. The engineering scale ISV unit and 30 KVA Scott-Tee transformer with saturable reactor control will be used in accordance to PNL Safe Operation Procedure No. 44, Rev. 6. This procedure is contained in Appendix A.

7.2 Calibration

Calibration will be performed on the following equipment per manufacturer's instructions. The results of these calibrations will be kept on file at the ARDC. Equipment calibration requirements are presented in Appendix A.

7.3 Decontamination

The test pit container will be emptied of all soil and loose material remaining from previous tests. All surfaces including test container, container lid, and off gas line to the point of sampling will be rinsed and wiped with distilled water prior to constructing the test pit.

8. ANALYTICAL PROCEDURES

All analytical analyses will be performed using RCRA SW-846 approved methods with the exception of TCLP which is codified in 40 CFR Ch. 1 Pt. 268 App. 1. Analytical methods are identified in Tables 5-1 and 5-2.

9. DATA REDUCTION, VALIDATION, AND VERIFICATION

Data management for this task includes data reporting, reduction, and validation. Additional guidance on this subject can be found in Section 10 of the DCQAP.

9.1 Data Reporting

Specified data reporting format is detailed in the DCQAP. Sample collection history and analytical data for outliers will be examined to determine possible natural causes for the outliers. If an outlier an attempt shall be made to determine the cause of the outliner, by checking field and laboratory logbooks and interviewing personnel who may have knowledge of the cause of the outlying observation, and correct for the cause if possible. If a systematic explanation can be found to support the validity of an outlier, the reason will be stated and the data used without adjustment. If no statistical or systematic explanation of the outlier is apparent, it will be reported with a warning statement. Unexplained outliers will not be used for decisions. However, it should be recognized that in some cases, the outliner may be the most important part of the data.

9.2 Data Reduction

Data reduction methods will be limited to placing the data in an ERP standardized format for incorporation into the Buried Waste Information System (BWIS). Units of measure will be consistent with those of the BWIS.

9.3 Data Validation

The ERP DIRC has the ultimate responsibility to review and validate the reported data. The DIRC may call upon technical experts to assist in data validation. Data will not be made for decisions until validated by the DIRC.

Data will be validated by examining QC sample data including trip blanks, COC, instrument calibration, duplicates (when applicable), equipment blanks, blind laboratory blanks, and matrix spikes (when applicable). All aspects of the sampling program will be subject to audit.

10. QUALITY ASSURANCE

All sampling and analysis activities described in this SAP will be performed in accordance with the QA/QC practices described in the ERP Data Collection Quality Assurance Plan (DCQAP). The DCQAP contains guidance for the following: sampling and decontamination, sample custody, calibration procedures and frequency, analytical procedures, data reduction, validation, and reporting, internal quality control checks and frequency, performance and system audits, preventive maintenance, specific routine procedures used to assess data precision, accuracy, and completeness, corrective actions, quality assurance reports to management.

This section summarizes QA/QC practices to be followed during the execution of this SAP.

10.1 Field QA/QC

Field QC for thermocouple measurement will be limited to calibrating the system to a reference standard prior to use. Calibration checks on the recorder will be made if temperature readings become erratic or suspect. All measurements will be recorded with a known tolerance. The manufacturers recommended operating procedure will be adhered to while taking the measurements.

QC samples required during sampling are specified in Tables 5-1 and 5-2.

10.2 Laboratory QA/QC

10.2.1 General Laboratory Controls

In addition to instrument calibration and analysis of quality control samples, the following controls will be implemented:

- Reagents and solvent will have certified compositions,
- Reagent storage environment and duration will meet the manufacturer's guidelines,
- Commercial laboratory equipment will be calibrated/standardized following SW-846, Test Methods for Evaluating Solid waste Physical/Chemical Methods, requirements for the method(s) used,
- Volumetric measurements will be made with certified glassware,
- Data reduction computations will be independently checked, and
- Qualified personnel will be used for laboratory analyses.
- Quality Assurance/Quality control requirements and guidelines specified in the SW-846 methods and the TCLP procedure will be followed.

10.2.2 Commercial Laboratory QA/QC

The contracted commercial laboratory shall run one duplicate sample for every 10 samples and calculate a relative standard deviation which will be recorded on the laboratory QC forms. If the results are outside internal control limits, the samples will be re-analyzed

A spike and a spike duplicate shall be run one in every 20 samples for each waste type with the parameters of interest to determine the accuracy as percent recovery. The percent recovery will be recorded on the analytical quality control forms. If the results fall outside internal limits, the samples will be re-analyzed

One reagent blank shall be carried through the entire analytical procedure. One check sample per waste type shall be run. The check sample shall contain a subset of the analytes to be determined. The concentration of these analytes shall approach the estimated quantification limit.

10.2.3 Laboratory Management Review

The laboratory manager or designate will review testing/analytical results prior to external distribution. The reviewer will:

- compare analyses performed to the request-for-analysis forms
- review results for reasonableness
- review quality control data results, and
- verify that required checking was properly performed.

If the laboratory manager finds that the review indicates the data meet the project quality requirements, the data will be released as final information.

10.3 Audits

Surveillance by the PNL QA Officer will fulfill the INEL audit requirement. A performance or field surveillance will be conducted during the melt and post test sampling on a random basis. Additional field audits may be made by the INEL ISV Laboratory Test Manager or designated alternate during any phase of this test including test soil preparation. These audits and surveillances will ensure the continuing use of the approved procedures and good logging practices. A written record of the audits and surveillances will be provided with the data package.

No performance audits are scheduled to be performed at the laboratory conducting the analyses.

10.3.1 Corrective Action

Following completion of the audits, any deficiencies will be discussed with responsible project staff and the corrective actions identified. Significant problems will result in the ceasing of both field and laboratory activities. Such a decision will only be made after discussion with the ERP QAO, the Project Manager, and the Unit Manager.

The ERP QAO will review results of major corrective actions after implementation to determine the effectiveness of the actions and will provide a written report of this review to the ERP Program Manager.

10.4 Reports to Management

A monthly report on the performance of the quality assurance program will be prepared by the ERP QAO and presented to the Unit Manager and ERP Program Manager. When appropriate, analytical laboratory QA/QC reports will be included. At the completion of a task and after data verification and validation, all QC data will be sent to the administrative Record and Document Control Manager to become part of the program files.

Monthly QA reports will include:

- Results of any systems and performance audits conducted during the period
- An assessment of accuracy, comparability, completeness, precision, and representativeness of data collected during the period,
- A list of any changes that have occurred in the SAP, and
- Identification of any significant quality assurance problems and recommended solutions.

All of this information will be collected and results documented in the field logbooks and data packages from the analytical laboratory.

11. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

The sampling plan and analytical procedures are designed to obtain estimates of precision and accuracy for all parameters of interest. Quality control measures instituted in the field and laboratory in the form of blanks and spikes will provide accuracy estimates. Splits will facilitate detection of laboratory precision. Information from splits and replicates together will provide information on sampling procedure error and natural variation.

11.1 Accuracy

Accuracy refers to the degree of difference between measured or calculated values and the true value. The equation used to calculate percent recovery is:

$$\text{Accuracy} = \text{Percent recovery} = \frac{Ar - Ao}{Af} \times 100 \text{ percent}$$

where:

Ar = total amount found in spiked samples

Ao = amount found in unspiked sample

Af = amount added to spiked sample

The accuracy of simple field analyses is difficult to assess quantitatively. Sampling accuracy can be maximized by adoption and adherence to a strict QA program. Specifically, all procedures must be documented as standard protocol and all equipment and instrumentation must be calibrated properly and well maintained. Trip blanks and field blanks will be included in all sample batches to ensure that all samples represent the particular site from which they taken and cross-contamination

has not occurred. In addition to equipment operation and standard operating procedures, a high level of accuracy can be maintained by frequent review of field operations. In this manner, deficiencies can be quickly documented and corrected. Laboratory accuracy will be determined by laboratory spike recoveries and must be within 25 percent of the recovery specified in the method (+/- (0.25*recovery specified in method)).

11.2 Precision

Precision refers to the reproducibility or degree of agreement among replicate measurements of the same quantity. The measure used to estimate the precision of a method is the standard error of the estimates for the least square regression line of "measured" versus "target" concentrations. The primary role of this application is to characterize the precision of any analysis method used specified conditions. This allows immediate comparison of precision of different results under the same method. Analytical precision is expressed as a percentage of the difference between results of duplicate samples for a given analyte. Relative percent difference is calculated as follows:

$$\text{Precision} = \text{Relative Percent Difference} = \frac{\left|C1 - C2\right|}{\frac{C1 + C2}{2}} \times 100 \text{ percent}$$

where:

C1 = concentration of the analyte in the sample

C2 = concentration of the analyte in the duplicate/replicate

During the collection of data using field methods and/or instrumentation, precision is checked by reporting several measurements taken at one location and comparing the results. Laboratory precision will be measured by the analysis of lab splits and duplicates. Laboratory precision must be within 25 percent of the precision limits specified in the method (+/- (0.25*precision limit specified in method)).

11.3 Completeness

Completeness is expressed as the percentage of the valid data obtained from a a measurement system. For data to be considered valid, it must meet all the acceptance criteria including accuracy, precision, and any other criteria specified by the analytical method used.

Field sampling conditions are unpredictable and non-uniform. The objective of the field sampling program is to obtain samples for all analytes required, and provide enough quality sample material to complete those analyses, and to produce QA samples that represent all possible contamination situations.

11.4 Representativeness

Representativeness is defined by the degree to which the data accurately and precisely represents a characteristic population, parameter variations at a sampling point, a process condition, or an environmental condition. If the same results are reproducible the data obtained can be said to represent the environmental condition.

11.5 Comparability

Comparability is defined by the confidence with which one data set can be compared to another. Field and laboratory procedures greatly affect comparability. To minimize this only the specific methods and protocols that have been selected or specified will be used to collect and analyze samples. By using specific sampling and analysis procedures, all data sets will be comparable through the duration of the project. In addition, all analytical results from a specified method will be reported in the same units.

11.6 Field Data

Field data includes all data recorded in field and laboratory logbooks during the field sampling activities including sample description and narratives. Field precision will be assessed by field audits conducted to ensure the use of uniform sampling techniques and by the evaluation of smears. Field completeness will be assessed by calculating the ratio of sample analyzed to the total number of samples taken. The completeness goal for field data is 85%.

11.7 Analytical Laboratory Data

The QAPP and SOP's of the laboratory will describe procedures to evaluate precision, accuracy, and completeness. This includes the preparation of blanks, replicates, and spikes. The accuracy, precision, and completeness of the data will be assessed for each sample lot using samples spiked to a known concentration and the percent recovery calculated.

Precision of laboratory data will be measured by the analysis of duplicates. Laboratory reagent blanks will be analyzed to monitor the introduction of artifacts into the process. The data obtained will be within the prescribed control limits for accuracy and precision.

Accuracy of laboratory data will be assessed by examining the analysis of certified EPA or National Bureau of Standard (NBS) QC check samples.

Completeness of the laboratory data will be measured by the ratio of samples with results of acceptable accuracy and precision to the total number of samples analyzed. The completeness goal for laboratory data is 90%.

12. SAFETY AND TRAINING

Battelle is responsible for establishing safety and training requirements and implementing safeguards for conducting engineering scale ISV Test 4. Battelle is also responsible for ensuring that all subcontractors and other parties involved with conducting the test, post test sampling, sample shipping, and sampling analyses are aware of the hazards involved and take adequate safeguards.

The safety and training requirements are identified in the PNL Plan.

13. DATA MANAGEMENT

All information, logbooks, analytical packages, project files, and field records will be submitted to the Administrative Records and Document Control (ARDC) Manager upon completion of ISV sampling activities. The safe keeping of this information is the responsibility ARDC Manager from this point on.

PNL will submit copies of the following information to the ARDC Manager with the final report: PNL logbooks, PNL working copy of the test plan, analytical package, calibration records, certification records of materials, statement of work for the analytical Laboratory, QA surveillance documentation and all other technical information pertaining to the preparation, performance an analysis of the test.

These records will be maintained under lock and key and access provided to EG&G Idaho and DOE-ID personnel following data validation. Document checkout entails filling out a form identifying document removed, date removed, and the person receiving the document. Upon return of the document, it will be placed under lock and key and the checkout form removed.

14. REFERENCES

1. Buried Waste Program (BWP) Data Collection Quality Assurance Plan (DCQAP), Rev. 1, EG&G Idaho, Inc., EGG-WM-8220, December 1988.

2. RCRA Facility Investigation (RFI) Work Plan, Rev. 1, EG&G Idaho, Inc., EGG-WM-8219, December 1988.

3. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, OSWER Directive 9355.2-01, EPA 540/G-89/004, October 1988.

4. Data Quality Objective For Remedial Response Activities: Development Process, EPA 540/G-87-003, March 1987.

5. J. L. Buelt, C. L. Timmerman, K. H. Oma, V .F. Fitzpatrick, J. G. Carter, In Situ Vitrification of Transuranic Waste: An Updated Systems Evaluation and Applications Assessment, PNL-4800, UC-70, Supplement 1, March 1987.

6. K. H. Oma, M. A. H. Reimus, and C. L. Timmerman, Support for the In Situ Vitrification Treatability Study at the Idaho National Engineering Laboratory: FY 1988 Summary, PNL-6787, UC-510, February 1989.

7. E. C. Garcia and J. L. Knight, Hazardous Organic Content of Pit 9, EDF BWP-ISV-002, January 24, 1989.

8. B. L. Charboneau, E. C. Garcia, and J. L. Knight, Draft - Toxic and Ordinary Metal Content in Pit 9, EDF BWP-ISV-001, Rev. 1, June 1989.

APPENDIX A - PNL PLAN FOR ENGINEERING SCALE ISV TEST INEL-ES-4.

APPENDIX B - PROGRAM DIRECTIVE 6.1

EG&G IDAHO, INC.	Title: SAMPLE PACKAGING AND SHIPPING PROCEDURES	No.: PD 6.1
		Page 1 of 16
PROGRAM DIRECTIVE ENVIRONMENTAL RESTORATION PROGRAM		Date: 09/15/89
	Approved: DRAFT Manager, ERP	LEGEND * REVISION # ADDITION
REVIEWED BY:	QUALITY	SAFETY TRAFFIC

1. PURPOSE AND SCOPE

This Environmental Restoration Program (ERP) Program Directive (PD) provides a protocol for screening, classifying, packaging, and shipping samples from the sampling region. All samples leaving the sampling region, to be either stored outside the perimeter of the area or analyzed at an analytical laboratory, will be screened for radioactivity, classified, and packaged before they are shipped. Adherence to this procedure will ensure that samples are classified correctly and comply with Department of Transportation (DOT), Environmental Protection Agency (EPA), and Department of Energy (DOE) packaging and shipping requirements.

2. ACRONYMS/DEFINITIONS

COC -- Chain-of-custody
DOE -- Department of Energy
DOT -- Department of Transportation
EPA -- Environmental Protection Agency
ERP -- Environmental Restoration Program
INEL -- Idaho National Engineering Laboratory
LSA -- Low Specific Activity
PD -- Program Directive
RML -- Radiation Measurements Laboratory

Sample: A portion of solid waste or water, soil, or air, which is collected for the sole purpose of testing to determine its characteristics or composition.

Environmental Sample: A sample with less than 10 ppm of any single contaminant. Generally collected a distance from direct contamination or where the concentration is reduced due to dilution, e.g., off-site wells, ditches, and soil.

Hazardous Sample - Medium Concentration: A sample with 10 ppm to 15% of any single contaminant. Generally collected from areas where there is direct but diluted contamination, e.g., core samples, lagoons, impoundments, and ditches.

Hazardous Sample - High Concentration: A sample with 15% to approaching 100% of any single contaminant. Generally collected where there is little or no evidence of contaminant dilution, e.g., tanks, drums, spills, direct discharges.

n.o.s.: Not otherwise specified (49 CFR 171.8).

2. ACRONYMS/DEFINITIONS (Continued)

Radioactive Sample: Any material having a specific activity greater than 0.002 uCi/g (49 CFR 173.403) is considered by DOT to be radioactive.

Limited Quantity Radioactive Sample: Any material whose activity per package does not exceed the limits specified in 49 CFR 173.423 using the appropriate A_2 value for the sample from 49 CFR 173.435. If the identity of the radionuclides cannot be determined, an A_2 value of 0.002 Ci or 0.4 should be used when alpha emitters are known to be absent (see 49 CFR 173.433).

Corrosive Sample: Any liquid or solid that causes visible destruction of human skin tissue or a liquid that has a severe corrosion rate on steel (see 49 CFR 173.240(a)(b)).

Poison A Sample: Poisonous gases or liquids of such a nature that a very small amount of the gas, or vapor of the liquid, mixed with air is dangerous to life (49 CFR 173.326). Most Poison A are gases or compressed gases which would be found only in closed containers.

Flammable Liquid Sample: Any liquid having a flash point below 100°F.

Flammable Solid Sample: Any solid material, other than one classed as an explosive, which, under conditions normally incident to transportation is liable to cause fires through friction, retain heat from manufacturing or processing, or which could be ignited readily and when ignited would burn so vigorously and persistently as to create a serious transportation hazard (49 CFR 173.150).

Low Specific Activity Sample: Materials of low radioactivity level such as ores and chemical concentrations of those ores. LSA is further defined in 49 CFR 173.403.

3. POLICY

3.1 It is the policy of the ERP that all samples transported from the sampling region will comply with all applicable DOT, DOE, and EPA requirements for classifying, packaging and transporting samples from an uncontrolled hazardous waste site.

3.2 It is the policy of EG&G and DOT that all personnel responsible for the classification, packaging, and shipping of samples be qualified Hazardous Materials Shippers, trained in DOT regulations. This PD is not intended to be a substitute for attending a training course but as a tool to understand regulations and procedures relevant to the shipment of samples.

3. POLICY (Continued)

3.3 To be consistent with EPA policy, unless known to be otherwise with analytical data, samples taken during a site assessment or investigation are presumed to be contaminated and hazardous. The shipper must judge which DOT class is applicable (see Attachment 1) and then package and ship the samples accordingly.

4. REQUIREMENTS

4.1 Sample Screening (Field Screening):

Health Physics Technician

.1 Screen all samples in the field for the presence of radiological contaminants using hand-held survey instruments and smears. A Beta-gamma smear survey and an alpha smear survey will be performed on the outside of the sample container. Contact Beta-gamma radiation readings will also be obtained.

.2 If the sample is a liquid, a contact reading will be taken at the bottom of the container because particles may have settled. If the sample is a solid, readings will be taken with the lid of the container off and on all sides of the container or of the sample before it is containerized as sample containers can shield significant quantities of alpha and beta emitting contaminants. All readings will be recorded in a sample shippers log book.

.3 If field instruments detect radioactivity greater than background, a portion of the sample will be sent to the INEL Radiation Measurements Laboratory (RML) to undergo a gross alpha/beta measurement and/or an isotopic gamma analysis before all samples from the same source are shipped to an analytical laboratory. As practicable, these aliquots should be classified, labeled, and shipped as either limited quantity radioactive or radioactive samples.

4. REQUIREMENTS (Continued)

4.1 Sample Screening (Field Screening): (Continued)

.4 If there is any possibility that the sample may contain pure alpha emitters, e.g., some isotope of plutonium or low energy beta emitters, e.g., strontium and tritium, then the sample must be sent to the RML and the activity of the sample determined. These contaminants are difficult to detect with hand-held instruments.

Note: This procedure will prevent contaminating analytical laboratory instruments and shipping samples not in compliance with DOT regulations.

UNKNOWN RADIOACTIVE SAMPLES MAY NOT BE TRANSPORTED, ACCORDING TO DOT REGULATIONS, BECAUSE RADIOACTIVE CONTAMINANTS MUST BE CLASSIFIED AND TYPED.

4.2 Classification:

Sample Shipper:

.5 Identify and classify each sample according to Attachment 1, appropriate DOT regulations and screening information.

.6 Document any assumptions, calculations, and/or field measurements used to classify the sample.

.7 For liquid samples, document the concentration of preservative in the sample. If the sample contains preservatives above allowable concentrations (see Attachment 2), use the Hazard Materials Table (49 CFR 172) to classify the sample.

.8 Classify a sample for which a reasonable doubt exists as to its class, and for which a sample must be transported for laboratory analysis, based upon:

- defining criteria [see definitions in Section 3 and 49 CFR 173.403, 171.8, 172.402(h)],

4. REQUIREMENTS (Continued)

4.2 Classification: (Continued)

- the hazard precedence described in 49 CFR 173.2 (see Attachment 4),
- the shipper's knowledge of the material.

Note: Most samples will fall into one or more of the following classes: (1) radioactive (2) flammable liquid (3) oxidizer (4) flammable solid and (5) corrosive.

4.3 ENVIRONMENTAL SAMPLES (Non-hazardous)

4.3.1 Sample Packaging:

Sample Shipper:

.1 Ensure sample has been surveyed by a health physics technician.

.2 Place sample container with properly completed label and tag in a polyethylene bag. Seal bag and ensure that tag can be read through bag.

.3 Tape inside and outside of drain plug of heavy duty ice chest. A fiberboard box can be used for solid samples. Line the ice chest or box with a heavy duty polyethylene bag.

.4 Pack ice chest or box with absorbent cushioning material e.g. vermiculite and place samples upright. When shipping cooled samples, refrigerate the vermiculite overnight before placing in ice chest.

.5 When shipping cooled samples, and when temperature control is required, place thermometer in-between samples.

.6 Seal large polyethylene bag with tape, string, or twist tie.

.7 If samples are to be cooled, place ice or blue ice in ice chest outside of polyethylene bag.

4. REQUIREMENTS (Continued)

4.3 ENVIRONMENTAL SAMPLES (Non-hazardous) (Continued)

4.3.1 Sample Packaging: (Continued)

Sample Shipper:

.8 Place original copy of chain-of-custody (COC) record, and any other necessary documents e.g., sample analysis request sheet, in a sealed plastic bag and tape to inner lid of ice chest or inside box and outside of the polyethylene bag.

.9 Tape ice chest or box shut with fiber filament tape and two signed custody seals.

.10 Place orientation arrows and mark all four sides "This End Up".

.11 Mark the outside of the container "Environmental Samples" or "Samples for Laboratory Analysis" and when necessary, "Fragile".

.12 When shipping samples off-site, place address label and return address label on top of box or ice chest.

Note: A correctly labelled and packaged ice-chest for environmental samples is represented in Attachment 3.

.13 Complete EG&G Form 176 and deliver to Traffic for all shipments.

4.3.2 Shipping Papers

.14 No DOT shipping papers are required for shipping non-hazardous environmental samples.

4.3.3 Transportation

.15 There are no DOT restrictions on mode of transportation.

4.4 HAZARDOUS SAMPLES

If the material in the sample is unknown, then use the DOT Hazardous Materials Classification.

4. REQUIREMENTS (Continued)

4.4 HAZARDOUS SAMPLES (Continued)

4.4.1 DOT Hazardous Material Classification (see Attachment 4):

Sample Shipper:

.1 Ensure sample has been surveyed by a health physics technician.

.2 Assign a DOT Hazard Category to the sample based on available information concerning the source and possible contaminant content. A sample is considered to be in the highest possible category until proven otherwise with analytical information.

.3 Use the DOT Hazard Category to identify the proper shipping name, hazard class, etc., in the DOT Hazardous Materials Table (49 CFR 172.101).

4.5 LIMITED-QUANTITY RADIOACTIVE MATERIAL

4.5.1 Packaging

Sample Shipper:

.1 Package the samples according to the procedures outlined for environmental samples except mark the outside of the inner packaging, e.g., the sample bottle, sample tag or ziplock bag, with the marking "radioactive" [see 49 CFR 173.421(d)].

.2 Enclose a notice in the package with the name of the shipper and the statement specified in 49 CFR 173.421-1(a).

.3 Have an HP perform a radiation survey at any point on the external surface of the outer packaging to ensure it does not exceed 0.5 millirem per hour [49 CFR 173.421(b)] and the level of nonfixed (removable) radioactive contamination does not exceed the limits specified in 49 CFR 173.443.

4.5.2 Shipping Papers

.4 There are no requirements for special DOT shipping papers. But Form ID 5480.1A must be completed and sent to Traffic with the samples.

4. REQUIREMENTS (Continued)

4.5 LIMITED-QUANTITY RADIOACTIVE MATERIAL (Continued)

4.5.1 Shipping Papers (Continued)

.5 There are no restrictions on mode of transport for limited quantity radioactive samples.

4.6 POISON A SAMPLES

4.6.1 Packaging

Sample Shipper:

.1 Ensure sample has been surveyed by a health physics technician.

.2 Partially fill a DOT specification #3A1800 or #3AA1800 metal cylinder with noncombustible, absorbent cushioning material, e.g., diatomaceous earth or vermiculite.

.3 Lower the sample into the cylinder. Place only one sample in each cylinder.

.4 Pack the cylinder with absorbent material to prevent breakage and absorb leakage.

.5 Replace valve, torque to 250 foot-pound (for 1-inch opening) and replace valve protector using Teflon tape.

.6 Place one or more cylinders in a DOT approved container.

4.6.2 Marking and Labelling

Sample Shipper

.7 Either hand print or in label form, place the following information on the outside of a cylinder:

- "Poisonous Liquid, n.o.s. NA1955" or "Poisonous Gas, n.o.s. NA1955".
- Laboratory name and address
- A DOT label "Poisonous Gas" on cylinder, even if the sample is a liquid.

4. REQUIREMENTS (Continued)

4.6 POISON A SAMPLES (Continued)

4.6.1 Making and Labelling (Continued)

- Place same markings on outside container as on metal cylinder.

.8 Place orientation arrows and "This Side Up" on the side of the container. Print "Laboratory Samples" or "Sample for Laboratory Analysis" on top of container.

.9 Place return address label on top of container.

4.6.3 Shipping Papers

Sample Shipper

.10 Prepare a Hazardous Materials Shipping Form ID 5480.1A and send to Traffic with samples.

4.6.4 Transportation

.11 Do not use any common-carrier (e.g., Federal Express) or commercial aircraft. Transport all samples by ground transport or government-owned aircraft only.

4.7 FLAMMABLE LIQUIDS (OR SOLIDS)

4.7.1 Packaging

Sample Shipper

.1 Ensure sample has been surveyed by a health physics technician.

.2 Place sample in 2-mil (or thicker) polyethylene bag, one sample per bag. Position tag so it can be read through bag.

.3 Place the sealed bag inside a metal can and cushion it with enough absorbent material to prevent breakage and absorb any leakage. Pack one sample per can. Tightly secure the lid.

.4 Place cans in a strong outside container, such as a ice chest or DOT-approved fiberboard box.

.5 Place original copies of COC records in plastic bag and tape inside cooler or box.

4. REQUIREMENTS (Continued)

4.7 FLAMMABLE LIQUIDS (OR SOLIDS) (Continued)

4.7.1 Packaging (Continued)

4.7.2 Marking/Labelling

Sample Shipper

.6 Place the following information on the can:

- Laboratory name and address
- Flammable Liquid, n.o.s. UN1993 or Flammable Solid, n.o.s. UN1325.

.7 Place a DOT label "Flammable Liquid" or "Flammable Solid" on the metal can.

.8 Place the same information as in .5 and .6 on the outside shipping container.

.9 Print "Laboratory Samples" or "Samples for Laboratory Analysis" and orientation arrows on the side of the shipping container.

4.7.3 Shipping Papers:

.10 Prepare a Hazardous Materials Shipping Form ID 5480.1A and send to Traffic with samples.

4.7.4 Transportation:

.11 Do not transport on passenger-carrying aircraft.

4.8 DOT HAZARDOUS MATERIALS TABLE

If the composition of a sample is known, it must be classified, packaged, marked, labeled, and transported according to regulations listed for the material in the Hazardous Materials Table, 49 CFR 172.01 (see Table I-6).

4.9 CORROSIVE MATERIAL (LIQUID OR SOLID)

Package samples same as flammable liquids or solids with the following exceptions/additions:

4.9.1 Marking and Labelling

Sample Shipper

.1 Affix the following labels on the paint can:

- "Corrosive"
- "Cargo Aircraft Only"

4. REQUIREMENTS (Continued)

4.9 CORROSIVE MATERIAL (LIQUID OR SOLID) (Continued)

4.9.1 Marking and Labelling (Continued)

Sample Shipper

.2 Mark the box with the following information:

- "Corrosive Liquid," n.o.s., UN 1760 or "Corrosive Solid," n.o.s., UN 1759.
- Laboratory name and address
- Orientation arrows on the side of the box.

.3 Place the paint cans in an ice chest (or DOT approved fiberboard box if samples are solid).

.4 Label the ice chest or box with the same information as in .1 and markings as stated in .2.

4.9.2 Shipping Papers

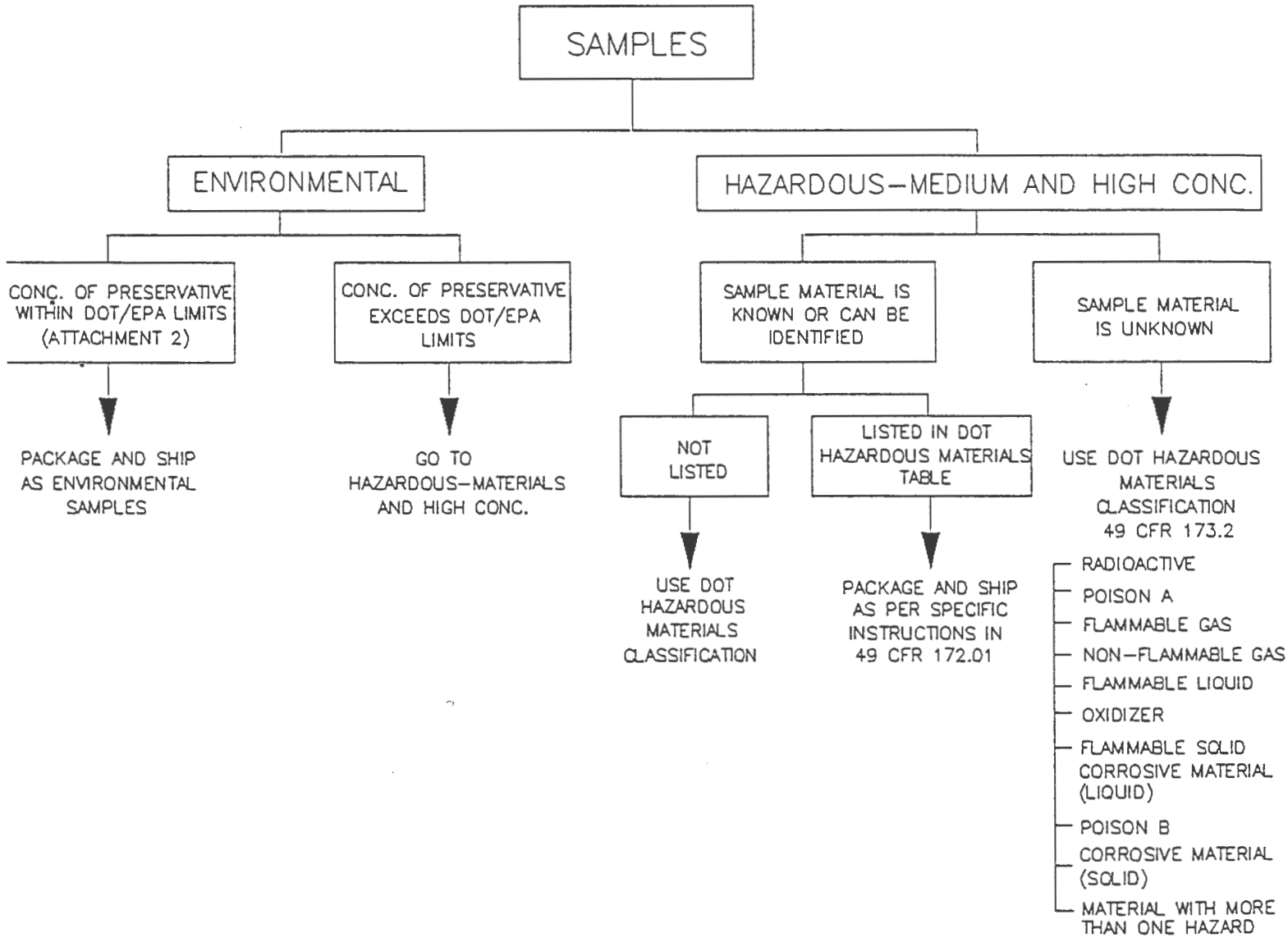
.5 Complete a Hazardous Materials Shipping Form ID 5480.1A, an EG&G Form 176, and send to Traffic with samples.

5. REFERENCES

1. Manual for Sampling, Packaging, and Shipping Hazardous Materials, prepared by the EPA Region X Technical Assistance Team, TDD#10-8212-03, August 1984.
2. Department of Transportation (DOT) Regulations for the Transport of Hazardous Materials, 49 CFR 171-179.
3. DOE Order 5480.3 Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes, 7/9/85.
4. U. S. DOE, The Environmental Survey Manual, Office of Environmental Audit, Washington, DC, DOE/EH-0053, Appendix I, Sample and Document Management Guidance, 1987.
5. 40 CFR 261.4(d), Environmental Protection Agency Regulations for Identifying Hazardous Waste.
6. EG&G Idaho, Inc. Company Procedures - Section 5.1.

ATTACHMENT 1

CLASSIFICATION AND PACKAGING OF SAMPLES



ATTACHMENT 2

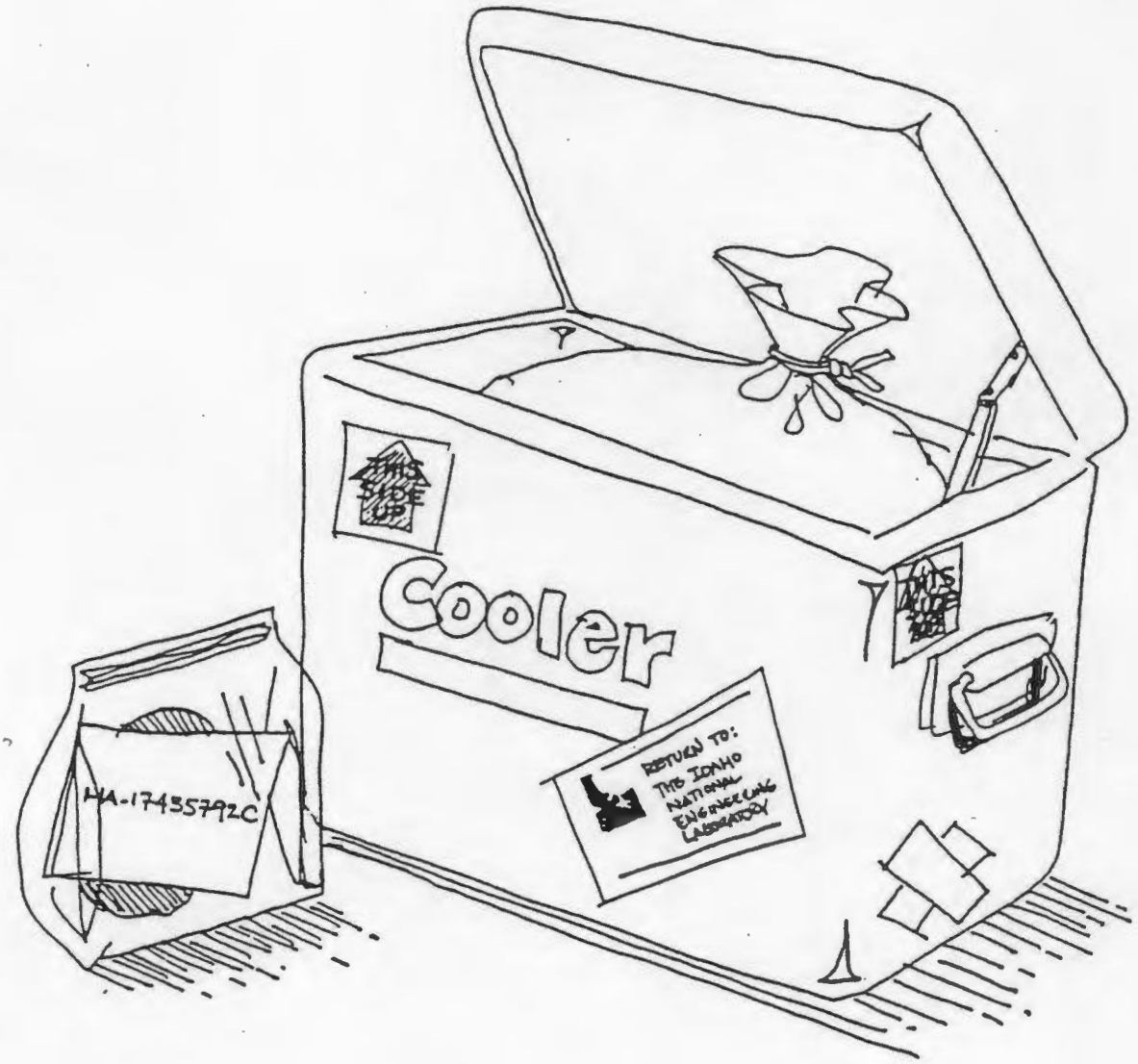
CONCENTRATION OF HAZARDOUS MATERIALS USED AS PRESERVATIVES
IN WATER SAMPLES THAT ARE EXEMPT
FROM DOT HAZARDOUS MATERIALS REGULATIONS

1. HCl in water solutions at concentrations of 0.4% by weight or less.
2. $HgCl_2$ in water solutions at concentrations of 0.004% by weight or less.
3. HNO_3 in water solutions at concentrations of 0.15% by weight or less.
4. H_2SO_4 in water solutions at concentrations of 0.35% by weight or less.
5. NaOH in water solutions at concentrations of 0.08% by weight or less.
6. H_3PO_4 in water solutions at concentrations yielding a pH range between 4 and 2.

(From Letter of Understanding between EPA and DOT, 11 April 1979).

ATTACHMENT 3

PACKAGING OF ENVIRONMENTAL SAMPLES FOR SHIPMENT
TO AN ANALYTICAL LABORATORY



ATTACHMENT 4

DOT PRIORITY RANKING OF HAZARDOUS MATERIALS

Radioactive Material

Poison A

Flammable Gas

Nonflammable Gas

Flammable Liquid

Oxidizer

Flammable Solid

Corrosive Material (Liquid)

Poison B

Corrosive Material (Solid)

Irritating Materials

Combustible Liquid (in containers exceeding 110-gal capacity)

ORM-B

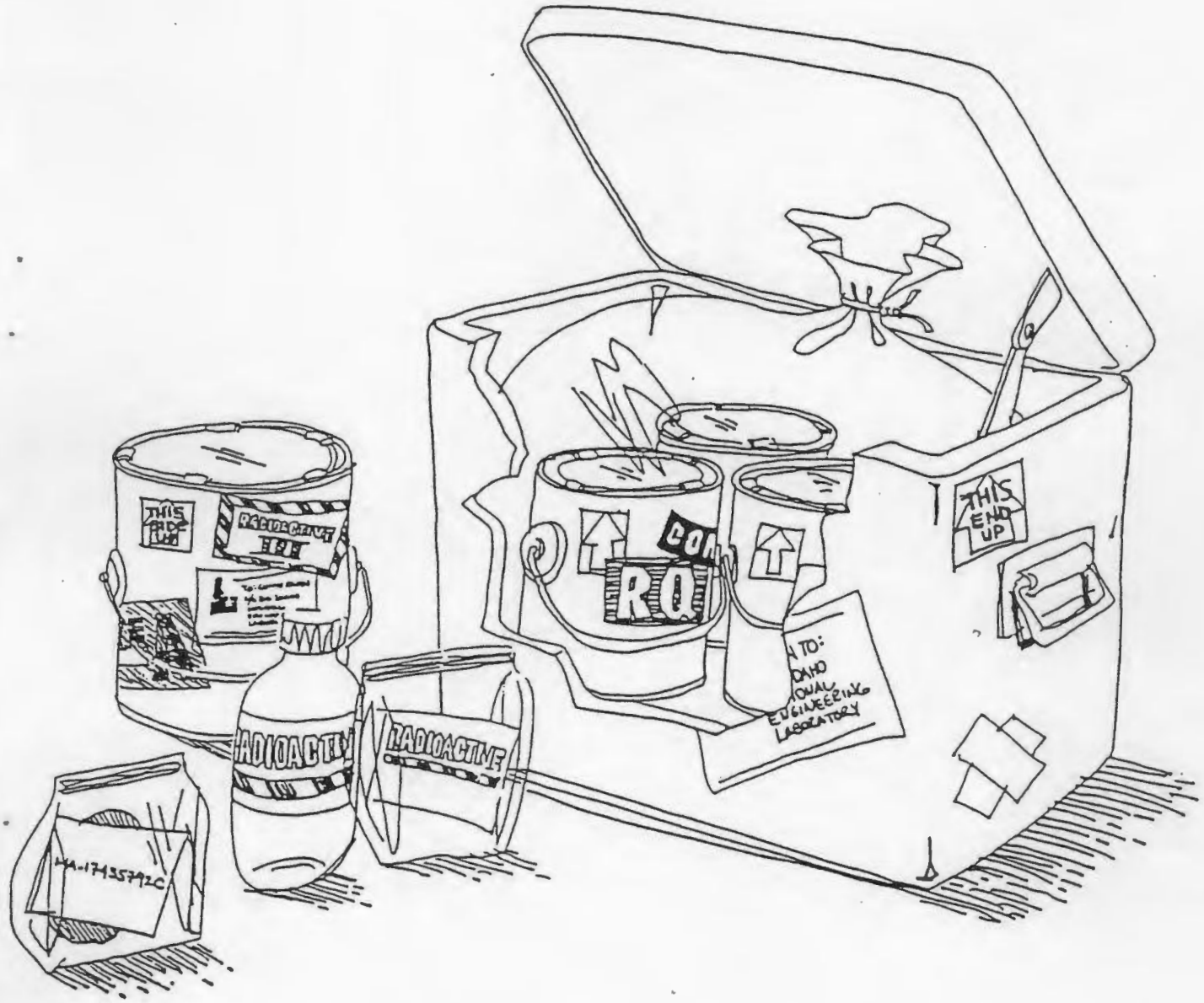
ORM-A

Combustible Liquid (in containers having capacities of 110 gal or less)

ORM-E

ATTACHMENT 5

PACKAGING OF HAZARDOUS SAMPLES FOR SHIPMENT
TO AN ANALYTICAL LABORATORY



APPENDIX C - ERP DATA SUMMARY FORMS

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: [X] Soil [ ] Groundwater [ ] Surface water/Sediment
[ ] Air [ ] Biological [ ] Other Basalt

3. Use(s): [ ] Site Characterization [ ] Health and Safety [ ] Risk Assessment
[X] Evaluate Alternatives [X] Engineering Design [ ] Monitoring
[ ] PRP Determination [ ] Other

4. Sampling Objective: Estimate the destruction and removal efficiency of heavy metals. Requires sample collection prior to test to establish baseline data, and sample collection following test to determine destruction and removal of heavy metals.

5. Site Information:

6. Data Types:

A. Analytical Data [ ] pH [ ] Conductivity [ ] Volatile Organics [X] Heavy Metals
Targeted Constituents

B. Physical Data [ ] Porosity [ ] Permeability [ ] Grain Size [ ] Bulk Density
Other

7. Sampling Method: [X] Environmental [ ] Source [ ] Biased [ ] Grid [ ] Phased
[ ] Non-intrusive [x] Grab [ ] Composite [ ] Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

[ ] Level 1: Field Screening - Equipment

[x] Level 2: Field Analysis - Equipment

[ ] Level 3: Non-CLP Laboratory - Methods

[ ] Level 4: CLP Laboratory - Methods

[ ] Level 5: Non-standard

9. Sampling Procedures: Samples will be collected with a stainless steel sampling spoon.

10. Quality Control Samples:

A. Field [X] Field Blank [ ] Reagent Blank [ ] Trip Blank [X] Equipment Blank
[X] Duplicate [ ] Split [ ] Other

B. Laboratory [ ] Reagent Blank [X] Matrix Spike [X] Replicate [ ] Other

11. Administrative Requirements:
Budget Schedule Appx. 4 hrs for pre- and post-test sampling.
Staff 2-3 sampling team, including team leader and quality assurance officer.

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: [X] Soil [ ] Groundwater [ ] Surface water/Sediment
[ ] Air [ ] Biological [ ] Other Basalt

3. Use(s): [ ] Site Characterization [ ] Health and Safety [ ] Risk Assessment
[X] Evaluate Alternatives [X] Engineering Design [ ] Monitoring
[ ] PRP Determination [ ] Other

4. Sampling Objective: Estimate the destruction and removal efficiency of hazardous volatile organics, requires sample collection prior to test to establish baseline data, and sample collection following test to determine destruction and removal of hazardous volatile organics.

5. Site Information:

6. Data Types:

A. Analytical Data [ ] pH [ ] Conductivity [X] Volatile Organics [ ] Heavy Metals
Targeted Constituents

B. Physical Data [ ] Porosity [ ] Permeability [ ] Grain Size [ ] Bulk Density
Other

7. Sampling Method: [X] Environmental [ ] Source [ ] Biased [ ] Grid [ ] Phased
[ ] Non-intrusive [x] Grab [ ] Composite [ ] Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

[ ] Level 1: Field Screening - Equipment

[x] Level 2: Field Analysis - Equipment

[ ] Level 3: Non-CLP Laboratory - Methods

[ ] Level 4: CLP Laboratory - Methods

[ ] Level 5: Non-standard

9. Sampling Procedures: Samples will be collected with a stainless steel sampling spoon.

10. Quality Control Samples:

A. Field [X] Field Blank [ ] Reagent Blank [X] Trip Blank [X] Equipment Blank
[X] Duplicate [ ] Split [ ] Other

B. Laboratory [ ] Reagent Blank [X] Matrix Spike [X] Replicate [ ] Other

11. Administrative Requirements:
Budget Schedule Appx. 4 hrs for pre- and post-test sampling.
Staff 2-3 sampling team, including team leader and quality assurance officer.

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological _X_ Other Cover blanket insulation

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
_X_ Evaluate Alternatives _X_ Engineering Design ___ Monitoring
___ PRP Determination ___ Other_____

4. Sampling Objective: Determine the mass percent of Volatile Organics Volatilized into the off gas.

5. Site Information:_____

6. Data Types:

A. Analytical Data ___pH ___Conductivity _X_Volatile Organics ___Heavy Metals
Targeted Constituents_____

B. Physical Data ___Porosity ___Permeability ___Grain Size ___Bulk Density
Other_____

7. Sampling Method: ___Environmental _X_Source ___Biased ___Grid ___Phased
___Non-intrusive ___Grab ___Composite _X_Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment_____

___ Level 2: Field Analysis - Equipment_____

_X_ Level 3: Non-CLP Laboratory - Methods_____

___ Level 4: CLP Laboratory - Methods_____

___ Level 5: Non-standard_____

9. Sampling Procedures:_____

10. Quality Control Samples:

A. Field _X_Field Blank ___Reagent Blank ___Trip Blank ___Equipment Blank
_X_Duplicate ___Split ___Other_____

B. Laboratory ___Reagent Blank ___Matrix Spike _X_Replicate ___Other_____

11. Administrative Requirements:
Budget_____ Schedule_____ Staff Battelle and EG&G Personnel

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: [X] Soil [ ] Groundwater [ ] Surface water/Sediment
[ ] Air [ ] Biological [ ] Other_____

3. Use(s): [ ] Site Characterization [ ] Health and Safety [ ] Risk Assessment
[ ] Evaluate Alternatives [ ] Engineering Design [X] Monitoring
[ ] PRP Determination [ ] Other_____

4. Sampling Objective: Establish Temperature gradient in waste/soils surrounding vitrification zone.

5. Site Information:

6. Data Types:

A. Analytical Data [ ] pH [ ] Conductivity [ ] Volatile Organics [ ] Heavy Metals
Targeted Constituents_____

B. Physical Data [ ] Porosity [ ] Permeability [ ] Grain Size [ ] Bulk Density
Other Temperature

7. Sampling Method: [ ] Environmental [ ] Source [ ] Biased [X] Grid [ ] Phased
[ ] Non-intrusive [ ] Grab [ ] Composite [ ] Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

[ ] Level 1: Field Screening - Equipment_____

[X] Level 2: Field Analysis - Equipment_____

[ ] Level 3: Non-CLP Laboratory - Methods_____

[ ] Level 4: CLP Laboratory - Methods_____

[ ] Level 5: Non-standard_____

9. Sampling Procedures:

10. Quality Control Samples:

A. Field [ ] Field Blank [ ] Reagent Blank [ ] Trip Blank [ ] Equipment Blank
[ ] Duplicate [ ] Split [ ] Other_____

B. Laboratory [ ] Reagent Blank [ ] Matrix Spike [ ] Replicate [ ] Other_____

11. Administrative Requirements:
Budget _____ Schedule_____
Staff Two engineers, operations personnel (during test matrix construction), Battelle operations during test, QA officer.

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological ___ Other Glass vitrified product (metal and glass phase)

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
_X_ Evaluate Alternatives _X_ Engineering Design ___ Monitoring
___ PRP Determination ___ Other_____

4. Sampling Objective: Determine the percent of heavy metals incorporated into the melt.

5. Site Information:

6. Data Types:

A. Analytical Data ___pH ___Conductivity ___Volatile Organics _X_Heavy Metals
Targeted Constituents_____

B. Physical Data ___Porosity ___Permeability ___Grain Size ___Bulk Density
Other_____

7. Sampling Method: ___Environmental _X_Source ___Biased ___Grid ___Phased
___Non-intrusive ___Grab ___Composite _X_Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment_____

___ Level 2: Field Analysis - Equipment_____

_X_ Level 3: Non-CLP Laboratory - Methods_____

___ Level 4: CLP Laboratory - Methods_____

___ Level 5: Non-standard_____

9. Sampling Procedures:

10. Quality Control Samples:

A. Field ___Field Blank ___Reagent Blank ___Trip Blank ___Equipment Blank
_X_Duplicate ___Split ___Other_____

B. Laboratory _X_Reagent Blank ___Matrix Spike _X_Replicate ___Other_____

11. Administrative Requirements:
Budget_____ Schedule_____ Staff Subcontracted

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological ___ Other Glass vitrified product

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
_X_ Evaluate Alternatives _X_ Engineering Design ___ Monitoring
___ PRP Determination ___ Other_____

4. Sampling Objective: Determine suitability of vitrified process as long-term remedial measure through product evaluation.

5. Site Information:_____

6. Data Types:

A. Analytical Data ___pH ___Conductivity ___Volatile Organics ___Heavy Metals
Targeted Constituents_____

B. Physical Data ___Porosity _X_Permeability ___Grain Size ___Bulk Density
Other_____

7. Sampling Method: ___Environmental _X_Source ___Biased ___Grid ___Phased
___Non-intrusive ___Grab ___Composite _X_Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment_____

___ Level 2: Field Analysis - Equipment_____

_X_ Level 3: Non-CLP Laboratory - Methods_____

___ Level 4: CLP Laboratory - Methods_____

___ Level 5: Non-standard_____

9. Sampling Procedures:_____

10. Quality Control Samples:

A. Field ___Field Blank ___Reagent Blank ___Trip Blank ___Equipment Blank
_X_Duplicate ___Split ___Other_____

B. Laboratory _X_Reagent Blank ___Matrix Spike _X_Replicate ___Other_____

11. Administrative Requirements:
Budget_____ Schedule_____ Staff Subcontracted

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological ___ Other Impinger solution

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
X Evaluate Alternatives X Engineering Design ___ Monitoring
___ PRP Determination ___ Other_____

4. Sampling Objective: Determine the amount of heavy metals volatilized into the off gas.

5. Site Information: The Modified Method 5 sampling system will be used for analysis of heavy metals volatilized into the off gas.

6. Data Types:

A. Analytical Data ___pH ___Conductivity ___Volatile Organics X Heavy Metals
Targeted Constituents_____

B. Physical Data ___Porosity ___Permeability ___Grain Size ___Bulk Density
Other_____

7. Sampling Method: X Environmental ___Source X Biased ___Grid ___Phased
___Non-intrusive X Grab ___Composite ___Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment_____

___ Level 2: Field Analysis - Equipment_____

X Level 3: Non-CLP Laboratory - Methods_____

___ Level 4: CLP Laboratory - Methods_____

___ Level 5: Non-standard_____

9. Sampling Procedures: The Modified Method 5 will be used to collect samples from the off gas.

10. Quality Control Samples:

A. Field X Field Blank ___Reagent Blank ___Trip Blank X Equipment Blank
X Duplicate ___Split ___Other_____

B. Laboratory ___Reagent Blank ___Matrix Spike X Replicate ___Other_____

11. Administrative Requirements:
Budget_____ Schedule_____ Staff Battelle and EG&G Personnel

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological ___ Other Impinger solution

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
_X_ Evaluate Alternatives _X_ Engineering Design ___ Monitoring
___ PRP Determination ___ Other_____

4. Sampling Objective: Determine the amount of hazardous volatile organics volatilized into the off gas.

5. Site Information: The Modified Method 5 sampling system will be used for analysis of hazardous volatile organics volatilized into the off gas.

6. Data Types:

A. Analytical Data ___pH ___Conductivity _X_Volatile Organics ___Heavy Metals
Targeted Constituents_____

B. Physical Data ___Porosity ___Permeability ___Grain Size ___Bulk Density
Other_____

7. Sampling Method: _X_Environmental ___Source _X_Biased ___Grid ___Phased
___Non-intrusive _X_Grab ___Composite ___Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment_____

___ Level 2: Field Analysis - Equipment_____

_X_ Level 3: Non-CLP Laboratory - Methods_____

___ Level 4: CLP Laboratory - Methods_____

___ Level 5: Non-standard_____

9. Sampling Procedures: The Modified Method 5 will be used to collect samples from the off gas.

10. Quality Control Samples:

A. Field _X_Field Blank ___Reagent Blank _X_Trip Blank _X_Equipment Blank
_X_Duplicate ___Split ___Other_____

B. Laboratory ___Reagent Blank ___Matrix Spike _X_Replicate ___Other_____

11. Administrative Requirements:
Budget_____ Schedule_____ Staff Battelle and EG&G Personnel

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological ___ Other Sorbent Resin

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
_X_ Evaluate Alternatives _X_ Engineering Design ___ Monitoring
___ PRP Determination ___ Other_____

4. Sampling Objective: Determine the amount of heavy metals volatilized into the off gas.

5. Site Information: The Modified Method 5 sampling system will be used for analysis of heavy metals volatilized into the off gas.

6. Data Types:

A. Analytical Data ___pH ___Conductivity ___Volatile Organics _X_ Heavy Metals
Targeted Constituents_____

B. Physical Data ___Porosity ___Permeability ___Grain Size ___Bulk Density
Other_____

7. Sampling Method: _X_ Environmental ___Source _X_ Biased ___Grid ___Phased
___Non-intrusive _X_ Grab ___Composite ___Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment_____

___ Level 2: Field Analysis - Equipment_____

_X_ Level 3: Non-CLP Laboratory - Methods_____

___ Level 4: CLP Laboratory - Methods_____

___ Level 5: Non-standard_____

9. Sampling Procedures: The Modified Method 5 will be used to collect samples from the off gas.

10. Quality Control Samples:

A. Field _X_ Field Blank ___Reagent Blank ___Trip Blank _X_ Equipment Blank
_X_ Duplicate ___Split ___Other_____

B. Laboratory ___Reagent Blank ___Matrix Spike _X_ Replicate ___Other_____

11. Administrative Requirements:
Budget_____ Schedule_____ Staff Battelle and EG&G Personnel

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological ___ Other Sorbent Resin

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
_X_ Evaluate Alternatives _X_ Engineering Design ___ Monitoring
___ PRP Determination ___ Other

4. Sampling Objective: Determine the amount of hazardous volatile organics volatilized into the off gas.

5. Site Information: The Modified Method 5 sampling system will be used for analysis of hazardous volatile organics volatilized into the off gas.

6. Data Types:

A. Analytical Data ___pH ___Conductivity _X_Volatile Organics ___Heavy Metals
Targeted Constituents

B. Physical Data ___Porosity ___Permeability ___Grain Size ___Bulk Density
Other

7. Sampling Method: _X_Environmental ___Source _X_Biased ___Grid ___Phased
___Non-intrusive _X_Grab ___Composite ___Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment

___ Level 2: Field Analysis - Equipment

_X_ Level 3: Non-CLP Laboratory - Methods

___ Level 4: CLP Laboratory - Methods

___ Level 5: Non-standard

9. Sampling Procedures: The Modified Method 5 will be used to collect samples from the off gas.

10. Quality Control Samples:

A. Field _X_Field Blank ___Reagent Blank _X_Trip Blank _X_Equipment Blank
_X_Duplicate ___Split ___Other

B. Laboratory ___Reagent Blank ___Matrix Spike _X_Replicate ___Other

11. Administrative Requirements:
Budget Schedule Staff Battelle and EG&G Personnel

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological ___ Other Glass filter

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
_X_ Evaluate Alternatives _X_ Engineering Design ___ Monitoring
___ PRP Determination ___ Other

4. Sampling Objective: Determine the amount of heavy metals volatilized into the off gas.

5. Site Information: The Modified Method 5 sampling system will be used for analysis of heavy metals volatilized into the off gas.

6. Data Types:

A. Analytical Data ___pH ___Conductivity ___Volatile Organics _X_Heavy Metals
Targeted Constituents

B. Physical Data ___Porosity ___Permeability ___Grain Size ___Bulk Density
Other

7. Sampling Method: _X_Environmental ___Source _X_Biased ___Grid ___Phased
___Non-intrusive _X_Grab ___Composite ___Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment

___ Level 2: Field Analysis - Equipment

_X_ Level 3: Non-CLP Laboratory - Methods

___ Level 4: CLP Laboratory - Methods

___ Level 5: Non-standard

9. Sampling Procedures: The Modified Method 5 will be used to collect samples from the off gas.

10. Quality Control Samples:

A. Field _X_Field Blank ___Reagent Blank ___Trip Blank _X_Equipment Blank
_X_Duplicate ___Split ___Other

B. Laboratory ___Reagent Blank ___Matrix Spike _X_Replicate ___Other

11. Administrative Requirements:
Budget Schedule Staff Battelle and EG&G Personnel

ERP DATA SUMMARY FORM

1. Project: Engineering-Scale ISV Test 4 Project Manager: J. L. Landon Expected Sampling Date: 9/89

2. Media: ___ Soil ___ Groundwater ___ Surface water/Sediment
___ Air ___ Biological ___ Other Glass filter

3. Use(s): ___ Site Characterization ___ Health and Safety ___ Risk Assessment
_X_ Evaluate Alternatives _X_ Engineering Design ___ Monitoring
___ PRP Determination ___ Other

4. Sampling Objective: Determine the amount of hazardous volatile organics volatilized into the off gas.

5. Site Information: The Modified Method 5 sampling system will be used for analysis of hazardous volatile organics volatilized into the off gas.

6. Data Types:

A. Analytical Data ___pH ___Conductivity _X_Volatile Organics ___Heavy Metals
Targeted Constituents

B. Physical Data ___Porosity ___Permeability ___Grain Size ___Bulk Density
Other

7. Sampling Method: _X_ Environmental ___Source _X_ Biased ___Grid ___Phased
___Non-intrusive _X_ Grab ___Composite ___Intrusive

8. Analytical Levels (Indicate Level(s), Equipment and Methods)

___ Level 1: Field Screening - Equipment

___ Level 2: Field Analysis - Equipment

_X_ Level 3: Non-CLP Laboratory - Methods

___ Level 4: CLP Laboratory - Methods

___ Level 5: Non-standard

9. Sampling Procedures: The Modified Method 5 will be used to collect samples from the off gas.

10. Quality Control Samples:

A. Field _X_ Field Blank ___Reagent Blank _X_ Trip Blank _X_ Equipment Blank
_X_ Duplicate ___Split ___Other

B. Laboratory ___Reagent Blank ___Matrix Spike _X_ Replicate ___Other

11. Administrative Requirements:
Budget Schedule Staff Battelle and EG&G Personnel

PNL PLAN

ENGINEERING-SCALE TESTING OF IN SITU VITRIFICATION

Run Number: ES-INEL-4, Rev. 1
EG&G, Idaho National Engineering Laboratory

PREPARED BY: R.K. Farnsworth R K Farnsworth 10-5-89

APPROVED BY:

C.H. Kindle — 10-5-89
C.H. Kindle — Date
Project Manager, Process Development Section

C E Bigelow — 10-9-89
C. E. Bigelow — Date
Equipment Custodian, Process Development Section

J. L. Buelt — 10-6-89
J. L. Buelt — Date
ISV Group Leader, Process Development Section

W F Bonner — 10-9-89
W. F. Bonner — Date
Section Manager, Process Development Section

M. J. Pueschner — 10-11-89
M. J. Pueschner — Date
324 Building Manager

D. W. Wright — 10-13-89
D.W. Wright — Date
Safety Engineer

L E Thompson — 10-9-89
L.E. Thompson — Date
Quality Engineer

TABLE OF CONTENTS

TABLES

FIGURES

PNL PLAN

ENGINEERING-SCALE TESTING OF IN SITU VITRIFICATION

Run Number: ES-INEL-4, Rev. 0
EG&G, Idaho National Engineering Laboratory

1.0 INTRODUCTION/SCOPE

The task will consist of an engineering-scale In Situ Vitrification (ISV) test using soils from Idaho National Engineering Laboratory (INEL). This test is designed to supplement the existing data base of information describing the waste products from ISV processing of different hazardous materials. The test (ES-INEL-4) will evaluate the ISV product quality for melts containing heavy metals, organics, combustibles and metals. The migration, if any, of the heavy metals and organics into the ISV system off gas and the soil surrounding the vitrification area will also be evaluated. Samples will be taken before, during and after the ISV test and will be analyzed to determine the extent of metal incorporation in the block, the amount of hazardous material migration (if any) away from vitrified block, and the destruction and/or off-gas entrainment of hazardous materials during processing.

Standard leach tests per Toxic Characteristics Leach Procedure (TCLP) and EP TOX leach testing will be conducted on samples of the contaminated pre-test materials (cemented sludge/grease and contaminated soils) and the vitrified block material (glass and metal) produced by ES-INEL-4. In addition, pre- and post-test TCLP and EP TOX leach tests will be performed on samples of the surrounding soil and basalt rock layer beneath the melt. This data is needed to determine the relative durability and non-hazardous nature of the vitrified glass product and surrounding materials. The data will be compared to the existing ISV data base and the results and assessments will be included in the final report. The final report will also provide assessments of ISV system performance, electrode feed system performance, electrode coating performance, container pressurization, and ISV feasibility.

This test plan replaces the ES-INEL-4 sections in the April 1989 Test Plan for ES-INEL-3 and ES-INEL-4. Some of the data from this test will be used to verify remediation of the Subsurface Disposal Area (SDA) at INEL. As a result, ES-INEL-4 will have to be performed under Level II Quality Assurance (QA) guidelines, using EPA Level 3, non-CLP laboratory methods. This differs significantly from the Level III QA guidelines described in the April 1989 Test Plan. The operator is directed to the INEL Sampling and Analysis Plan (SAP) for further guidance on ES-INEL-4 sampling activities, and pre- and post-test sample preparation activities.

2.0 OBJECTIVE

An engineering-scale ISV test utilizing INEL soil, metals (consisting of 5.8 wt% stainless steel and 5.8 wt% carbon steel), combustibles (0.5 wt% paper and 0.5 wt% wood), eight heavy metals (Ag, As, Ba, Cd, Cr, Hg, Pb, and Se), and two cemented sludge/grease mixtures containing representative organics will be conducted to determine ISV feasibility. Test No. ES-INEL-4 will evaluate and verify the product quality of vitrified INEL soil that originally contained various concentrations of metals, combustibles, heavy metals, and organics. It will also determine the extent of contaminant destruction and release to the ISV off-gas system, and the migration (if any) of contaminants into the soil surrounding the vitrified area.

3.0 MATERIALS/SAMPLING

Pre-test samples of the INEL soil and basalt rock will be analyzed for both inorganic and organic compositions. This is necessary to determine if the uncontaminated INEL soil contains any trace organic or inorganic compositions that may affect the material balances for inorganic or organic soil migration. The inorganic compositions of each material will be determined using either ICP(1) acid digestion procedures, or the Cold Vapor AA(2) procedure (for mercury), while organic compositions will be determined using standard GC/MS(3) procedures.

Pre-test samples of the cemented sludge/grease mixtures will also be analyzed, using ICP acid digestion, Cold Vapor AA, and GC/MS. The GC/MS procedure is needed to determine the actual concentrations of organic contaminants present in the cemented sludge/grease mixtures. This is needed because of the possibility of some of the organic chemicals volatilizing before they are encapsulated in the cement substrate. The ICP and Cold Vapor AA procedures are needed to determine if the cemented sludge/grease mixtures contain any trace heavy metal contamination.

The ICP acid digestion procedures involve sample preparation in accordance with EPA SW846 Method 3050, followed by analytical testing in accordance with EPA SW846 Method 6010. The GC/MS procedure involves sample preparation in accordance with EPA SW846 Method 5030, followed by analytical testing in accordance with EPA SW846 Method 8240. Cold Vapor AA is performed using EPA SW846 Method 7471.

In addition, pre-test samples of the uncontaminated soil, the basalt rock, and the cemented sludge/grease mixtures, and prepared samples of INEL soil contaminated with heavy metals will be leach tested in accordance with TCLP and/or EP TOX procedures. EP TOX testing will only be performed for the eight heavy metal contaminants. However, TCLP testing will be performed for

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(1) Inductively-Coupled Plasma spectroscopy
(2) Atomic Absorption
(3) Gas Chromatography/Mass Spectroscopy

five organic contaminants (carbon tetrachloride, trichloroethylene, 1,1,1-trichloroethane, tetrachloroethylene and ethyl ether), in addition to the eight heavy metal contaminants. TCLP Metal testing will be performed using both the powder test (on the soil, glass, basalt rock, and cemented sludge/grease mixture samples) and the 5-24-88 proposed rule change for monolith testing (on glass and metal samples). TCLP-ZHE testing will only be performed using the powder test (on soil, basalt rock and cemented sludge/grease mixture samples).

The EP TOX samples are prepared in accordance with EPA SW846 Method 1310, followed by either Method 7470 for mercury or Methods 3010 and 6010 for the other heavy metals. The TCLP Powder Test samples are first prepared in accordance with 40CFR 268, App. 1 (use 40CFR 264 App. 9 for analyzing ethyl ether, using TCLP-ZHE procedures). The TCLP Monolith test samples are prepared in accordance with 40CFR 268, App. 1 and proposed rule change Vol. 53, No. 100 for monolith testing. The prepared TCLP samples are then either analyzed for organics (EPA SW846 Method 8240), or mercury (EPA SW846 Method 7470) and the other heavy metal contaminants (EPA SW846 Methods 3010 and 6010). The results will eventually be compared to post-test leach testing results to evaluate product quality.

An ICP fusion analysis of INEL soil from previous tests is in Table 1. The ICP fusion analysis indicates that a proper ratio of glass-forming constituents exists in the INEL soils to make an acceptable ISV product. As a result, no pre-test ICP fusion testing is required for this test.

Post-test analysis of ES-INEL-4 will quantify the fraction of heavy metal and organic contaminants released to the off-gas treatment system, the fraction destroyed or encapsulated in the vitrified glass product, and the extent of migration of inorganic or organic contaminants to the surrounding soil and basalt rock layer. To determine the contaminant fraction that is volatilized, it is necessary to analyze pre- and post-test samples of the cover blanket insulation, the lid and off-gas line smears, the glass fiber filters, the sorbent resin tubes, and the impinger solutions. Post-test analysis of ES-INEL-4 will also include EP TOX and TCLP leach tests of the vitrified glass, TCLP leach testing of the metal slab at the bottom of the

TABLE 1. INEL Soil Oxide Composition

Oxide	Wt%(a)
Al_2O_3	11.85
B_2O_3	0.05
BaO	0.09
CaO	3.68
Cr_2O_3	0.02
Fe_2O_3	4.25
K_2O	2.99
MgO	1.72
MnO_2	0.10
Na_2O	1.37
NiO	0.04
SiO_2	62.60
SrO	0.02
TiO_2	0.68
ZrO_2	0.05
TOTAL	89.50
Moisture wt%	7.5

(a) Average of two analyses of soil samples

melt, and EP TOX and TCLP leach testing of the surrounding soils and basalt rock layer. Leach testing of the vitrified glass and molten metal slab is used to determine product durability, while leach testing of the surrounding soils and basalt rock layer are used to demonstrate that the vitrified block surroundings can be considered nonhazardous after ISV processing.

A list of the samples to be collected for ES-INEL-4, together with sample collection procedures, and pre- and post-test sample preparation procedures is shown in the INEL SAP. All samples will be labeled with a unique sample identification number, the initials of the sampler, and the sampling date. A description of the unique sample identification number is

given in the INEL SAP. In addition, each analytical sample will have the appropriate EPA Chain of Custody (COC) forms and Request for Analysis forms.

Because of the presence of volatile organics in the samples, it is necessary to have all of the organic samples (including TCLP Zero Head Extractables) analyzed by the Analytical Laboratory within 10 days after initial sampling. (For TCLP-ZHE testing, the organic samples only need to have analysis started within 10 days.) All other non-archive samples will be analyzed within 26 days after initial sampling. (Archive samples must be analyzed within six months after sampling, if needed, and can only be analyzed for the seven EP TOX metals covered by the ICP procedure.) The holding times may require partial shipments of samples to the Analytical Laboratory. All samples should be refrigerated below 4°C before shipment. The samples should also be shipped with refrigerated blue ice to maintain their refrigerated conditions.

The engineering-scale ISV unit, using the 30 kVA Scott-Tee transformer with saturable reactor control, will be used to conduct the test. Safe Operating Procedure No. 44, Rev. 7, details the power supply and the electrical control system for the engineering-scale ISV system. A charcoal-filtered scrubber will be placed in the engineering-scale off-gas line to capture any organic aerosols exiting the hood during ES-INEL-4. Back pressure HEPA-filtered relief will also be provided on the engineering-scale hood to prevent any particulate releases if the off-gas system fails during operation of the engineering-scale ISV system.

As shown in Figure 1, the test soil used for ES-INEL-4 will be placed in the engineering-scale ISV test unit, located in EDL 101 of the 324 Building. The upper portion will have a 10-cm (4-in.) thick layer of uncontaminated INEL soil on top of a 41-cm (16-in.) thick layer of the prepared test soil (see Figure 1). The prepared test soil has a diameter of 86 cm (34 in.), and contains 5.8 wt% stainless steel, 5.8 wt% carbon steel, 0.5 wt% paper, and 0.5 wt% wood, distributed evenly throughout the soil. In addition, the eight heavy metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) and the cemented sludge/grease mixtures containing the volatile

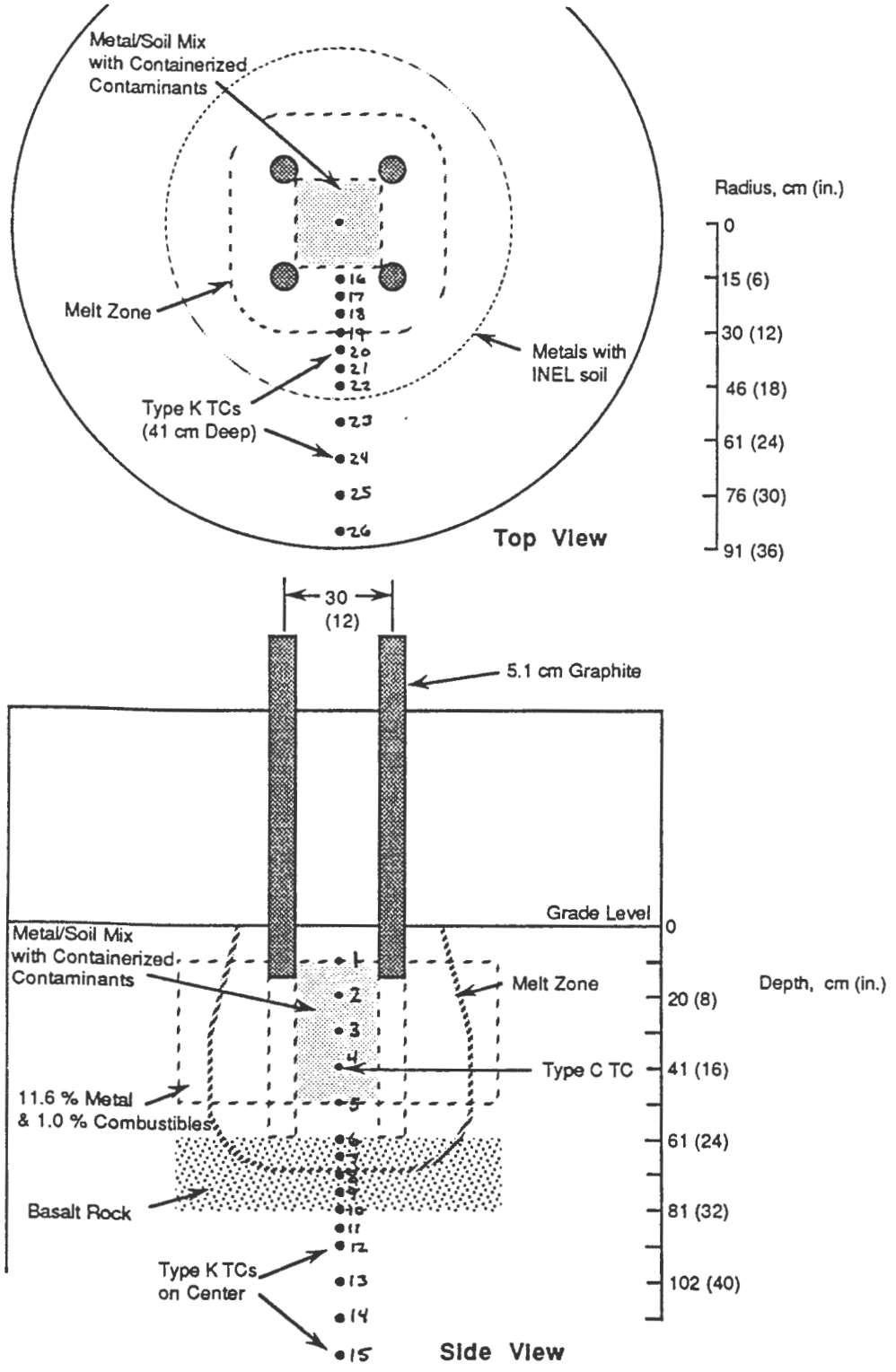


FIGURE 1. ES-INEL-4 Test Configuration

organics will be placed in the center portion of the prepared test soil, between the four electrodes.

Table 2 gives a hazardous waste constituents evaluation for the SDA that was provided to PNL by EG&G. The evaluation showed that there was approximately 0.023 wt% Pb, 0.4 wt% cemented sludge/grease mixture, and possible traces of the remaining EP-TOX metals in the SDA. However, the waste composition of the SDA is not homogeneous, and it is possible that significantly greater hazardous materials concentrations exist in various isolated areas within the SDA. To provide reliable data on the amount of hazardous materials entrained to the ISV system off-gas and the leachability

TABLE 2. INEL Hazardous Waste Constituent Evaluation for the SDA

Hazardous Compound	Wt% in Site	Wt% in Test
Pb	0.023	0.2
Ag	TBD(a)	0.02
As	TBD	0.02
Ba	TBD	0.02
Cd	TBD	0.02
Cr	TBD	0.02
Hg	TBD	0.02
Se	TBD	0.02
Sludge/Grease(b)	0.4	1.3
Texaco Regal Oil	25.2	
CCl_4	28.0	
Oil	10.2	
Ether	2.82	
1,1,1-trichloroethane	4.66	
Trichloroethylene	4.03	
Tetrachloroethylene	4.30	
Alcohols	4.90	
Organic Acids	7.35	
Versene (EDTA soln, lathe coolant)	8.58	

(a) To Be Determined
(b) Components of Sludge/Grease listed directly below it. Wt% values given refer to percent of component present in Sludge/Grease.

of the resultant vitrified product, it is necessary to increase the concentration of each of these hazardous materials in ES-INEL-4. As a result, the concentrations of each of the hazardous heavy metal constituents will be increased to between 0.2 wt% of the projected block weight (350 kg) for lead, and 0.02 wt% for the other heavy metal contaminants. The concentration of sludge/grease mixture in ES-INEL-4 will be increased to 1.3 wt% of the projected glass block weight (see Table 2).

Table 3 lists the amounts and form of the heavy metal additives, and the amounts of metals and combustibles that are to be added to ES-INEL-4. Most of the hazardous heavy metal constituents will be added in their oxide form to simulate their expected oxidized condition in the SDA. However, the lead and mercury will be added to ES-INEL-4 as metals. This is due to reports that the lead and mercury were disposed of in their metallic form, as shielding to some of the more radioactive components in the waste. In addition, the barium will be added as a carbonate to ES-INEL-4. This is due

TABLE 3. Material Chemical Additions to the ES-INEL-4 Test Soils

Mixture	Compound	Amount
Metal-Soil Mixture	INEL Soil	286.4 kg
	Stainless Steel	19.51 kg
	Carbon Steel	19.51 kg
	Paper	1682 g
	Wood	1682 g
EP TOX Metals		
	Pb (Metal)	700.0 g
	Cr_2O_3	102.3 g
	$BaCO_3$	100.6 g
	SeO_2	98.4 g
	As_2O_3	92.4 g
	CdO	80.0 g
	Ag_2O	75.2 g
	Hg (Metal)	70.0 g
Organic Sludge/Grease Mixture		(0.5 Gal.) 1892 mL

to its availability as a carbonate, and the fact that it will eventually form an oxide during ISV processing, without affecting the vitrified melt.

All of the hazardous heavy metal contaminants will be placed in localized areas between the four electrodes, to simulate the localized concentrations of these materials in the actual waste site. However, the mercury metal will be contained in a sealed container, while the other heavy metal contaminants will not be in any type of packaging. The presence of mercury in a sealed container will eliminate any safety concerns with mercury vapors during pre-test setup. For safety reasons, it is also recommended that the other heavy metal contaminants be weighed out in a laboratory hood and placed in containers prior to test setup. Each of the seven sample containers will then be opened and poured into the prepared test soil location at the appropriate time during test setup.

The cemented sludge/grease mixture will be added to ES-INEL-4 as two separate batches of cemented organic "sludge." One of the batches will be mixed with calcium silicate while the other batch will be mixed with Portland cement. These mixtures simulate the sludge/grease mixture disposed of in the SDA. The composition for each simulated batch of the sludge/grease mixture is shown in Table 4. The cemented sludge/grease mixtures will first be prepared and allowed to cure in one or two sealed containers prior to test operation. The sealed container(s) will have a pressure transducer plumbed into its bottom to measure the pressure build-up before the container is breached. The cured sludge container(s) will then be added to the prepared test soil, between the four electrodes.

A large piece of basalt rock, 63 cm (25 in.) long, 46 to 58 cm (18 to 23 in.) wide, and 25 to 38 cm (10 to 15 in.) thick, will be buried 10 cm (4 in.) below the metals/soil layer, directly beneath the four electrodes (see Figure 1). The basalt rock will be placed in the melt such that the top surface of the basalt rock layer is relatively flat. The basalt rock layer has been added to simulate the geology beneath the INEL SDA. The basalt rock layer is to be analyzed before and after ISV processing to determine if there is any presence of organic or inorganic materials on the basalt rock surfaces. In addition, EP TOX and TCLP leach tests will be performed on samples of the basalt rock layer after the ISV test is completed. This is

TABLE 4. Simulated Organic Sludge Compositions for ES-INEL-4 (includes pre-test samples)

	COMPONENT	Vol.%	Volume, mL	Weight, g
BATCH 1 MIXED W/ $CaO \cdot SiO_2$* (includes 825 ml of analytical pre-test samples)	Texaco Regal Oil (R&O 68, Segal 10193)	31.7	245	223.4
	CCl_4	19.9	153	243.9
	Unocal Soluble Oil 10 (cutting fluid)	12.8	99	90.5
	Ethyl Ether	4.53	35	25.0
	1,1,1-trichloroethane	4.07	31	42.4
	Tetrachloroethylene	3.05	24	34.5
	Trichloroethylene	3.05	24	38.4
	Total	79.1	611	698.1
BATCH 2 MIXED W/PORTLAND CEMENT**	Glacial Acetic Acid	6.95	54	56.3
	EDTA	6.95	54	46.2
	Isopropyl Alcohol	6.95	54	42.1
	Total	20.8	162	144.6

* V/V = 81.5 CaO.SiO2/18.5 organics
** V/V = 52 portland cement/48 liquids

AMOUNT OF $CaO \cdot SiO_2$: 2694 mL
AMOUNT OF PORTLAND CEMENT: 175 mL

necessary to demonstrate that the basalt rock layer can be considered nonhazardous after ISV processing.

The basalt rock layer and the layer of prepared test soil is surrounded by clean uncontaminated INEL soil. INEL soil is used to simulate the soil migration pathways at the INEL SDA. The uncontaminated surrounding soil will be analyzed for heavy metal and organic contamination before and after ISV testing. The post-test surrounding soils will also be leach tested to demonstrate that the surrounding post-test soils can be considered non-hazardous.

The electrodes will be fed into the melt using an electrode feeding system that employs air hydraulics and 46-cm long electrode sections. Figure 2 shows the motor control valve for the electrode feed system. The system will be operated with a motor air pressure of 30 psi and a gripper air pressure of 60 psi.

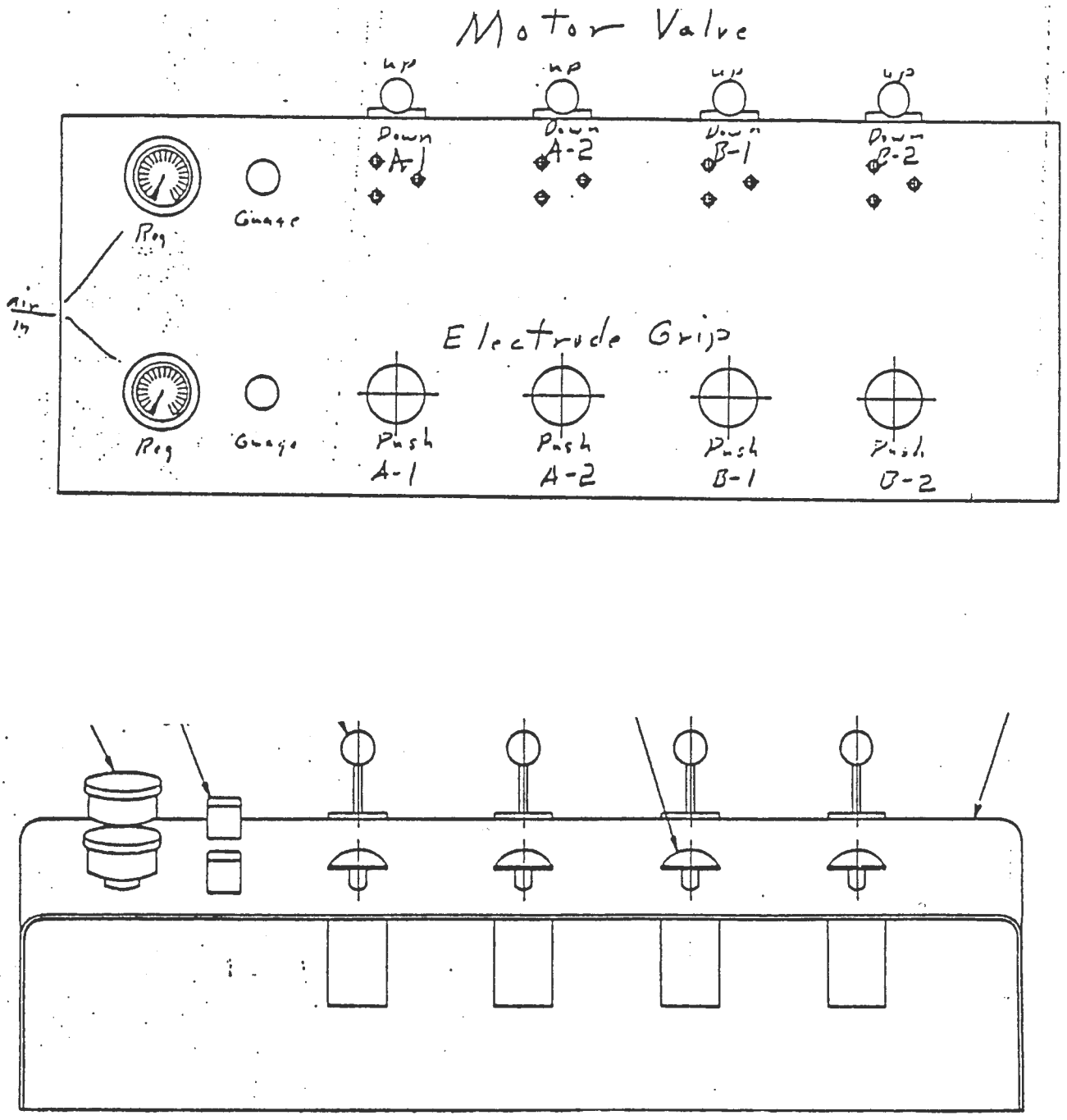


FIGURE 2. Engineering Control Panel, Electrode Feed System

Four graphite electrodes 5.1 cm (2 in.) in diameter will be initially inserted in the upper soil to a 15 cm (6 in.) depth. The electrodes will be spaced in a 30.5 cm x 30.5 cm (12 in. x 12 in.) square array. Two of the electrodes will be coated with three coats of ZYP type SC (a paint-on SiC coating) and the other two electrodes will be coated with SiC using Carbon Vapor Deposition (CVD). Each electrical phase will contain a Zyp type SC electrode and a CVD electrode. The four electrodes will be initially lowered independently into the melt by gravity feeding. However, if a significant difference in electrode depth (greater than 15 cm or 6 in.) develops, the lower electrodes will be held (or raised, as a last resort), until the significant difference in electrode melt depth is eliminated. Upon encountering an electrical short, the shorted electrode phase will be either held in place or raised (as a last resort) until the short disappears. The electrodes can then be reinserted into the melt until the original depth is achieved, and the four electrodes can resume normal insertion operations. If possible, the electrodes would then resume gravity feeding operations.

During the test, an attempt will be made to monitor the amount of time that each electrode is exposed to the highly oxidizing atmosphere (HOA) above the melt, before and after being coated with molten glass from the melt. This will be done by periodically measuring electrode depth and melt subsidence during ES-INEL-4. The resultant curves will then be analyzed to determine the amount of glass-coated and uncoated exposure to the HOA for various locations on each of the four electrodes. This will provide an estimation of the effectiveness of each of the two SiC electrode coatings.

The zone to be vitrified will be covered with at least 2-in. of blanket insulation, leaving a 0.5-in. gap around each electrode in the insulation for venting. The insulation is intended to help promote subsidence of the molten glass surface and improve efficiency of the melting operation. The electrodes and the test container will be considered electrically hot and <u>will not</u> be handled by operators while power is on. In addition, the exposed conductors on the outside of the engineering-scale container will be protected from accidental contact. The area immediately surrounding the ISV engineering-scale unit will be restricted entry to authorized personnel only and "DANGER HIGH VOLTAGE" signs will be posted during the test.

Type K thermocouples will be installed in the center of the melt, starting 10 cm (4 in.) below the soil surface and at 5-cm and 10-cm (2-in. and 4-in.) intervals (see Figure 1). These thermocouples will monitor the melt progress of the ES-INEL-4 test. A high temperature, Type C thermocouple, located as shown in Figure 1, will be used to hourly monitor actual melt temperatures during the tests. The Type C thermocouple will be surrounded by an alumina sheath to prevent the thermocouple from being corroded by the ISV melt. However, a duplicate Type C thermocouple will be available for insertion into the melt if the alumina-sheathed thermocouple fails. A string of Type K thermocouples, at 5-cm to 10-cm (2-in. to 4-in.) intervals, will be installed at the same depth as the Type C thermocouple (see Figure 1) to monitor the horizontal growth of the ISV melt.

Run time is projected to be 10-24 hrs for ES-INEL-4, depending on the amount of time necessary for graphite start-up, and the number of times that the electrodes need to be retracted during ISV processing. The electrodes will be lowered independently using the electrode feed system as the melt zone progresses downward. Power will be adjusted, as necessary, to keep the average power near 30 kW. The test will be completed when a depth of at least 66 cm (26 in.) is reached. This is 5 cm (2 in.) into the basalt rock layer.

An off-gas treatment system will be utilized for ES-INEL-4. The 21 SCFM flow rate for the ISV engineering-scale off-gas system is sufficient to provide excess oxygen for combustion of pyrolyzed gases that will be released during processing. The use of a 21 SCFM off-gas flow rate will require the engineering-scale test to have an initial plenum height of 61-cm (24-in.) to simulate the residence time in the large-scale ISV system. The off-gas vacuum for the hood will always be above 0.10 in. W.C. to ensure that the off gases will be captured by the ISV off-gas system.

Off-gas from the vitrification zone will be sampled continuously during Test ES-INEL-4. A fraction of the total off-gas flow (~13 LPM) will be drawn isokinetically through a stainless steel sample tube connected to a sampling train. The train is designed to capture heavy metal semivolatiles and particulates which may volatilize during ISV processing. The train consists of a nozzle, a heated glass fiber filter, a series of five gas impingers with fritted glass ends, a vacuum pump, a flowmeter, and a flow totalizer. The

solutions used for the five impingers will be as follows: (1) empty, (2 and 3) 0.1 N HNO_3, (4) 1.5% $KMnO_4$ and 10% H_2SO_4, and (5) silica gel. The sampling train is an adaptation of an M5 train developed for multiple metals sampling. This train is shown in Figure 3. Liquid volumes from the first four impingers should be combined prior to analytical sampling and testing. It is not necessary to perform analytical testing on the silica gel impinger.

A second sampling train is used for sampling organic vapors. This sample train is shown in Figure 4. The organic sample train runs at a flow rate of 50 ml/min, and consists of a glass fiber filter, two Carbon Molecular Sieve sample tubes (in series), a silica gel impinger, a vacuum pump, a flowmeter, and a flow totalizer. The second Carbon Molecular Sieve sample tube is only needed to capture any organic vapors that "break through" the first sample tube. As a result, the two tubes should be analyzed together.

After ES-INEL-4 is completed, samples of the vitrified material (metal and glass), the surrounding soils (in both the horizontal and vertical directions) and the basalt rock layer will be obtained and packaged in accordance with the INEL SAP. To minimize soil disturbance, the soil shall be removed in layers until the side thermocouples are exposed. The horizontal surrounding soil samples should then be taken (see the INEL SAP). The exact location of these samples shall be based on horizontal Type K thermocouple readings. The soil should then be removed in layers until the bottom of the vitrified block is exposed. The block will then be removed, and the soil underneath the block will be removed and sampled layer by layer based on thermocouple readings. Special care must be taken during soil sampling to prevent cross-contamination (see the INEL SAP for further details).

Upon removing the vitrified block, any compacted dirt will be removed from its surface (by wire brushing, if necessary). The vitrified block will then be measured (for height and maximum diameter), and weighed. Photographs of the vitrified block should also be taken (at all different perspectives, including the top and bottom of the melt). The block should then be broke open, and an estimate of the amount of metal vs. glass present in the vitrified block should be made. The amount of metal and glass present in the vitrified block will be combined with the results of the ICP and cold

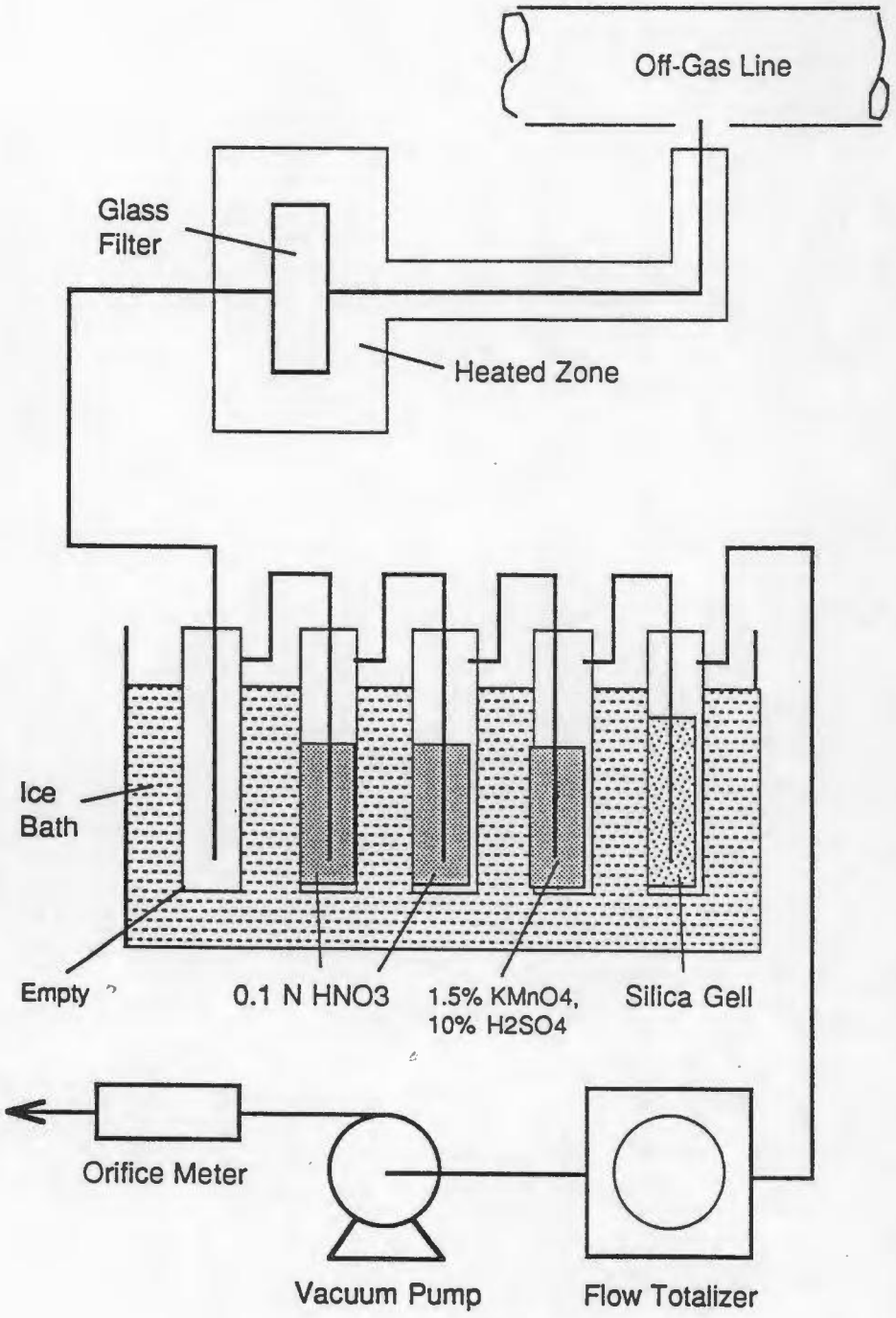


Figure 3. ES-INEL-4 Off-Gas Sample Train for Inorganics

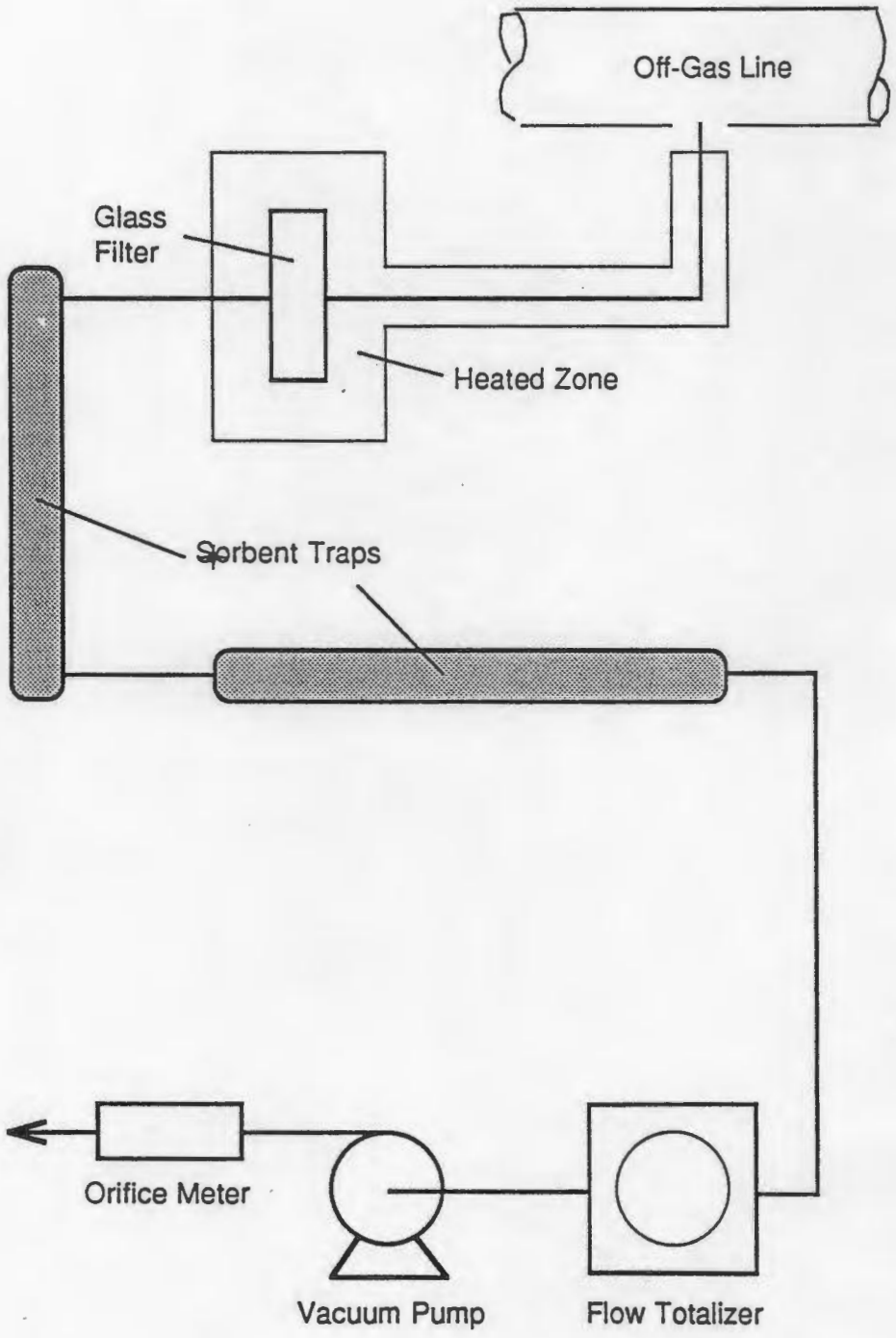
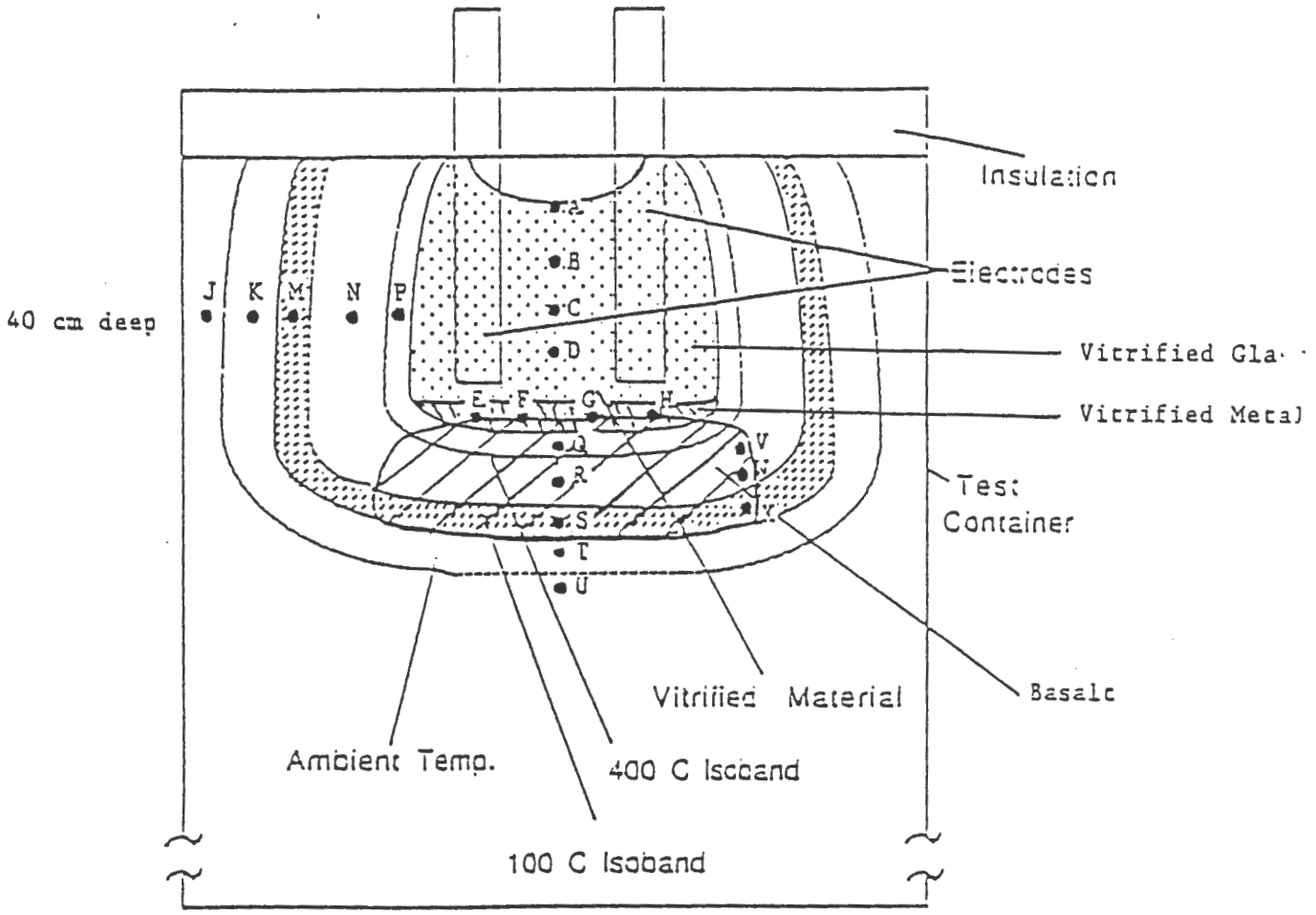


Figure 4. ES-INEL-4 Off-Gas Sample Train for Organics

vapor AA analyses to determine the total amount of heavy metal contaminants glass and molten metal. Photographs and measurements of the broken block should also be performed. In particular, any presence of voids in the vitrified block should be recorded in the laboratory record book. The metal and glass phases of the vitrified block can then be sampled in accordance with the INEL SAP. During all sampling and block breakage activities, special care should be taken to eliminate any potential of sampling cross-contamination (see the INEL SAP for further details).

Figure 5 shows the approximate sample locations for the vitrified glass, molten metal slab, and surrounding soils that are to be taken. The specific samples to be collected are listed in the INEL SAP. In addition, all of the off-gas samples will be analyzed for heavy metals and organic content (where applicable). This includes samples of the cover blanket insulation, lid smears, off-gas line smears, glass fiber filter, gas sorbent tube (for organics) and sample gas impingers. The samples will be sealed, packaged, identified, and sent to the appropriate analytical laboratory for analysis, in accordance with procedures identified in the INEL SAP.

While the samples are being analyzed, the engineering data (electrical performance, electrode performance, melt depth and subsidence, canister pressurization, etc.) collected during the tests will be analyzed to determine the overall system performance. These data will be combined with the analytical results and overall performance assessments will be made in a report. Copies of the raw data will be sent to EG&G along with the performance assessment report.



Sample locations shown as: •

Samples consist of a composite within the "band" of soil as indicated by the sample location. The soil sample below the ambient temperature band extends to 2" below the band.

Figure 5. ES-INEL-4 Post Test Sample Locations (I, L, O omitted to not confuse with Number Designations)

4.0 APPLICABLE DRAWINGS & DOCUMENTS

- ISV Engineering-Scale Power Supply (see SOP 44, Rev. 7)
- ES-INEL-4 Test Configuration (Figure 1)
- Engineering Control Panel, Electrode Feed System (Figure 2)
- ES-INEL-4 Off-Gas Sample Train for Inorganics (Figure 3)
- ES-INEL-4 Off-Gas Sample Train for Organics (Figure 4)
- ES-INEL-4 Post-Test Sample Locations (Figure 5).
- INEL Sampling and Analysis Plan (SAP) for ES-INEL-4
- Safe Operating Procedure No. 44 Rev. 7 (Engineering-Scale ISV System)
- Biosafety Protocol for ES-INEL-4 (see Appendix A of the Test Plan)
- ES-INEL-4 Data Sheets (see Appendix B of the Test Plan)
- Material Safety Data Sheets for each hazardous chemical added (see Appendix C of the Test Plan)
- PNL Waste Management and Environmental Compliance Manual (PNL-MA-8)
- PNL Health and Safety Management Manual (PNL-MA-43)
- PNL Radiation Protection Manual (PNL-MA-6)

5.0 TEST MATRIX

A parametric matrix has been established (Table 5) to summarize key parameters and system constraints for the test. Testing contaminants, soil moisture content, off-gas flow requirements, and combustible content limits are provided in Table 5.

TABLE 5. Test Matrix for INEL Soil Engineering-Scale Test 4

Contaminants and Additives	See Tables 2, 3 & 4
Moisture Content	TBD (~11%)
Off-Gas Flow: System	21 scfm
Inorganic Sampling	13 L/min
Organic Sampling	50 ml/min
Combustible limit (based on flow, 100% excess air and design factor of 2)	15 wt%
Maximum Power Input	≤30 kW
Expected Vitrification Depth	>66 cm (26 in.) below the surface.

6.0 CALIBRATION REQUIREMENTS

Calibration records will be maintained in project record storage. User calibration will be noted in the project logbook (Laboratory Record Book #53517). The measuring and test equipment critical to the success of the test and their calibration levels are indicated in Table 6.

Due to the short duration of the test, post-test calibrations to check the as-found condition of measuring and test equipment will not be performed.

TABLE 6. Measuring and Test Equipment

3-Phase Scott-Tee Electrical and Control System	Calibration Level	Accuracy
High temperature thermocouple readout	1	±2%
System off-gas rotameter	1	±4%
Sample train wet test meter	1	±4%
Fluke voltage and ammeter	1	±2%
Electrical and control system	3	-
Strip-chart recorder (temperature recording)	1	±2%
Sample train flowmeter	3	-

7.0 QUALITY ASSURANCE

This test will be performed in a controlled, reproducible manner in accordance with Level II requirements defined in PNL-MA-70 (ISV QA WTC-014). Pre- and post-test analytical efforts will be in accordance with EPA Level 3, non-CLP laboratory methods. This is necessary because of the need to use some of the analytical samples from the engineering-scale test to verify that ISV can effectively remediate the INEL SDA. All pertinent data and observations will be recorded on appropriate data sheets or in the project laboratory notebook with all entries signed and dated. All assumptions, calculations, and analyses will be documented in the project laboratory notebook or filed in the principal investigator's project file.

Procedures for pre-and post-test sampling and pre-test preparation activities must be in accordance with the INEL SAP. As a result, this Test Plan must coincide with the requirements in the INEL SAP. Furthermore, any departures from this test plan will have to be approved by the Project Manager and documented in both the project logbook (Laboratory Record Book #53517) and the record copy of the test plan. Test Plan changes must also be approved by EG&G, Idaho (contact Briant Charboneau). This is done by informing EG&G, Idaho via telecon and obtaining documented approval via FAX.

8.0 DISPOSAL REQUIREMENTS

Because of the hazardous nature of the inorganic heavy metals and some of the organics, it is possible (although unlikely) that the vitrified block or surrounding soils from ES-INEL-4 will have to be disposed of as hazardous waste. Any waste materials from ES-INEL-4 will be packaged and provided to PNL Waste Management Personnel for disposal per PNL-MA-8.

9.0 SAFETY EVALUATION

The potential hazards and measures taken to control or preclude the consequences of any potential hazards for the ISV engineering-scale tests on INEL materials are identified in this section. Based on the potential hazards and control measures described below, we conclude that the risks associated with this test are acceptable.

Handling: A minimum of safety glasses, lab coat, and electrical leather gloves will be worn when working inside the engineering-scale ISV containment unit. In addition, chemical resistant gloves should be used whenever handling any of the hazardous waste envelopes or glass containers.

Qualifications: Only qualified ISV shift engineers will direct the test operations.

Access: The area will be identified by "Authorized Personnel Only" signs.

Hazards:

Electrical
- Electrodes will have an electrical potential and must be protected from accidental contact.
- The thermocouples and thermocouple cables will have an electrical potential and shall not be handled when power is on to the electrodes.
- All metal off-gas tubing and components will be grounded.
- Lock and tag procedures will be used to secure power off to the engineering-scale system when the system is out of service or when an operator handles potentially electrically hot equipment, such as electrodes.

Thermal
- The modified container will be thermally hot; operators will wear protective gloves when handling.
- Off-gas tubing and other system components could be hot and should be handled carefully.

Chemical - The heavy metals, organics used in these tests are hazardous. Use appropriate protective clothing and equipment when handling. Refer to the Bio-safety Protocol attached when working with carbon tetrachloride, trichloroethylene, tetrachloroethylene, cadmium oxide, chrome (III) oxide, or arsenic trioxide (see the Test Plan Appendix for the ES-INEL-4 Bio-safety Protocol and Material Safety Data Sheets).

- Because of the potential presence of mercury contamination in the post-test materials, extreme care is required during post-test sampling. As a result, mercury detection instrumentation will be in use during initial post-test sampling activities (at least), and whenever required during the remaining post-test sampling activities. If the mercury vapor levels are found to be hazardous during post-test sampling, it may be necessary to go to fresh air lines or self-contained breathing apparatus during post-test sampling. A decision on the level of protection necessary for post-test sampling is left to the responsible engineer, in consultation with Lab Safety and personnel in charge of the mercury detection instrumantation.

Radioactive - It is likely that the engineering-scale test will be performed while the ISV engineering-scale system is under a Radiation Work Permit. This permit is due to the presence of trace amounts of relatively fixed contamination on the inside surface of the ISV engineering-scale off-gas pipe. ISV Engineering-Scale Test personnel will perform all testing activities in accordance with the requirements of the Radiation Work Permit, if it is in place. This includes the use of appropriate clothing during pre- and post-test sampling activities.

10.0 TEST No. ES-INEL-4 CHECKLIST

PRE-TEST - ES-INEL-4

Initial	Date	
_____	_____	1) Make up the two cemented sludge/grease mixture batches, per Table 4 of the Test Plan. Reserve 1605 ml of Batch 1 (Calcium Silicate Batch) and 145 ml of Batch 2. Combine the two reserved portions of each batch, then split the reserved batch mixture into 2 EP TOX samples, 2 TCLP-Metal samples (powder test), 2 TCLP-ZHE samples, 2 archive samples, 2 GC/MS samples, 2 ICP samples, and 2 Cold Vapor AA samples. The EP TOX, TCLP, and archive samples will each have a volume of 200 ml, while the GC/MS, ICP and Cold Vapor AA samples will have a volume of 25 ml. Pour the remaining cemented sludge/grease mixture batches (0.5 gal total) into one or two sample containers that have pressure transducers plumbed into their bottom. Allow at least 48 hr for the cemented sludge/grease mixture to cure. (Do not analyze the cemented sludge/grease mixture samples until after they have set at least 48 hours.)

NOTE: Clearly identify each pre- and post-test sample taken with the sampler's initials, the date, and the unique 12-digit sample identification number, as specified in the INEL SAP.

_____	_____	2) Mix up a 800 g sample of the INEL soil with representative amounts of the inorganic hazardous metals (see Table 2). Split the sample into four 200 g samples and set the samples aside for EP TOX, and TCLP Metal Powder Tests (2 each).
_____	_____	3) Add the proper amount of each inorganic heavy metal contaminant to its respective sample container. Record each amount in Laboratory Record Book #53517. Seal and identify each container.

_____ _____ 4) Obtain ten 200-g pre-test samples and nine 25-g pre-test samples of the basalt rock layer that is to be added to ES-INEL-4 (see the INEL SAP). Set four of the 200-g samples aside for archive, and set the other six 200-g samples aside for eventual EP TOX, TCLP-Metal (powder), and TCLP-ZHE analysis (2 each). Set the nine 25-g samples aside for eventual ICP, Cold Vapor AA, GC/MS, and possible EP TOX, and TCLP Metal (Powder) analyses (3 each).

NOTE: Special procedures need to be followed to prevent the cross-contamination of pre- and post-test samples from ES-INEL-4 (see the INEL SAP for procedural details).

_____ _____ 5) Verify the engineering-scale ISV unit is electrically grounded.

_____ _____ 6) Clean the inside of the ISV engineering-scale container and lid to verify that the test is not cross-contaminated by materials from previous ISV tests. Take 1 smear of the off-gas line and 6 smears of the off-gas hood after cleaning. Split the pre-test off-gas line smear in thirds, and set the 9 total samples aside as pre-test lid and off-gas line smear samples. (See the INEL SAP for further details on pre-test preparation procedures.)

_____ _____ 7) The project manager shall review the pre-test preparation activities and finalize test parameters. Record instructions in Laboratory Record Book #53517 for ES-INEL-4.

_____ _____ 8) Make up the test container; use the identified amounts and locations of soil, metal, paper/wood, EP TOX heavy metals, and sludge/grease mixture per the Project Manager's instructions and Section 3 of this test plan. (Mercury and the cemented sludge/grease mixtures will be added to the test in its sample container, while the other heavy metal contaminants will be loosely poured into the prepared test soil between the four electrodes.) Record the method of material addition and the make-up procedure in Laboratory Record Book #53517. Take pictures of each stage of soil makeup for a photographic record.

9) During pre-test makeup, be sure to take eleven 200-g samples and nine 25-g samples of the surrounding INEL soils at the positions indicated by the INEL SAP. These locations are to be in the approximate vicinity of where the post-test surrounding soil samples will be taken (see Figure 4 and the INEL SAP for more details). Set five 200-g samples aside as archive samples with the other six 200-g samples set aside for eventual EP TOX, TCLP-Metal (powder), and TCLP-ZHE tests (2 each). The nine 25-g samples will be set aside for eventual ICP, Cold Vapor AA, and GC/MS tests (3 each).

10) Coat at least eight 2-ft sections of 2-in. diameter graphite with three coats of Zyp type SC coating. Make certain that sufficient time is allowed between each coat for drying. Use a portion of the Zyp type SC-coated electrode sections to make two 6-ft long electrodes. Make certain to use contact paste between each electrode section.

11) Assemble six of the CVD electrode sections into two 6-ft long electrodes. Make certain to use contact paste between each electrode.

12) Place the lid of the ISV engineering-scale system on top of the ISV engineering-scale container. Seal the off-gas lid with tape.

13) Secure the electrode feed system (EFS) to the top of the ISV engineering-scale lid.

14) Position the four electrodes in the EFS, with the bottom of each electrode 15 cm (6 in.) into the soil. Make certain that each electrical phase will contain one Zyp type SC-coated electrode and one CVD-coated electrode. Record the initial depth of each electrode, along with its yardstick measurement at the top.

_____ _____ 15) Lay the graphite starter path in the manner described in Laboratory Record Book #53024, page 79 (Criss-Crossed Square Pattern, 2-in. wide by 1.5-in. deep, with a 0.75-in. deep, 1.5-in. thick annulus of pure graphite and a 0.75-in. deep, 1.5-in. thick annulus of graphite starter path around each electrode). The graphite starter path shall have a graphite to frit ratio of 65:35 by weight. Lay a 1-in. thick layer of cover blanket insulation on top of the soil surface (be certain to allow vent holes around each graphite electrode). Obtain one 20-in^2 archive sample and three 4-in^2 pre-test samples of the cover blanket insulation.

_____ _____ 16) Connect the electrode feed system to the ISV engineering-scale power cables.

_____ _____ 17) Set up the ES-INEL-4 off-gas sampling train for inorganic materials. Obtain 2 pre-test samples of clean glass fiber filters by splitting 1 glass fiber filter blank in half. Set aside a second complete glass fiber filter as an archive blank. Obtain 4 pre-test samples of impinger solution blanks, with each sample comprising 2/3 nitric acid solution (0.1 N) and 1/3 potassium permanganate/sulfuric acid solution (1.5%/10%). (See the INEL SAP for further details). Test the off-gas system to assure that a system flow rate of 21 scfm and a sample flow rate of 13 L/min can be maintained.

_____ _____ 18) Set up the ES-INEL-4 off-gas sampling train for organic materials. Obtain 1 pre-test sample of the sorbent tube prefilter. Obtain 1 Carbon Molecular Sieve sample tube blank as a pre-test sample. (See the INEL SAP for further details.) Test the organic sampling train to assure that a sample flow rate of 50 ml/min can be maintained.

_____ _____ 19) Heat trace the sampling line in front of the filters with 110 V electrical heat trace tape.

NOTE: Filter temperature will be maintained above 100°C.

_____ _____ 20) Post the Test Plan in EDL 101, 324 Building.

_____	_____	21)	Post "Authorized Personnel Only" signs at the entrances to modules and rope off area around engineering-scale unit.
_____	_____	22)	Post sign at roped off area at the engineering-scale unit "Danger High Voltage."
_____	_____	23)	Connect air hoses to the feed system and the hose inlets to building air. Set motor air pressure at 30 psi and gripper air pressure at 60 psi.
_____	_____	24)	Set the grippers on the electrode feed system at the mid-travel position. Keep grippers loose.
_____	_____	25)	Obtain approval to proceed: Project Manager _____.

OPERATING PROCEDURE - ES-INEL-4

Initial	Date		
_____	_____	1)	Notify J. L. Buelt (ISV Group Leader - 376-3926), M. J. Pueschner (324 Building Manager - 376-3693), and W. F. Bonner (Process Development Section Manager - 376-3340) of the intention to run the test.
_____	_____	2)	Identify the location of the transformer electrical connection and circuit breaker.
_____	_____	3)	Make all electrical connections in accordance with SOP 44, Rev. 7.
_____	_____	4)	Before closing the engineering-scale breaker (see SOP 44, Rev. 7), verify the controller is set to zero.
_____	_____	5)	Obtain approval to proceed: Project Manager _____.
_____	_____	6)	Establish an off-gas system flow rate of approximately 21 scfm. Turn on the off-gas heater. Establish a off-gas sampling rate of approximately 13 LPM for the inorganics sampling train, and a rate of 50 ml/min for the organic sample train.

POST TEST - ES-INEL-4

Initial	Date	
_____	_____	1) Allow at least 72 hrs for the vitrified block to cool before proceeding with sampling.
_____	_____	2) Take measurements of each retracted electrode and record those measurements in the Laboratory Record Book for ES-INEL-4, along with any observations as to electrode corrosion. Take photographs of each retracted electrode.
_____	_____	3) Sample the cover blanket insulation, and take sample smears of the engineering-scale lid and off gas line (see NOTE below). Set these samples aside after labelling each (see the INEL SAP for further details.

NOTE: Because of the possible presence of mercury in the ISV post-test system and surrounding soils, mercury sampling of the air will be performed during at least the initial phase of post-test sampling. This will determine if fresh air is necessary during post-test sampling.

_____	_____	4) Begin to remove the surrounding soil from around the vitrified block, as outlined in Section 3 of the Test Plan. Remove in layers until a depth of 41 cm (16 in.) is reached. Then take surrounding soil samples in accordance with Figure 4 and the INEL SAP. Use the temperature data to specify the exact locations of each surrounding soil sample. Be certain to fill the entire sample bottle with soil, while minimizing the amount of soil movement. Seal and refrigerate each surrounding soil sample, after individually identifying each one with the sampler's initials, the sampling date, and the unique 12-digit sample number. Be careful to avoid cross-contamination of the surrounding soil samples. (See the INEL SAP for specific sampling details).

NOTE: The SAP provides a summary of Sample Label coding. Record each sample taken in the Laboratory Record Book (#53517) for ES-INEL-4. Tightly seal and refrigerate all organic samples to a temperature of 4°C immediately after sampling, and ship these samples in their refrigerated condition to the appropriate Analytical Laboratory for analysis. Be certain that the containers of all organic samples are filled to the brim of the sample container. Maintain a photographic record during all sampling procedures.

_____ _____ 5) Continue removing the soil surrounding the vitrified block, layer by layer, until the entire vitrified block is exposed. Remove the vitrified block from the engineering-scale container while minimizing any disturbance to the surrounding soil or vitrified block.

_____ _____ 6) Remove any compacted dirt from the surface of the vitrified block, using a wire brush. If possible, sample a portion of the compacted dirt underneath the block. Make certain that the sample container is completely filled, and that procedures to avoid cross-contamination of samples are properly followed (see the INEL SAP for further details. Label each sample taken with the sampler's initials, the sampling date, and the 12-digit sample number.

_____ _____ 7) Collect and weigh all of the metal that wasn't incorporated in the vitrified block, to get a measure of the amount of metal that was incorporated in the block.

_____ _____ 8) Remove the basaltic rock from either the ISV engineering-scale container, or the bottom of the vitrified block (if it is attached). Take samples of the basalt rock in the manner described in the INEL SAP. Be sure to label each sample with the sampler's initials, the sampling date, and the sample identification number (see the INEL SAP for further details).

_____ _____ 9) Take any remaining surrounding soil samples from the area directly beneath the basalt rock layer, as directed by the INEL SAP. Use the type K temperature data for an exact determination of each sampling location.Be certain to provide the proper sample identification (see the INEL SAP for further details). Be careful to avoid cross contamination of the surrounding soil samples (see the INEL SAP). Verify the sample container/bottle is properly labeled to maintain traceability. Maintain a photographic record of the sample preparations. Be careful to avoid cross contamination of the surrounding soil samples (see the INEL SAP).

_____ _____ 10) Take measurements of the height and diameter of the vitrified block, along with the total amount of melt subsidence observed. Obtain a weight of the vitrified block. Record the weight and dimensional measurements in the Laboratory Record Book for ES-INEL-4 (#53517), along with any other observations of the vitrified block's dimensions. Obtain photographs of the vitrified block at all angles (elevation views, underside views, plan views, etc.).

_____ _____ 11) Break the vitrified block in half, using an unpainted chisel. Obtain photographs of the vitrified cross-sections. Record any observations of the vitrified cross section, particularly measurements of void formations in the glass, if any.

_____ _____ 12) Sample the glass phase of the vitrified block in the locations shown in Figure 4 and the INEL SAP. Be careful to avoid cross-contamination of the glass samples (see the INEL SAP for further details). Label each glass sample with the sampler's initials, the date sampled, and the 12-digit sample number described in the INEL SAP.

_____ _____ 13) Obtain an approximate weight of the metal phase material present in the vitrified melt. Take photographs of the metal phase from the bottom of the vitrified melt. Sample the metal phase at the bottom of the vitrified melt in the locations shown in Figure 4 and described in the INEL SAP. Be careful to avoid cross-contamination of the metal phase samples (see the INEL SAP for further details). Label each metal phase sample with the sampler's initials, the date sampled, and the 12-digit sample number described in the INEL SAP.

_____ _____ 14) Collect all samples and document them using the proper QA procedures (see the INEL SAP). Then package all samples requiring analysis in the manner described in the INEL SAP, and send it to the appropriate analytical laboratory for analysis, in accordance with procedures identified in the INEL SAP.

_____ _____ 15) Restore test area to its previous condition. Collect all of the surrounding soil, and vitrified block waste in drums. Mark these drums as non-regulated waste currently under analysis. Await the analytical results before deciding on the means of disposing of these wastes.

_____ _____ 16) Notify the Project Manager the test is complete and that the laboratory is clean and released.

APPENDIX A. BIOSAFETY PROTOCOL

SAFE HANDLING OF POTENTIALLY CARCINOGENIC MATERIALS DURING ENGINEERING-SCALE IN SITU VITRIFICATION TESTS

CHEMICALS

Carcinogenic chemicals used in this project include chromic oxide, arsenic trioxide, cadmium oxide, carbon tetrachloride, trichloroethylene and tetrachloroethylene. See the attached Material Safety Data Sheets (MSDSs) for their CAS Numbers.

METHOD OF RECEIVING

The chemicals will be received in clearly identified, sealed containers. The amounts used for the ES-INEL-4 engineering-scale ISV test will be as follows:

Cr_2O_3	102.3 g
As_2O_3	92.4 g
CdO	80.0 g
CCl_4	119.0 ml
Trichloroethylene	18.2 ml
Tetrachloroethylene	18.2 ml

METHOD OF CONTROL

The chemicals will be stored in sealed, clearly labeled containers, that are placed in shelves in Laboratory 208 of the 324 Building. Chemicals not used in this test will be disposed of properly (in accordance with PNL-MA-8).

METHOD OF USE

The chemicals will be used in the ES-INEL-4 engineering-scale ISV test to determine the applicability of the ISV process for stabilization and/or destruction of contaminated soils from the Idaho National Engineering Laboratory's (INEL's) Subsurface DIsposal Area (SDA). These soils also contain other organic and inorganic species, including gear oil, cutting oil, ether, methyl chloroform, alcohols, organic acids, barium selenium, mercury and lead. The cemented organic sludge/grease mixtures and the inorganic chemicals will be prepared prior to test operation and placed in sealed containers.

The inorganic chemicals and cemented sludge/grease mixtures will be packaged in a fume hood. Protective gloves, laboratory coat, and safety goggles will be used while working with the chemicals. Once the mixtures are prepared and

placed in sealed containers, careful handling to prevent container breach will be employed.

The packaged chemicals will then be moved to the engineering-scale ISV system during ES-INEL-4 test preparation. All of the prepared chemicals will be placed in localized areas of the prepared test soil, between the four electrodes, to simulate the localized concentrations of chemicals in the actual waste site. However, all of the materials but mercury and the cemented sludge/grease mixtures will be removed from their sealed containers and poured loosely into the prepared test soil. This is necessary to simulate the worst case experience of chemicals in the actual INEL SDA. During each chemical pouring activity, it is necessary to keep chemical dusting at a minimum. Immediately after placing each of the loose chemicals in the prepared test soil, the localized soil area surrounding each chemical will be covered with at least 2.5 cm (1 in.) of uncontaminated soil, to prevent future entrainment.

ISV Testing of the chemicals will occur within one month of preparing the inorganic chemicals and cemented sludge/grease mixtures. Clean-up of the testing area will be completed within 1 month of the test.

AREA OF USE

The test area will be conducted in the engineering-scale ISV system container located in EDL 101 of the 324 Building. During the test, access to the test area will be restricted to authorized personnel only; the test will be roped off and warning signs posted. The test will be performed while under an off gas vacuum of at least 0.1-in. W.C. This biosafety protocol will be posted on the outside of the engineering-scale ISV system, together with phone numbers to call in an emergency (See Emergency Plans section). In addition, the engineering-scale ISV system will be labelled as containing potentially carcinogenic contamination.

PERSONNEL PROTECTION

Protective gloves (nitrile or polyvinyl alcohol), laboratory coat or coveralls, impervious sleeve coverings, and chemical splash goggles will be worn when mixing or handling the organic or inorganic chemicals. All mixing and handling of inorganics and organics will be conducted in a fume hood. Protective gloves shall also be worn when handling any of the carcinogenic material packages outside of the hood area.

Gloves will be inspected before use and disposed of after use. Protective clothing such as a laboratory coat will be worn to protect against skin contact. The clothing will be removed after use and immediately after any contact with the organic or inorganic chemicals identified above. Hands will be washed with soap and water after removal of gloves and lab coats. See the attached MSDSs for specific exposure actions.

WASTE DISPOSAL AND PROJECT CLOSEOUT

Any waste materials produced during the experiment will be disposed of

properly by methods approved by Waste Management and Environmental Compliance (contact Glenn Thornton, Gene Grohs, or Jim Cartmell). Typically, all of the organic sludge will be either consumed during the experiment, or archive sampled for future testing. All inorganic materials will be encapsulated by the glass/metal product, or present in the off-gas samples. The only waste materials expected are contaminated protective clothing, storage containers, and off-gas components. Waste materials will be placed in a labelled disposal can for disposal. The disposal can will be stored in a hood until cleanup and disposal operations are completed for final disposal. The engineering-scale ISV system will be cleaned within 1 month after the conclusion of any experiment.

EMERGENCY PLANS IN THE EVENT OF A GROSS RELEASE

In the event of a spill, the area will be evacuated, and the 375-2400 number will be called and instructed to call the building manager, occurrence representative and line manager. Notification of a spill involving contamination of personnel will be made immediately by calling 375-2400 and Waste Management and Environmental Compliance at 376-1058 or 376-4781. Skin contact areas will be immediately washed with soap and water. An emergency eyewash and shower will be located nearby.

Waste Management and Environmental Compliance will be contacted at 376-1058 or 376-4781 concerning clean-up of any spill. See the attached MSDSs for specific clean-up actions.

SAFETY DATA SHEETS

Emergency procedures for skin and clothing contact are: remove contaminated clothing and shoes immediately, wash affected areas with soap or mild detergent and large amounts of water until no evidence of chemical remains (approximately 15-20 minutes). For inhalation: immediately remove to fresh air, if breathing has stopped, and perform artificial respiration, keeping person warm and at rest, and get medical attention immediately. See the attached MSDSs for any further information.

PERSONNEL INFORMATION

The following individuals may be participating in the experiment:

Name	Title	Age	Date of Last Physical
R.K. Farnsworth	Dev. Eng.	32	December 1988
C.L. Timmerman	Sr. Res. Eng.	37	July 1987
J.T. Jeffs	Sr. Tech. II	35	September 1988
T.D. Powell	Sr. Tech. I	31	March 1988
C.E. Bigelow	Tech. Spec. I	53	October 1988
C.H. Kindle	Sr. Res. Eng.	41	January 1988

A special carcinogen physical shall be given to those individuals exposed to carcinogens for more than 10 days in any given year.__

APPENDIX B

SAMPLE DATA SHEETS

FOR

ES-INEL-4

ISV ENGINEERING-SCALE POWER SYSTEM DATA SHEET

TEST ID: _____ COLLECTION INTERVAL:_____ Page _____ of _____

		DATE:												
		TIME:												
		BY:												
		UNITS:												
A-Phase -	Voltage	volts												
	Current	amps												
	Power	kW												
B-Phase -	Voltage	volts												
	Current	amps												
	Power	kW												
Total Power		kW												
Total Energy		kWh												
Contactor Shoe Resistance	A1-1	Ω												
	A1-2	Ω												
	A2-1	Ω												
	A2-2	Ω												
	B1-1	Ω												
	B1-2	Ω												
	B2-1	Ω												
	B2-2	Ω												

ISV ELECTRODE FEED SYSTEM DATA SHEET

TEST ID: _____

DEPTH DATA COLLECTION INTERVAL:_____ Page _____ of _____

		DATE:												
		TIME:												
		BY:												
		UNITS:												
Electrode	A1	in.												
	A2	in.												
	B1	in.												
	B2	in.												

		DATE:												
		TIME:												
		BY:												
		UNITS:												
Electrode	A1	in.												
	A2	in.												
	B1	in.												
	B2	in.												

SYSTEM DATA COLLECTION INTERVAL:_____

			Air Pressures, psi			Elect Contact Ring Temp,°C				Contact Ring Resistance, Ω				Hood Temp,°C	
DATE	TIME	BY	Motor	S. Grip	M. Grip	A-1	A-2	B-1	B-2	A-1	A-2	B-1	B-2	ogPort	Struct

ISV TEMPERATURE DATA SHEET

TEST ID: _____ COLLECTION INTERVAL: _____ Page _____ of _____

POINT	T/C NO.	LOCATION	DATE:											
			TIME:											
			BY:											
			UNITS:											
Inside TR No.1:														
1	1	4 " CL												
2	2	8 " CL												
3	3	12 " CL												
4	4	16 " CL												
5	5	20 " CL												
6	6	24 " CL												
7	7	26 " CL												
8	8	28 " CL												
9	9	30 " CL												
10	10	32 " CL												
11	--	--												
12	11	34 " CL												
13	12	36 " CL												
14	13	40 " CL												
15	14	44 " CL												
16	15	48 " CL												
Outside TR No. 2:														
17	16	6 " N of CL												
18	17	8 " N of CL												
19	18	10 " N of CL												
20	19	12 " N of CL												
21	20	14 " N of CL												
22	21	16 " N of CL												
23	22	18 " N of CL												
24	23	22 " N of CL												
25	24	26 " N of CL												
26	25	30 " N of CL												
27	26	34 " N of CL												

APPENDIX C

MATERIAL SAFETY DATA SHEETS

FOR

ES-INEL-4

MATERIAL SAFETY DATA SHEET OHS02070

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212) 967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615) 292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 1327-53-3
RTEC-NUMBER CG3325000

SUBSTANCE: ARSENIC TRIOXIDE, SOLID

TRADE NAMES/SYNONYMS:
ARSENIC OXIDE (AS2O3): ARSENIC SESQUIOXIDE (AS2O3): ARSENIC TRIOXIDE: ARSENICUM ALBUM: ARSENIOUC OXIDE: ARSENIC OXIDE: ARSENOUS ACID: ARSENOUS ACID ANHYDRIDE: ARSENIC SESQUIOXIDE: WHITE ARSENIC: ARSENOUS TRIOXIDE: CRUDE ARSENIC: ARSENOUS OXIDE: ARSENIC(III) OXIDE: ARSENOUS OXIDE ANHYDRIDE: RCRA P012: STCC 493115: UN 1561: A-59: AS2O3: OHS02070

CHEMICAL FAMILY:
METAL OXIDE

MOLECULAR FORMULA: AS2-O3 MOLECULAR WEIGHT: 197.84

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=4 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: ARSENIC TRIOXIDE PERCENT: 100.0

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
ARSENIC, INORGANIC AND SOLUBLE COMPOUNDS:
10 UG(AS)/M3 OSHA TWA
200 UG(AS)/M3 ACGIH TWA
2 UG(AS)/M3 NIOSH RECOMMENDED 15 MINUTE CEILING

SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING
SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY WARNING AND RELEASE REQUIREMENTS- (FEBRUARY 27, 1987)

ARSENIC TRIOXIDE, SOLID:
ACGIH A2-SUSPECTED HUMAN CARCINOGEN (PRODUCTION).

100/10,000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
5000 POUNDS SARA SECTION 304 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: ODORLESS, TASTELESS, WHITE OR COLORLESS AMORPHOUS LUMPS OR CRYSTALLINE POWDER.

BOILING POINT: 869 F (465 C) MELTING POINT: 594 F (312 C)

SPECIFIC GRAVITY: 3.738 SOLUBILITY IN WATER: 3.7% @ 20 C

VAPOR PRESSURE: 1 MMHG @ 212.5 C

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
SOLUBLE IN ACIDS, ALKALIES, DILUTE HYDROCHLORIC ACID,
GLYCEROL, CARBONATE SOLUTIONS; INSOLUBLE IN CHLOROFORM, ETHER, ALCOHOL.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE (1987 EMERGENCY RESPONSE GUIDEBOOK,
DOT P 5800.4, GUIDE PAGE 53).

USE AGENTS SUITABLE FOR TYPE OF FIRE, USE FLOODING AMOUNTS OF WATER AS A FOG.
AVOID BREATHING POISONOUS VAPORS, KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
POISON B

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
POISON

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.366 AND
49CFR173.368
EXCEPTIONS: 49CFR173.364

TOXICITY

ARSENIC TRIOXIDE, SOLID;
TOXICITY DATA: 29 MG/KG ORAL-MAN LDLO; 1429 UG/KG ORAL-HUMAN LDLO; 40 MG/KG
ORAL-RAT LD50; 31,500 UG/KG ORAL-MOUSE LD50; 4 MG/KG ORAL-RABBIT LDLO;
10 MG/KG ORAL-DOG LDLO; 30 MG/KG ORAL-CATTLE LDLO; 8 MG/KG SUBCUTANEOUS-RAT
LDLO; 9800 MG/KG SUBCUTANEOUS-MOUSE LD50; 6 MG/KG SUBCUTANEOUS-GUINEA PIG
LDLO; 7 MG/KG SUBCUTANEOUS-RABBIT LDLO; 10,700 UG/KG INTRAVENOUS-MOUSE

LD50; 10,560 UG/KG INTRAVENOUS-RABBIT LDLO; 871 MG/KG INTRAPERITONEAL-RAT LD50; 2 MG/KG INTRADERMAL-DOG LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS);
CARCINOGEN STATUS: OSHA CARCINOGEN; KNOWN HUMAN CARCINOGEN (NTP); HUMAN SUFFICIENT EVIDENCE (IARC); ANIMAL INADEQUATE EVIDENCE (IARC). THERE IS SUFFICIENT EVIDENCE THAT INORGANIC ARSENIC COMPOUNDS ARE SKIN AND LUNG CARCINOGENS IN HUMANS. THE DATA SUGGESTING AN INCREASED RISK FOR CANCER AT OTHER SITES ARE INADEQUATE FOR EVALUATION.
LOCAL EFFECTS: IRRITANT- INHALATION, SKIN AND EYE.
ACUTE TOXICITY LEVEL: HIGHLY TOXIC BY INGESTION.
TARGET EFFECTS: NEUROTOXIN; SENSITIZER- DERMAL. POISONING MAY ALSO AFFECT THE SKIN, GASTROINTESTINAL TRACT, LIVER, KIDNEYS, HEMATOPOIETIC AND CARDIOVASCULAR SYSTEMS.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH PRE-EXISTING DIABETES, CARDIOVASCULAR DISEASES, ALLERGIC OR OTHER SKIN DISEASES, NEUROLOGIC, HEPATIC OR RENAL LESIONS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ARSENIC TRIOXIDE, SOLID:
IRRITANT/NEUROTOXIN/CARCINOGEN.
ACUTE EXPOSURE- INORGANIC ARSENIC CONPOUNDS MAY CAUSE IRRITATION OF THE RESPIRATORY TRACT WITH COUGH, FOAMY SPUTUM, PAIN IN THE CHEST, DYSPNEA, AND POSSIBLY PULMONARY EDEMA. THERE MAY BE CYANOSIS OF THE FACE, GIDDINESS, RESTLESSNESS, LASSITUDE, HEADACHE, EXTREME GENERAL WEAKNESS, AN INITIAL RISE, THEN FALL IN TEMPERATURE, HYPOTENSION, PAIN IN THE LIMBS, AND LEUKOCYTOSIS. DELAYED GASTROINTESTINAL SYMPTOMS MAY INCLUDE NAUSEA, VOMITING, COLIC AND DIARRHEA. ACUTE, SEVERE SYSTEMIC INTOXICATION BY INHALATION IS UNLIKELY, BUT IF SUFFICIENT AMOUNTS ARE ABSORBED, OTHER EFFECTS AS DESCRIBED IN ACUTE INGESTION ARE POSSIBLE. ONE CASE OF A SINGLE PROLONGED EXPOSURE TO AN ARSENICAL WEED SPRAY RESULTED IN MEGALOBLASTIC ANEMIA.
CHRONIC EXPOSURE- REPEATED EXPOSURE TO INORGANIC ARSENIC COMPOUNDS MAY CAUSE WEAKNESS, PERSISTENT HEADACHE, ANOREXIA, WEIGHT LOSS, FATIGUE, PALLOR, MALAISE, LOW GRADE FEVER, SALIVATION, AND GASTROINTESTINAL DISTURBANCES WITH NAUSEA, OCCASIONAL VOMITING, A SENSE OF HEAVINESS IN THE STOMACH, COLIC AND DIARRHEA ALTERNATING WITH CONSTIPATION. EFFECTS ON MUCOUS MEMBRANES MAY RESULT IN CONJUNCTIVITIS WITH A SENSATION OF IRRITATION AND LACRIMATION, A CATARRHAL STATE OF THE NOSE, LARYNX, AND RESPIRATORY PASSAGES, CORYZA, HOARSENESS, MILD TRACHEOBRONCHITIS, AND STOMATITIS. PERFORATION OF THE NASAL SEPTUM MAY OCCUR. MANY FORMS OF SKIN LESIONS ARE POSSIBLE INCLUDING PIGMENTATION (MELANOSIS), ERYTHEMA, ECZEMA, KERATOSIS OF PALMS AND SOLES, LOCALIZED SUBCUTANEOUS EDEMA, ESPECIALLY OF THE EYELIDS, SCALING AND DESQUAMATION, BRITTLE NAILS, AND WHITE BANDS ON THE NAILS (MEES LINES), ALOPECIA AND VITILIGO. PERIPHERAL NEURITIS MAY DEVELOP, INITIALLY OF THE HANDS AND FEET, WHICH IS USUALLY SENSORY WITH PARESTHESIA, HYPESTHESIA, PAIN, BURNING, AND TENDERNESS. IN VERY SEVERE CASES, MOTOR PARALYSIS AND MUSCLE ATROPHY MAY OCCUR WITH FOOT AND WRIST DROP. EFFECTS ON THE LIVER, KIDNEY, MYOCARDIUM, AND BONE MARROW MAY OCCUR BUT ARE MORE COMMON WITH CHRONIC INGESTION. INORGANIC ARSENIC COMPOUNDS HAVE BEEN SHOWN TO BE LUNG AND SKIN CARCINOGENS IN HUMANS. THE LATENCY TIME BETWEEN ONSET OF EXPOSURE AND THE APPEARANCE OF CANCER IS USUALLY BETWEEN 15 AND 30 YEARS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST.

TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
ARSENIC TRIOXIDE, SOLID:
IRRITANT/SENSITIZER.
ACUTE EXPOSURE- ARSENIC AND INORGANIC ARSENIC COMPOUNDS IRRITATE THE SKIN WITH ERYTHEMA, ITCHING AND BURNING. SENSITIZATION DERMATITIS MAY OCCUR IN PREVIOUSLY EXPOSED PERSONS. INORGANIC ARSENIC COMPOUNDS ARE SLIGHTLY ABSORBED THROUGH THE SKIN WHEN ADMINISTERED IN A LIPID VEHICLE. POISONING HAS CAUSED ALOPECIA, BRONZING OF THE SKIN, AND BRITTLE NAILS. IF SUFFICIENT ABSORPTION OCCURS SEVERE GASTRITIS OR GASTROENTERITIS MAY OCCUR.
CHRONIC EXPOSURE- OCCUPATIONAL EXPOSURE TO AIRBORNE ARSENIC MAY CAUSE BURNING AND ITCHING WITH TWO TYPES OF DERMATITIS DUE TO LOCAL IRRITATION OR SENSITIZATION. AN ECZEMATOUS TYPE WITH ERYTHEMA, SWELLING AND PAPULES OR VESICLES AND A FOLLICULAR TYPE WITH ERYTHEMA AND FOLLICULAR SWELLING OR PUSTULES. THE DERMATITIS IS USUALLY LOCALIZED ON THE MOST HEAVILY EXPOSED AREAS SUCH AS THE FACE, BACK OF THE NECK, FOREARMS, WRISTS AND HANDS. CHRONIC DERMAL LESIONS MAY FOLLOW THIS TYPE OF INITIAL REACTION, BUT USUALLY ONLY AFTER MANY YEARS OF EXPOSURE. HYPERKERATOSIS, WARTS AND MELANOSIS OF THE SKIN ARE CONSPICUOUS SIGNS. THESE CHRONIC SKIN LESIONS, PARTICULARLY THE HYPERKERATOSIS, MAY DEVELOP INTO PRECANCEROUS AND CANCEROUS LESIONS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
ARSENIC TRIOXIDE, SOLID:
IRRITANT.
ACUTE EXPOSURE- ARSENICAL DUST MAY CAUSE IRRITATION CHARACTERIZED BY ITCHING, BURNING, WATERING OF THE EYES, PHOTOPHOBIA AND SOMETIMES HYPEREMIA AND CHEMOSIS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DISCOMFORT, EDEMA OF THE LIDS, AND CORNEAL INJURY AND OPACITY.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
ARSENIC TRIOXIDE, SOLID:
NEUROTOXIN/CARCINOGEN/HIGHLY TOXIC.
ACUTE EXPOSURE- THE APPROXIMATE LETHAL DOSE IS 120 MG. NEONATAL DEATH HAS BEEN REPORTED FOLLOWING ACUTE MATERNAL INTOXICATION. LARGE DOSES OF INORGANIC ARSENIC COMPOUNDS MAY CAUSE SYSTEMIC POISONING WITH SYMPTOMS USUALLY APPEARING ONE-HALF TO FOUR HOURS AFTER INGESTION. SYMPTOMS MAY INCLUDE BURNING AND PAIN IN THE CHEST, ESOPHAGUS, STOMACH AND BOWEL, CONSTRICTION IN THE THROAT, DYSPHAGIA, WEAKNESS, A SWEETISH METALLIC TASTE, VIOLENT GASTROENTERITIS WITH VOMITING, COPIUS WATERY OR BLOODY DIARRHEA CONTAINING SHREDS OF MUCOUS, AND DEHYDRATION WITH INTENSE THIRST AND MUSCULAR CRAMPS. THERE MAY BE A GARLIC ODOR TO THE BREATH, VOMIT, AND FECES. VERTIGO, FRONTAL HEADACHE, FEVER, SWEATING, RESTLESSNESS, CONFUSION, DELIRIUM AND EVEN MANIA MAY OCCUR. WITH LESS THAN LETHAL DOSES, SOME SYMPTOMS MAY DEVELOP WITHOUT PROMINENT GASTROINTESTINAL SIGNS. LATER SYMPTOMS MAY INCLUDE COLD, CLAMMY SKIN, CYANOSIS, RAPID, FEEBLE PULSE, HYPOTENSION, SHOCK, CARDIAC DISTURBANCES, INCLUDING VENTRICULAR

FIBRILLATION, AND GENERAL PARALYSIS. DEATH WITHIN 1-48 HOURS IS USUALLY DUE TO CIRCULATORY FAILURE; COMA AND CONVULSIONS MAY OCCUR TERMINALLY. DEATH DELAYED 3-14 DAYS IS USUALLY DUE TO DEHYDRATION, ELECTROLYTE IMBALANCE AND GRADUAL HYPOTENSION. LIVER AND KIDNEY DEGENERATIVE CHANGES MAY BE PRESENT. IF THE ACUTE PHASE IS SURVIVED, DELAYED SEQUELAE MAY INCLUDE: A VARIETY OF SKIN LESIONS, ALOPECIA, MEES LINES, EDEMA OF THE FACE AND EYELIDS, AND CONJUNCTIVITIS; NEUROPATHY WITH SENSORY AND MOTOR INVOLVEMENT; ENCEPHALOPATHY; LIVER DAMAGE WITH MULTIPLE PROFILE ABNORMALITIES, JAUNDICE, AND HEPATOMEGALY; RENAL FAILURE WITH HEMATURIA, ALBUMINURIA, GLUCOSURIA, AND OLIGURIA OR ANURIA; AND ANEMIA AND AND LEUKOPENIA, ESPECIALLY NEUTROPENIA. WEAKNESS AND DIARRHEA MAY PERSIST FOR WEEKS.

CHRONIC EXPOSURE- REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS. REPEATED INGESTION OF SMALL AMOUNTS OF INORGANIC ARSENIC COMPOUNDS MAY CAUSE EFFECTS AS DESCRIBED IN CHRONIC INHALATION. OTHER REPORTED SYMPTOMS MAY INLCUDE METALLIC TASTE, THIRST, GARLIC ODOR TO THE BREATH AND SWEAT, ANXIETY, HOT FLUSHES, ATAXIA, MENTAL CONFUSION, EDEMA OF THE ANKLES AND LOWER EYELIDS, NOSE BLEEDS AND BLEEDING GUMS. LIVER EFFECTS MAY INCLUDE JAUNDICE, HEPATOMEGALY, CIRRHOSIS, ASCITES, NON-CIRRHOTIC PORTAL HYPERTENSION, AND FATTY INFILTRATION AND CENTRAL NECROSIS. THE KIDNEYS MAY BE SEVERELY DAMAGED AND THERE MAY BE OLIGURIA, PROTEINURIA, HEMATURIA, AND CASTS. HEMATOLOGIC EFFECTS MAY INCLUDE ANEMIA, LEUKOPENIA, ESPECIALLY NEUTROPENIA, THROMBOCYTOPENIA WITHOUT SEVERE BLEEDING, DISTURBED ERYTHROPOIESIS, AND DISTURBED OR DEPRESSED MYELOPOIESIS. APLASTIC ANEMIA WITH SUBSEQUENT FATAL MYELOGENOUS LEUKEMIA HAS BEEN REPORTED. REPORTED CARDIOVASCULAR EFFECTS INCLUDE SEVERE CARDIAC PERIPHERAL EDEMA AND LEFT-SIDED HEART FAILURE AND GANGRENE OF THE EXTREMITIES DUE TO PERIPHERAL VASCULAR CHANGES. AN INCREASED INCIDENCE OF CHROMOSOMAL ABBERATIONS HAS BEEN OBSERVED IN PERSONS TREATED WITH ARSENICAL COMPOUNDS. CANCER IN HUMANS IS ASSOCIATED WITH CHRONIC INGESTION OF ARSENIC.

FIRST AID- REMOVE BY GASTRIC LAVAGE OR EMESIS. FOLLOW WITH A SALINE CATHARTIC. MAINTAIN BLOOD PRESSURE, AIRWAY, AND GIVE OXYGEN IF RESPIRATION IS DEPRESSED. DO NOT PERFORM GASTRIC LAVAGE OR EMESIS IF VICTIM IS UNCONSCIOUS. GET MEDICAL ATTENTION IMMEDIATELY. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.) ADMINISTRATION OF GASTRIC LAVAGE OR OXYGEN SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL.

ANTIDOTE:
THE FOLLOWING ANTIDOTE(S) HAVE BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

ARSENIC POISONING:
GIVE DIMERCAPROL, 3 MG/KG (OR 0.3 ML/KG) EVERY 4 HOURS FOR 2 DAYS AND THEN 2 MG/KG EVERY 2 HOURS FOR A TOTAL OF 10 DAYS. DIMERCAPROL IS AVAILABLE AS A 10% SOLUTION IN OIL FOR INTRAMUSCULAR ADMINISTRATION. NEXT, GIVE PENICILLAMINE, UP TO 100 MG/KG/DAY (MAXIMUM 1 G/DAY) DIVIDED INTO 4 DOSES FOR NO LONGER THAN 1 WEEK. IF A LONGER ADMINISTRATION PERIOD IS WARRANTED, DOSAGE SHOULD NOT EXCEED 40 MG/KG/DAY. GIVE THE DRUG ORALLY HALF AN HOUR BEFORE MEALS (DREISBACH, HANDBOOK OF POISONING, 11TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
ARSENIC TRIOXIDE, SOLID:
ACIDS: VIGOROUS REACTION.
ALUMINUM: CORROSIVE IN THE PRESENCE OF MOISTURE.
CHLORINE TRIFLUORIDE: VIOLENT REACTION WITH POSSIBLE IGNITION.
COPPER: CORROSIVE IN THE PRESENCE OF MOISTURE.
FLUORINE: VIOLENT REACTION.
HYDROGEN FLUORIDE: REACTS WITH INCANDESCENCE.
IRON SOLUTIONS: CORRODES.
MERCURY: VIGOROUS RECTION.
METALS: CORROSIVE IN THE PRESENCE OF MOISTURE.
OXYGEN DIFLUORIDE: VIGOROUS REACTION.
RUBIDIUM CARBIDE: IGNITES.
SODIUM CHLORATE: FORMS SPONTANEOUSLY FLAMMABLE MIXTURE.
SODIUM NITRATE + IRON(II) SULFATE: SPONTANEOUS IGNITION.
ZINC: EXPLODES WHEN HEATED.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE TOXIC AND/OR HAZARDOUS GASES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE IN ACCORDANCE WITH 40 CFR 165 RECOMMENDED PROCEDURES FOR THE DISPOSAL AND STORAGE OF PESTICIDES AND PESTICIDE CONTAINERS.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

KEEP IN A TIGHTLY CLOSED CONTAINER, STORE IN A COOL, DRY, VENTILATED AREA.

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.

SPILLS AND LEAKS

SOIL-RELEASE:
DIG A HOLDING AREA SUCH AS PIT, POND OR LAGOON TO CONTAIN SPILLED MATERIAL. USE PROTECTIVE COVER SUCH AS A PLASTIC SHEET TO PREVENT DISSOLVING IN FIREFIGHTING WATER OR RAIN.

WATER-SPILL:
ADD CALCIUM HYPOCHLORITE TO SPILL.

NEUTRALIZE WITH AGRICULTURAL LIME, SLAKED LIME, CRUSHED LIMESTONE, OR SODIUM BICARBONATE.

ADD FERRIC CHLORIDE TO SPILL.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

THE CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (PROPOSITION 65) PROHIBITS CONTAMINATING ANY KNOWN SOURCE OF DRINKING WATER WITH SUBSTANCES KNOWN TO CAUSE CANCER AND/OR REPRODUCTIVE TOXICITY.

OCCUPATIONAL-SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROCESS ENCLOSURE RECOMMENDED TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS ARE THE MINIMUM LEGAL REQUIREMENTS AS SET FORTH BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION FOUND IN 29 CFR1910, SUBPART Z.

RESPIRATORY PROTECTION FOR INORGANIC ARSENIC PARTICULATE EXCEPT THOSE WITH SIGNIFICANT VAPOR PRESSURE

CONCENTRATION OF INORGANIC ARSENIC (AS) OR CONDITION OF USE	REQUIRED RESPIRATOR
UNKNOWN OR GREATER OR LESS THAN 20,000 UG/M3 (20 MG/M3) OR FIREFIGHTING	ANY FULL FACEPIECE, SELF CONTAINED BREATHING APPARATUS, OPERATED IN POSITIVE PRESSURE MODE.
NOT GREATER THAN 20,000 UG/M3 (20 MG/M3)	SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE, HOOD OR HELMET OR SUIT AND OPERATED IN POSITIVE PRESSURE MODE.

NOT GREATER THAN 10,000 UG/M3 (10 MG/M3)	POWERED-AIR PURIFYING RESPIRATORS IN ALL INLET FACE COVERINGS WITH HIGH EFFICIENCY FILTERS; OR HALF-MASK SUPPLIED-AIR RESPIRATOR OPERATED IN POSITIVE PRESSURE MODE.
NOT GREATER THAN 500 UG/M3	FULL FACEPIECE AIR-PURIFYING RESPIRATOR EQUIPPED WITH HIGH EFFICIENCY FILTERS; OR ANY FULL FACEPIECE SUPPLIED-AIR RESPIRATOR; OR ANY FULL FACEPIECE SELF-CONTAINED BREATHING APPARATUS.
NOT GREATER THAN 100 UG/M3	HALF-MASK AIR-PURIFYING RESPIRATOR EQUIPPED WITH HIGH EFFICIENCY FILTERS; OR ANY HALF-MASK SUPPLIED-AIR RESPIRATOR.

(HIGH EFFICIENCY FILTER- 99.97% EFFICIENCY AGAINST 0.3 MICROMETER MONODISPERSE DIETHYL-HEXYL PHTHALATE (DOP) PARTICLES)

RESPIRATORY PROTECTION FOR INORGANIC ARSENICALS (SUCH AS ARSENIC TRICHLORIDE OR ARSENIC PHOSPHIDE) WITH SIGNIFICANT VAPOR PRESSURE.

CONCENTRATION OF INORGANIC ARSENIC (AS) OR CONDITION OF USE	REQUIRED RESPIRATOR
UNKNOWN OR GREATER OR LESS THAN 20,000 UG/M3 (20 MG/M3)	ANY FULL FACEPIECE SELF-CONTAINED BREATHING APPARATUS OPERATED IN POSITIVE PRESSURE MODE.
NOT GREATER THAN 20,000 UG/M3 (20 MG/M3)	SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HOOD OR HELMET OR SUIT OPERATED IN POSITIVE PRESSURE MODE.
NOT GREATER THAN 10,000 UG/M3 (10 MG/M3)	HALF-MASK SUPPLIED AIR RESPIRATOR OPERATED IN POSITIVE PRESSURE MODE.
NOT GREATER THAN 500 UG/M3	FRONT- OR BACK-MOUNTED GAS MASK EQUIPPED WITH HIGH-EFFICIENCY FILTERS AND ACID GAS CANISTER; OR ANY FULL FACEPIECE SUPPLIED AIR RESPIRATOR; OR ANY FULL FACEPIECE SELF-CONTAINED BREATHING APPARATUS.
NOT GREATER THAN 100 UG/M3	HALF-MASK AIR-PURIFYING RESPIRATOR EQUIPPED WITH HIGH EFFICIENCY FILTER AND ACID GAS

CARTRIDGE; OR
ANY HALF-MASK SUPPLIED-AIR
RESPIRATOR.

(HIGH EFFICIENCY FILTER- 99.97% EFFICIENCY AGAINST 0.3 MICROMETER MONODISPERSE DIETHYL-HEXYL PHTHALATE (DOP) PARTICLES)
(HALF-MASK RESPIRATORS SHALL NOT BE USED FOR PROTECTION AGAINST ARSENIC TRICHLORIDE, AS IT IS RAPIDLY ABSORBED THROUGH THE SKIN).

THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

AT ANY DETECTABLE CONCENTRATION:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ACID GAS CANISTER HAVING A HIGH-EFFICIENCY PARTICULATE FILTER.
ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

ARSENIC (INORGANIC):
PROTECTIVE CLOTHING SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29CFR1910.1018(J).

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

ARSENIC (INORGANIC):
PROTECTIVE GLOVES SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29CFR1910.1018(J).

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT

EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

ARSENIC (INORGANIC):
PROTECTIVE EYE EQUIPMENT SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29CFR1910.1018(J).

AUTHORIZED BY- OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 10/16/84 REVISION DATE: 01/12/89

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MATERIAL SAFETY DATA SHEET OHS02340

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 513-77-9
RTEC-NUMBER CQ8600000

SUBSTANCE: BARIUM CARBONATE

TRADE NAMES/SYNONYMS:
CARBONIC ACID, BARIUM SALT: C.I. 77099: C.I. PIGMENT WHITE 10: B-29: B-30: OHS02340

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: BA-C-03 MOL WT: 197.3

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: BARIUM CARBONATE PERCENT: 99.0

EXPOSURE LIMIT:
SOLUBLE BARIUM COMPOUNDS:
0.5 MG(BA)/M3 OSHA TWA
0.5 MG(BA)/M3 ACGIH TWA

PHYSICAL DATA

DESCRIPTION: ODORLESS WHITE SOLID OR POWDER.

BOILING POINT: 2372 F (1300 C)
DECOMPOSES MELTING POINT: 1491.8 F (811 C)

SPECIFIC GRAVITY: 4.43 SOLUBILITY IN WATER: 0.024 PPM

VAPOR PRESSURE: <0.1 MMHG @ 20 C

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
SOLUBLE IN ACETIC ACID, HYDROCHLORIC ACID, NITRIC ACID, AMMONIUM NITRATE, AMMONIUM CHLORIDE; INSOLUBLE IN SULFURIC ACID

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. FIGHT FIRE FROM MAXIMUM DISTANCE. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL. DO NOT SCATTER MATERIAL (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 55).

EXTINGUISH USING AGENT INDICATED. USE FLOODING AMOUNTS OF WATER AS A FOG. AVOID BREATHING DUSTS AND FUMES FROM BURNING MATERIAL; KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-E

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

BARIUM CARBONATE:
11 MG/KG ORAL-HUMAN TDLO; 57 MG/KG ORAL-HUMAN LDLO; 29 MG/KG ORAL-HUMAN TDLO; 418 MG/KG ORAL-RAT LD50; 200 MG/KG ORAL-MOUSE LD50; 400 MG/KG ORAL-DOG LDLO; 20 MG/KG INTRAVENOUS-RAT LDLO; 50 MG/KG INTRAPERITONEAL-MOUSE LD50; REPRODUCTIVE EFFECTS DATA (RTEC); CARCINOGEN STATUS: NONE.
  BARIUM CARBONATE IS TOXIC, AND A SKIN, EYE AND MUCOUS MEMBRANE IRRITANT. PERSONS WITH CHRONIC RESPIRATORY, CARDIOVASCULAR OR SKIN DISEASE MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
BARIUM CARBONATE:
IRRITANT. 250 MG(BA)/M3 IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
  ACUTE EXPOSURE- BRONCHIAL IRRITATION HAS BEEN REPORTED FROM INHALATION OF BARIUM CARBONATE DUST. OTHER EFFECTS MAY INCLUDE COUGHING, SORE THROAT, AND SHORTNESS OF BREATH.
  CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE BARITOSIS, A BENIGN PNEUMOCONIOSIS, THAT IS NOT INCAPACITATING, BUT MAY PRODUCE REVERSIBLE RADIOLOGIC CHANGES. MATERNAL AND PATERNAL REPRODUCTIVE EFFECTS HAVE BEEN REPORTED FOLLOWING INHALATION EXPOSURE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING

HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
BARIUM CARBONATE:
IRRITANT.
ACUTE EXPOSURE- CONTACT MAY CAUSE LOCAL IRRITATION. AQUEOUS SOLUTIONS OF SOME BARIUM COMPOUNDS MAY BE VERY CAUSTIC.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
BARIUM CARBONATE:
IRRITANT.
ACUTE EXPOSURE- CONTACT MAY CAUSE IRRITATION. AQUEOUS SOLUTIONS OF SOME BARIUM COMPOUNDS MAY CAUSE SEVERE EYE BURNS.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
BARIUM CARBONATE:
TOXIC.
ACUTE EXPOSURE- INGESTION MAY CAUSE EXCESSIVE SALIVATION, VOMITING, VIOLENT DIARRHEA, ABDOMINAL PAIN, TIGHTNESS IN THE MUSCLES OF THE FACE AND NECK, CONVULSIONS, TREMORS, ANXIETY, WEAKNESS, DIFFICULTY IN BREATHING, SLOW PULSE, IRREGULAR HEARTBEAT, CARDIAC AND RESPIRATORY FAILURE, GASTROINTESTINAL AND KIDNEY HEMORRHAGES, MUSCULAR PARALYSIS, HYPOKALEMIA, AND DEATH.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- INDUCE VOMITING IMMEDIATELY WHEN SOLUBLE BARIUM COMPOUNDS ARE INGESTED. TREAT SUPPORTIVELY AND SYMPTOMATICALLY (PARMEGGIANI, ENCYCLOPEDIA OF OCCUPATIONAL HEALTH AND SAFETY, 3RD EDITION). GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
FOR BARIUM POISONING:
GIVE 30 GRAMS OF SODIUM SULFATE IN 250 ML OF WATER ORALLY AND REPEAT IN ONE HOUR. GIVE BY GASTRIC TUBE IF SYMPTOMS HAVE APPEARED. THE ADMINISTRATION OF SULFATE SALTS INTRAVENOUSLY IS HAZARDOUS SINCE THEY INDUCE PRECIPITATION OF BARIUM SULFATE IN THE KIDNEY, WITH SUBSEQUENT RENAL FAILURE. IF SYMPTOMS ARE SEVERE AND OTHERWISE UNCONTROLLABLE, GIVE 10 ML OF 10% SODIUM SULFATE SLOWLY INTRAVENOUSLY WHILE MAINTAINING MAXIMUM DIURESIS.

IN PERSISTENT PARALYSIS THAT DOES NOT RESPOND TO SULFATE ADMINISTRATION, BEGIN NORMAL SALINE INFUSION AT A RATE OF 1 LITER EVERY 4 HOURS TO INDUCE SALINE DIURESIS. GIVE FUROSEMIDE, 10-40 MG INTRAVENOUSLY EVERY 4-6 HOURS OR AS NECESSARY TO MAINTAIN DIURESIS FOR 24 HOURS.

IN THE PRESENCE OF HYPOKALEMIA, 1-2 MILLIEQUIVILANTS OF POTASSIUM SUPPLEMENTATION PER KG OF BODY WEIGHT CAN BE GIVEN ORALLY OR SLOWLY INTRAVENOUSLY EVERY 8 HOURS.

GIVE MORPHINE, 5-10 MG SUBCUTANEOUSLY, FOR SEVERE COLIC. (DREISBACH, HANDBOOK OF POISONING, 11TH EDITION). ANTIDOTES MUST BE

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. CONTAINERS MAY EXPLODE IN HEAT OF FIRE.

SPILLS AND LEAKS

OCCUPATIONAL-SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINERS AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.

~~SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER~~
POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 09/13/84 REVISION DATE: 12/16/87

MATERIAL SAFETY DATA SHEET OHS03790

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212) 967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615) 292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 1306-19-0
RTEC-NUMBER EV1925000

SUBSTANCE: CADMIUM OXIDE

TRADE NAMES/SYNONYMS:
CADMIUM MONOXIDE: C-16: CDO: OHS03790

CHEMICAL FAMILY:
METAL OXIDE

MOLECULAR FORMULA: CD-O MOLECULAR WEIGHT: 128.40

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=4 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: CADMIUM OXIDE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
CADMIUM:
* OSHA EXPOSURE LIMIT REMOVED AS PER OSHA INSTRUCTION PUB 8-1.4
0.05 MG(CD)/M3 ACGIH TWA (DUST, SALTS)
(NOTICE OF INTENDED CHANGES 1987-1988)
0.05 MG(CD)/M3 ACGIH CEILING LIMIT (CADMIUM OXIDE FUME)
(NOTICE OF INTENDED CHANGES 1987-1988)
LOWEST FEASIBLE LIMIT NIOSH RECOMMENDED EXPOSURE CRITERIA

SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING
SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY
WARNING AND RELEASE REQUIREMENTS- (OCTOBER 1, 1987)

CADMIUM OXIDE:
0.05 MG(CD)/M3 ACGIH TWA (CADMIUM OXIDE PRODUCTION)
(NOTICE OF INTENDED CHANGE 1987-1988)

100/10,000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
1 POUND SARA SECTION 304 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: ODORLESS, DARK-BROWN POWDER OR CUBIC CRYSTALS.

BOILING POINT: 1652 F (900 C)

DECOMPOSES

MELTING POINT: 2838 F (1559 C)
SUBLIMES

SPECIFIC GRAVITY: 8.150

SOLUBILITY IN WATER: INSOLUBLE

VAPOR PRESSURE: 1 MMHG @ 1000 C

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
SOLUBLE IN AMMONIA SALTS, DILUTE ACIDS; INSOLUBLE IN ALKALIES, ETHANOL, DIMETHYLSULFOXIDE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 53).

EXTINGUISH USING AGENTS SUITABLE FOR TYPE OF FIRE. AVOID BREATHING POISONOUS VAPORS, KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
POISON B

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND SUBPART E:
POISON

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.365
EXCEPTIONS: 49CFR173.364

TOXICITY

CADMIUM OXIDE:
500 UG/M3/5 YEARS INTERMITTENT INHALATION-MAN TCLO; 40 UG/M3 INHALATION-MAN TCLO; 72 MG/KG ORAL-MOUSE LD50; 72 MG/KG ORAL-MAMMAL LD50; 780 MG/M3/10 MINUTES INHALATION-RAT LC50; 340 MG/M3/10 MINUTES INHALATION-MOUSE LC50; 3 GM/M3/10 MINUTES INHALATION-DOG LC50; 15 GM/M3/10 MINUTES INHALATION-MONKEY LC50; 3 GM/M3/15 MINUTES INHALATION-RABBIT LC50; 3 GM/M3/15 MINUTES INHALATION-GUINEA PIG LC50; 12 MG/KG INTRAPERITONEAL-RAT LD50; REPRODUCTIVE

EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS).
CARCINOGEN STATUS: ANTICIPATED HUMAN CARCINOGEN (NTP); HUMAN LIMITED EVIDENCE, ANIMAL SUFFICIENT EVIDENCE (IARC CLASS 2A). CADMIUM OXIDE PRODUCED LOCAL SARCOMAS IN RATS AFTER SUBCUTANEOUS INJECTION. EXPOSURE TO CADMIUM, PRIMARILY AS THE OXIDE HAS BEEN ASSOCIATED WITH INCREASED RISKS OF PROSTATIC AND RESPIRATORY CANCERS.

CADMIUM OXIDE IS A HIGHLY TOXIC RESPIRATORY TRACT IRRITANT AND NEPHROTOXIN. POISONING MAY AFFECT THE RESPIRATORY AND GASTROINTESTINAL SYSTEMS, BLOOD, PROSTATE AND LIVER. PERSONS WITH PRE-EXISTING KIDNEY, BLOOD, RESPIRATORY, OR LIVER CONDITIONS MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CADMIUM OXIDE:
IRRITANT/NEPHROTOXIN/HIGHLY TOXIC.

ACUTE EXPOSURE- LARGE CONCENTRATIONS OF DUST OR CONCENTRATIONS OF FUMES AS LITTLE AS 0.5 MG/M3 MAY CAUSE SEVERE PULMONARY IRRITATION. THE INITIAL SYMPTOMS WHICH MAY BE DELAYED FOR SEVERAL HOURS ARE METALLIC TASTE IN THE MOUTH, NASOPHARYNGEAL IRRITATION, RHINITIS, FOLLOWED BY A FEELING OF CHEST CONSTRICTION OR SUBSTERNAL PAIN, WITH COUGH, HEMOPTYSIS, AND DYSPNEA. THERE ALSO MAY BE HEADACHE, DIZZINESS, TACHYPNEA, FEVER, CHILLS, MUSCLE ACHES, LEG PAINS, NAUSEA, VOMITING, ABDOMINAL PAIN, DIARRHEA, ANOREXIA AND PNEUMONITIS. SEVERE PULMONARY EDEMA MAY DEVELOP AND RESULT IN DEATH. IN NONFATAL CASES, RESPIRATORY SYMPTOMS MAY LINGER FOR SEVERAL WEEKS, WHILE IMPAIRMENT OF PULMONARY FUNCTION MAY PERSIST FOR MONTHS. CONCENTRATIONS OF FUMES RESPONSIBLE FOR FATALITIES HAVE BEEN 5 MG/M3 FOR 8 HOURS, 9 MG/M3 FOR FIVE HOURS AND 40 TO 50 MG/M3 FOR ONE HOUR.

CHRONIC EXPOSURE- MAY CAUSE PALLOR, FATIGUE, ANOREXIA, STERNAL AND ABDOMINAL PAIN, PROGRESSIVE EMPHYSEMA WITH SYMPTOMS OF COUGH AND GRADUALLY INCREASING SHORTNESS OF BREATH, FIBROSIS, AND IRREVERSIBLE RENAL TUBULAR DAMAGE WITH ANURIA, PROTEINURIA, AND OTHER SIGNS OF RENAL DYSFUNCTION. OTHER EFFECTS MAY INCLUDE RHINITIS, YELLOW DISCOLORATION OF THE TEETH, OCCASIONAL ULCERATION OF THE NASAL SEPTUM AND DAMAGE TO THE OLFACTORY NERVE POSSIBLY LEADING TO THE LOSS OF SENSE OF SMELL (ANOSMIA), ANEMIA, EOSINOPHILIA, BONE CHANGES SUCH AS OSTEOMALCIA, KIDNEY STONES, CARDIOVASCULAR EFFECTS AND LIVER DAMAGE. THE INCIDENCE OF PROSTATE AND RESPIRATORY TRACT CANCERS IS INCREASED IN WORKERS EXPOSED TO CADMIUM. REPEATED EXPOSURE BY PREGNANT RATS PRODUCED ADVERSE EFFECTS ON BEHAVORIAL, SURVIVIAL, AND GROWTH STATISTICS IN THE OFFSPRING.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
CADMIUM OXIDE:

ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE IRRITATION, REDNESS AND PAIN.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:

CADMIUM OXIDE:
ACUTE EXPOSURE- MAY CAUSE IRRITATION, SMARTING, REDNESS AND PAIN, BUT LOCAL INJURY HAS NOT BEEN REPORTED.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CADMIUM OXIDE:
NEPHROTOXIN/TOXIC
ACUTE EXPOSURE- INGESTON MAY CAUSE NAUSEA AND VOMITING, DIARRHEA, ABDOMINAL PAIN, HEADACHE, DIZZINESS, SALIVATION, MUSLCE CRAMPS, SHOCK, COLLAPSE, LIVER DAMAGE AND RENAL AND CARDIOPULMONARY FAILURE.
CHRONIC EXPOSURE - MAY CAUSE OSTEOMALACIA, PAINFUL FRACTURES, AND LIVER AND KIDNEY DAMAGE. CADMIUM-INDUCED KIDNEY DAMAGE IS IRREVERSIBLE AND MAY GROW WORSE EVEN AFTER EXPOSURE HAS CEASED.

FIRST AID- GIVE MILK OR BEATEN EGGS EVERY 4 HOURS TO RELIEVE GASTROINTESTINAL IRRITATION. REMOVE UNABSORBED CADMIUM BY CATHARSIS WITH FLEET'S PHOSPHO-SODA, 30-60 ML DILUTED 1:4 IN WATER. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.) TREATMENT MUST BE ADMINISTERED MEDICAL PERSONNEL.

ANTIDOTE:
THE FOLLOWING ANTIDOTE HAS BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

CADMIUM POISONING:
DO NOT GIVE DIMERCAPROL. IF SYMPTOMS PERSIST, THE ADMINISTRATION OF CALCIUM DISODIUM EDETATE IS RECOMMENDED. GIVE 15-25 MG/KG (0.08-0.125 ML OF 20% SOLUTION PER KILOGRAM OF BODY WEIGHT) IN 250-500 ML OF 5% DEXTROSE INTRAVENOUSLY OVER A 1 TO 2 HOUR PERIOD, TWICE DAILY. THE MAXIMUM DOSE SHOULD NOT EXCEED 50 MG/KG/DAY. THE DRUG SHOULD BE GIVEN IN 5-DAY COURSES WITH A REST PERIOD OF AT LEAST 2 DAYS BETWEEN COURSES. AFTER THE FIRST COURSE, SUBSEQUENT COURSES SHOULD NOT EXCEED 50 MG/KG/DAY. DAILY URINALYSES SHOULD BE DONE DURING THE TREATMENT PERIOD. THE DOSAGE SHOULD BE REDUCED IF ANY UNUSUAL URINARY FINDINGS APPEAR. INTRAVENOUS ADMINISTRATION IS CONTRA-INDICATED IN THE PRESENCE OF ELEVATED CEREBROSPINAL FLUID PRESSURE.
FOR INTRAMUSCULAR ADMINISTRATION, GIVE 20% SOLUTION (200 MG/ML), 12.5 MG/KG BODY WEIGHT EVERY 4-6 HOURS. DILUTE EACH DOSE WITH AN EQUAL VOLUME OF 1% PROCAINE. DOSE LIMITATION IS THE SAME AS THAT GIVEN ABOVE (DREISBACH, HANDBOOK OF POISONING, 11TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
CADMIUM OXIDE:
MAGNESIUM: MAY REDUCE CADMIUM OXIDE EXPLOSIVELY ON HEATING.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CADMIUM.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.

SPILLS AND LEAKS

WATER-SPILL:
THE CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (PROPOSITION 65) PROHIBITS CONTAMINATING ANY KNOWN SOURCE OF DRINKING WATER WITH SUBSTANCES KNOWN TO CAUSE CANCER AND/OR REPRODUCTIVE TOXICITY.

OCCUPATIONAL-SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 1 POUND
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROCESS ENCLOSURE RECOMMENDED TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

CADMIUM DUST AND FUME (AS CD):
AT ANY DETECTABLE CONCENTRATION:

ANY SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
ANY SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH HIGH-EFFICIENCY PARTICULATE FILTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED BY- OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 11/06/84 REVISION DATE: 04/12/89

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OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 1308-38-9
RTEC-NUMBER GB6475000

SUBSTANCE: CHROMIUM(III) OXIDE

TRADE NAMES/SYNONYMS:
CHROMIUM OXIDE: CHROMIC OXIDE: DICHROMIUM TRIOXIDE: CHROME OXIDE: ANADOMIS GREEN: CASALIS GREEN OXIDE PIGMENT: CHROMIA: CHROMIUM SESQUIOXIDE: GREEN ROUGE: CHROMIUM(III) OXIDE(2:3): CHROMIUM(3+) TRIOXIDE: CHROMIUM OXIDE PIGMENT: CHROMIC ACID GREEN: NA 1463: C-333: C-334: OHS05060

CHEMICAL FAMILY:
METAL OXIDE

MOLECULAR FORMULA: CR2-03 MOLECULAR WEIGHT: 151.99

CERCLA RATINGS (SCALE 0-3): HEALTH=U FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=U FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: CHROMIUM(III) OXIDE PERCENT: 100.0

EXPOSURE LIMIT:
CHROMIUM (III) OXIDE:
1.0 MG/(CR)/M3 OSHA TWA
0.5 MG(CR)/M3 ACGIH TWA

PHYSICAL DATA

DESCRIPTION: LIGHT TO DARK GREEN CRYSTALS

BOILING POINT: 7232 F (4000 C) MELTING POINT: 4415 F (2435 C)

SPECIFIC GRAVITY: 5.21 SOLUBILITY IN WATER: INSOLUBLE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:

DRY CHEMICAL, CARBON DIOXIDE OR WATER SPRAY
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGE FIRES, USE WATER SPRAY OR FOG
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAME WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES (1984 EMRGENCY RESPONSE GUIDEBOOK, DOT 5800.3, GUIDE PAGE 42).

USE FLOODING QUANTITIES OF WATER; APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING DUSTS.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-E

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

CHROMIUM (III) OXIDE:
MUTAGENIC DATA (RTECS); TUMORIGENIC DATA (RTECS); INDEFINITE ANIMAL CARCINOGEN (IARC). THERE IS SUFFICIENT EVIDENCE OF RESPIRATORY CARCINOGENICITY IN MEN OCCUPATIONALLY EXPOSED DURING CHROMATE PRODUCTION. THE EPIDEMIOLOGICAL DATA DO NOT ALLOW AN EVALUATION OF THE RELATIVE CONTRIBUTIONS TO CARCINOGENIC RISK OF METALLIC CHROMIUM, CHROMIUM (III) AND CHROMIUM (VI) OR OF SOLUBLE VERSUS INSOLUBLE CHROMIUM COMPOUNDS.
INSOLUBLE CHROMIUM COMPOUNDS ARE RESPIRATORY IRRITANTS AND MAY CAUSE CHRONIC RESPIRATORY DISEASE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CHROMIUM (III) OXIDE:
500 MG(CR)/M3 IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- SOME CHROMIUM (III) COMPOUNDS MAY CAUSE IRRITATION AND PULMONARY EDEMA AFTER HIGH CONCENTRATIONS.
CHRONIC EXPOSURE- HISTOLOGIC FIBROSIS OF THE LUNGS MAY OCCUR, PROGRESSING TO PNEUMOCONIOSIS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
CHROMIUM (III) OXIDE:
ACUTE EXPOSURE- NO DATA AVAILABLE.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CHROMIUM (III) OXIDE:
ACUTE EXPOSURE- NO DATA AVAILABLE.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CHROMIUM (III) OXIDE:
ACUTE EXPOSURE- THE TOXICITY OF CHROMIUM COMPOUNDS DEPENDS UPON THE VALENCE STATE OF THE METAL. CHROMIUM METAL IS POORLY ABSORBED BY THE BODY SINCE IT IS IN THE ZERO VALENCE STATE. NO EFFECTS ARE KNOWN IN HUMANS.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD LOWER THAN HIPS TO PREVENT ASPIRATION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
CHROMIUM (III) OXIDE:
CHLORINE TRIFLUORIDE: REACTS WITH INCANDESCENCE.
COPPER OXIDE: RAPID EXOTHERM AND AUTOIGNTION.
GLYCEROL: MAY PRODUCE AN EXPLOSION.
LITHIUM: EXOTHERMIC REACTION.
NITROALKANES: INCREASE THE SENSITIVITY AND LOWERS IGNITION TEMPERATURE.
OXYGEN DIFLUORIDE: VIGOROUS REACTION.
RUBIDIUM ACETYLIDE: REACTS EXOTHERMICALLY.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE TOXIC AND/OR HAZARDOUS GASES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

CONDITIONS TO AVOID

MAY BURN RAPIDLY AND IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTION WITH FUELS MAY BE VIOLENT.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

SPILLS AND LEAKS

SOIL-RELEASE:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

USE PROTECTIVE COVER SUCH AS A PLASTIC SHEET TO PREVENT MATERIAL FROM DISSOLVING IN FIRE EXTINGUISHING WATER OR RAIN.

WATER-SPILL:
USE ACTIVATED CARBON TO ABSORB SPILLED SUBSTANCE THAT IS DISSOLVED.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL-SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

CHROMIUM, METAL AND INSOLUBLE SALTS (AS CR):

0.25 MG(CR)/M3- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.
ANY DUST AND MIST RESPIRATOR EXCEPT SINGLE-USE AND QUARTER-MASK RESPIRATORS.

0.625 MG(CR)/M3- ANY POWERED AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SUPPLIED-AIR RESPITATOR OPERATED IN A CONTIUOUS FLOW MODE.

1.25 MG(CR)/M3- ANY AIR-PURIFYING FULL FACEPIECE WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY POWERED AIR-PURIFYING RESPIRATOR WITH A TIGHT-FITTING FACEPIECE AND A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

25 MG(CR)/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A HALF-MASK AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

50 MG(CR)/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 11/09/84 REVISION DATE: 09/01/87

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MATERIAL SAFETY DATA SHEET OHS12510

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212) 967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615) 292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 7439-92-1
RTEC-NUMBER OF7525000

SUBSTANCE: LEAD

TRADE NAMES/SYNONYMS:
C.I. PIGMENT METAL 4: C.I. 77575: LEAD FLAKE: KS-4: LEAD S 2: SI: SO: PLUMBUM: SO: PB-S 100: LEAD ELEMENT: L-18: L-24: L-29: L-27: T-134: PB: OHS12510

CHEMICAL FAMILY:
METAL

MOLECULAR FORMULA: PB MOLECULAR WEIGHT: 207.19

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: LEAD PERCENT: 99.8

OTHER CONTAMINANTS: BISMUTH, COPPER, ARSENIC, ANTIMONY, TIN, IRON, SILVER, ZINC

EXPOSURE LIMIT:
LEAD, INORGANIC FUMES AND DUST (AS PB):
50 UG(PB)/M3 OSHA 8 HOUR TWA
30 UG(PB)/M3 OSHA 8 HOUR TWA ACTION LEVEL
IF AN EMPLOYEE IS EXPOSED TO LEAD FOR MORE THAN 8 HOURS PER DAY THE FOLLOWING FORMULA IS USED:
MAXIMUM PERMISSIBLE LIMIT (IN UG/M3)= 400 DIVIDED BY HOURS WORKED IN THE DAY
0.15 MG(PB)/M3 ACGIH TWA
<0.10 MG(PB)/M3 NIOSH RECOMMENDED 10 HOUR TWA

1 POUND CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING
SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY WARNING AND RELEASE REQUIRMENTS- (FEBRUARY 27, 1987)

PHYSICAL DATA

DESCRIPTION: BLUISH-WHITE, SILVERY GRAY, HEAVY, MALLEABLE METAL

BOILING POINT: 3164 F (1740 C) MELTING POINT: 622 F (328 C)

SPECIFIC GRAVITY: 11.3 SOLUBILITY IN WATER: INSOLUBLE

VAPOR PRESSURE: 1.3 MMHG @ 970 C

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
SOLUBLE IN NITRIC ACID, HOT CONCENTRATED SULFURIC ACID

OTHER PHYSICAL DATA
HARDNESS: 1.5 MOHS

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD IN METALLIC FORM; HOWEVER, POSSIBLE FIRE AND EXPLOSION HAZARD IN DUST FORM WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1997 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
NO ACUTE HAZARD. MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. AVOID BREATHING VAPORS OR DUSTS; KEEP UPWIND.

USE AGENTS SUITABLE FOR TYPE OF SURROUNDING FIRE. AVOID BREATHING HAZARDOUS VAPORS, KEEP UPWIND.

TOXICITY

LEAD:
150 MG/KG/6 YEAR ORAL-WOMAN TDLO; 10 UG/M3 INHALATION-HUMAN TCLO; 1000 MG/KG INTRAPERITONEAL-RAT LDLO; 160 MG/KG ORAL-PIGEON LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: HUMAN INADEQUATE EVIDENCE, ANIMAL SUFFICIENT EVIDENCE (IARC CLASS-2B FOR INORGANIC LEAD COMPOUNDS). RENAL TUMORS WERE PRODUCED IN ANIMALS BY LEAD ACETATE, SUBACETATE AND PHOSPHATE GIVEN ORALLY, SUBCUTANEOUSLY OR INTRAPERITONEALLY. NO EVALUATION COULD BE MADE OF THE CARCINOGENICITY OF POWDERED LEAD.
LEAD IS A NEUROTOXIN, NEPHROTOXIN, TERATOGEN, AND A CUMULATIVE POISON WHICH MAY ALSO AFFECT THE BLOOD, HEART, ENDOCRINE, AND IMMUNE SYSTEMS. PERSONS WITH NERVOUS SYSTEM OR GASTROINTESTINAL DISORDERS, ANEMIA, OR CHRONIC BRONCHITIS MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
LEAD:

NEUROTOXIN/NEPHROTOXIN/TERATOGEN.

ACUTE EXPOSURE- INHALATION OF LARGE AMOUNTS OF LEAD MAY CAUSE A METALLIC TASTE, THIRST, A BURNING SENSATION IN THE MOUTH AND THROAT, SALIVATION, ABDOMINAL PAIN WITH SEVERE COLIC, VOMITING, BLOODY DIARRHEA, CONSTIPATION, FATIGUE, SLEEP DISTURBANCES, DULLNESS, RESTLESSNESS, IRRITABILITY, MEMORY LOSS, LOSS OF CONCENTRATION, DELIRIUM, OLIGURIA OFTEN WITH HEMATURIA AND ALBUMINURIA, ENCEPHALOPATHY WITH VISUAL FAILURE, PARESTHESIAS, MUSCLE PAIN AND WEAKNESS, CONVULSIONS, AND PARALYSIS. DEATH MAY RESULT FROM CARDIORESPIRATORY ARREST OR SHOCK. SURVIVORS OF ACUTE EXPOSURE MAY EXPERIENCE THE ONSET OF CHRONIC INTOXICATION. LIVER EFFECTS MAY INCLUDE ENLARGEMENT AND TENDERNESS AND JAUNDICE. THE FATAL DOSE OF ABSORBED LEAD IS APPROXIMATELY 0.5 GRAMS. PATHOLOGICAL FINDINGS INCLUDE GASTROINTESTINAL INFLAMMATION AND RENAL TUBULAR DEGENERATION. METAL FUME FEVER, AN INFLUENZA-LIKE ILLNESS, MAY OCCUR DUE TO THE INHALATION OF FRESHLY FORMED METAL OXIDE PARTICLES SIZED BELOW 1.5 MICRONS AND USUALLY BETWEEN 0.02-0.05 MICRONS. SYMPTOMS MAY BE DELAYED 4-12 HOURS AND BEGIN WITH A SUDDEN ONSET OF THIRST AND A SWEET, METALLIC OR FOUL TASTE IN THE MOUTH. OTHER SYMPTOMS MAY INCLUDE UPPER RESPIRATORY TRACT IRRITATION ACCOMPANIED BY COUGHING AND A DRYNESS OF THE MUCOUS MEMBRANES, LASSITUDE AND A GENERALIZED FEELING OF MALAISE. FEVER, CHILLS, MUSCULAR PAIN, MILD TO SEVERE HEADACHE, NAUSEA, OCCASIONAL VOMITING, EXAGGERATED MENTAL ACTIVITY, PROFUSE SWEATING, EXCESSIVE URINATION, DIARRHEA, AND PROSTRATION MAY ALSO OCCUR. TOLERANCE TO FUMES DEVELOPS RAPIDLY, BUT IS QUICKLY LOST. ALL SYMPTOMS USUALLY SUBSIDE WITHIN 24-36 HOURS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO LOW LEVELS OF LEAD MAY RESULT IN AN ACCUMULATION IN BODY TISSUES AND EXERT ADVERSE EFFECTS ON THE BLOOD, NERVOUS SYSTEMS, HEART, ENDOCRINE AND IMMUNE SYSTEMS, KIDNEYS, AND REPRODUCTION. EARLY STAGES OF LEAD POISONING, "PLUMBISM", MAY BE EVIDENCED BY PALLOR, ANOREXIA, WEIGHT LOSS, CONSTIPATION, APATHY OR IRRITABILITY, OCCASIONAL VOMITING, FATIGUE, HEADACHE, WEAKNESS, METALLIC TASTE IN THE MOUTH, GINGIVAL LEAD LINE IN PERSONS WITH POOR DENTAL HYGIENE, AND ANEMIA. LOSS OF RECENTLY DEVELOPED MOTOR SKILLS IS GENERALLY OBSERVED ONLY IN CHILDREN. MORE ADVANCED STAGES OF POISONING MAY BE CHARACTERIZED BY INTERMITTENT VOMITING, IRRITABILITY AND NERVOUSNESS, MYALGIA OF THE ARMS, LEGS, JOINTS, AND ABDOMEN, PARALYSIS OF THE EXTENSOR MUSCLES OF THE ARMS AND LEGS WITH WRIST AND/OR FOOT DROP, AND INTESTINAL SPASMS WHICH CAUSE SEVERE ABDOMINAL PAIN. SEVERE "PLUMBISM" MAY RESULT IN PERSISTENT VOMITING, ATAXIA, PERIODS OF STUPOR OR LETHARGY, ENCEPHALOPATHY WITH VISUAL DISTURBANCES WHICH MAY PROGRESS TO OPTIC NEURITIS AND ATROPHY, HYPERTENSION, PAPILLEDEMA, CRANIAL NERVE PARALYSIS, DELIRIUM, CONVULSIONS, AND COMA. NEUROLOGIC SEQUELAE MAY INCLUDE MENTAL RETARDATION, SEIZURES, CEREBRAL PALSY, AND DYSTONIA MUSCULORAM DEFORMANS. IRREVERSIBLE KIDNEY DAMAGE HAS BEEN ASSOCIATED WITH INDUSTRIAL EXPOSURE. REPRODUCTIVE EFFECTS HAVE BEEN EXHIBITED IN BOTH MALES AND FEMALES. PATERNAL EFFECTS MAY INCLUDE DECREASED SEX DRIVE, IMPOTENCE, STERILITY, AND ADVERSE EFFECTS ON THE SPERM WHICH MAY INCREASE THE RISK OF BIRTH DEFECTS. MATERNAL EFFECTS MAY INCLUDE MISCARRIAGE AND STILLBIRTHS IN EXPOSED WOMEN OR WOMEN WHOSE HUSBANDS WERE EXPOSED, ABORTION, STERILITY OR DECREASED FERTILITY., AND ABNORMAL MENSTRUAL CYCLES. LEAD CROSSES THE PLACENTA AND MAY AFFECT THE FETUS CAUSING BIRTH DEFECTS, MENTAL RETARDATION, BEHAVIORAL DISORDERS, AND DEATH DURING THE FIRST YEAR OF CHILDHOOD. ANIMAL STUDIES INDICATE THAT REPRODUCTIVE EFFECTS MAY BE ADDITIVE IF BOTH PARENTS ARE EXPOSED TO LEAD.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:

.EAD:
ACUTE EXPOSURE- DIRECT CONTACT WITH LEAD POWDERS OR DUST MAY CAUSE IRRITATION. LEAD IS NOT ABSORBED THROUGH THE SKIN, BUT MAY BE TRANSFERRED TO THE MOUTH INADVERTENTLY BY CIGARETTES, CHEWING TOBACCO, FOOD, OR MAKE-UP.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO THE POWDER OR DUST MAY RESULT IN DERMATITIS. SYSTEMIC TOXICITY MAY DEVELOP IF LEAD IS TRANSFERRED TO THE MOUTH BY CIGARETTES, CHEWING TOBACCO, FOOD, OR MAKE-UP.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
.EAD:
ACUTE EXPOSURE- LEAD DUST OR POWDERS MAY CAUSE IRRITATION. METALLIC LEAD PARTICLES MAY CAUSE AN INFLAMMATORY FOREIGN BODY REACTION; INJURY IS GENERALLY THOUGHT TO BE MECHANICAL AND NOT TOXIC.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
.EAD:
NEUROTOXIN/NEPHROTOXIN/TERATOGEN.
ACUTE EXPOSURE- ABSORPTION OF LARGE AMOUNTS OF LEAD FROM THE INTESTINAL TRACT MAY CAUSE SYSTEMIC EFFECTS AS DETAILED IN ACUTE INHALATION. THE FATAL DOSE OF ABSORBED LEAD IS APPROXIMATELY 0.5 GRAMS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO LOW LEVELS OF LEAD MAY RESULT IN AN ACCUMULATION IN BODY TISSUES AND ADVERSE EFFECTS ON THE KIDNEYS, HEART, AND BLOOD, AND ON THE NERVOUS, REPRODUCTIVE, ENDOCRINE, AND IMMUNE SYSTEMS AS DETAILED IN CHRONIC INHALATION.

FIRST AID- DO NOT INDUCE VOMITING. QUALIFIED MEDICAL PERSONNEL SHOULD REMOVE CHEMICAL BY GASTRIC LAVAGE OR CATHARSIS. ACTIVATED CHARCOAL IS USEFUL. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
THE FOLLOWING ANTIDOTE HAS BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

FOR LEAD POISONING:
INITIATE URINE FLOW FIRST. GIVE 10% DEXTROSE IN WATER INTRAVENOUSLY, 10-20 ML/KG BODY WEIGHT, OVER A PERIOD OF 1-2 HOURS. IF URINE FLOW DOES NOT START, GIVE MANNITOL, 20% SOLUTION, 5-10 ML/KG BODY WEIGHT INTRAVENOUSLY OVER 30 MINUTES. FLUID MUST BE LIMITED TO REQUIREMENTS AND CATHERTIZATION MAY BE NECESSARY IN COMA. DAILY URINE OUTPUT SHOULD BE 350-500 ML/M2/24 HOURS. EXCESSIVE FLUIDS FURTHER INCREASE CEREBRAL EDEMA.
FOR ADULTS WITH ACUTE ENCEPHALOPATHY, GIVE DIMERCAPROL, 4 MG/KG, INTRAMUSCULARLY EVERY 4 HOURS FOR 30 DOSES. BEGINNING 4 HOURS LATER, GIVE CALCIUM DISODIUM EDETATE AT A SEPERATE INJECTION SITE, 12.5 MG/KG INTRAMUSCULARLY EVERY 4 HOURS AS A 20% SOLUTION, WITH 0.5% PROCAINE ADDED, FOR A TOTAL OF 30 DOSES. IF SIGNIFICANT IMPROVEMENT HAS NOT OCCURRED BY THE FOURTH DAY, INCREASE THE NUMBER OF INJECTIONS BY 10 FOR EACH DRUG.
FOR SYMPTOMATIC ADULTS, THE COURSE OF DIMERCAPROL AND CALCIUM DISODIUM EDETATE CAN BE SHORTENED OR CALCIUM DISODIUM EDETATE ONLY CAN BE GIVEN IN

A DOSAGE OF 50 MG/KG INTRAVENOUSLY AS 0.5% SOLUTION IN 5% DEXTROSE IN WATER OR NORMAL SALINE BY INFUSION OVER NOT LESS THAN 8 HOURS FOR NOT MORE THAN 5 DAYS. FOLLOW WITH PENICILLAMINE, 500-750 MG/DAY, ORALLY FOR 1-2 MONTHS OR UNTIL URINE LEAD LEVELS DROPS BELOW 0.3 MG/24 HOURS (DREISBACH, HANDBOOK OF POISONING, 11TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
LEAD:
- AMMONIUM NITRATE: VIOLENT OR EXPLOSIVE REACTION.
- CHLORINE TRIFLUORIDE: VIOLENT REACTION.
- DISODIUM ACETYLIDE: TRITURATION IN MORTAR MAY BE VIOLENT AND LIBERATE CARBON.
- HYDROGEN PEROXIDE (52% OR GREATER): VIOLENT DECOMPOSITION.
- HYDROGEN PEROXIDE (60% SOLUTION) AND TRIOXANE: SPONTANEOUSLY DETONABLE.
- METALS (ACTIVE): INCOMPATIBLE.
- NITRIC ACID: LEAD-CONTAINING RUBBER MAY IGNITE.
- OXIDIZERS (STRONG): INCOMPATIBLE.
- SODIUM AZIDE: FORMS LEAD AZIDE AND COPPER AZIDE IN COPPER PIPE.
- SODIUM CARBIDE: VIGOROUS REACTION.
- SULFURIC ACID (HOT): REACTS.
- ZIRCONIUM-LEAD ALLOYS: IGNITION ON IMPACT.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS ARE TOXIC OXIDES OF LEAD.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.

SPILLS AND LEAKS

WATER-SPILL:
THE CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (PROPOSITION 65) PROHIBITS CONTAMINATING ANY KNOWN SOURCE OF DRINKING WATER WITH SUBSTANCES KNOWN TO CAUSE CANCER AND/OR REPRODUCTIVE TOXICITY.

OCCUPATIONAL-SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

RESIDUE SHOULD BE CLEANED UP USING A HIGH-EFFICIENCY PARTICULATE FILTER VACUUM.

REPORTABLE QUANTITY (RQ): 1 POUND
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

LEAD (ELEMENTAL, INORGANIC, AND SOAPS):
VENTILATION SHOULD MEET THE REQUIREMENTS IN 29CFR1910.1025(E).

RESPIRATOR:
THE FOLLOWING RESPIRATORS ARE THE MINIMUM LEGAL REQUIREMENTS AS SET FORTH BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION FOUND IN 29 CFR1910, SUBPART Z.

RESPIRATORY PROTECTION FOR LEAD AEROSOLS

AIRBORNE CONCENTRATION OF LEAD OR CONDITION OF USE	REQUIRED RESPIRATOR
NOT IN EXCESS OF 0.5 MG/M3 (10X PEL)	HALF-MASK, AIR PURIFYING RESPIRATOR EQUIPPED WITH HIGH-EFFICIENCY FILTERS.
NOT IN EXCESS OF 2.5 MG/M3 (50X PEL)	FULL FACEPIECE, AIR-PURIFYING RESPIRATOR WITH HIGH EFFICIENCY FILTERS.

NOT IN EXCESS OF 50 MG/M3 (1000X PEL)	ANY POWERED AIR-PURIFYING RESPIRATOR WITH HIGH EFFICIENCY FILTERS; OR HALF-MASK SUPPLIED-AIR RESPIRATOR OPERATED IN POSITIVE-PRESSURE MODE.
NOT IN EXCESS OF 100 MG/M3	SUPPLIED-AIR RESPIRATORS WITH FULL FACEPIECE, HOOD OR HELMET OR SUIT, OPERATED IN POSITIVE PRESSURE MODE.
GREATER THAN 100 MG/M3, UNKNOWN CONCENTRATIONS OR FIREFIGHTING	FULL FACEPIECE, SELF-CONTAINED BREATHING APPARATUS OPERATED IN POSITIVE-PRESSURE MODE.

(RESPIRATORS SPECIFIED FOR HIGHER CONCENTRATIONS CAN BE USED AT LOWER CONCENTRATIONS OF LEAD).
(FULL FACEPIECE IS REQUIRED IF THE LEAD AEROSOLS CAUSE EYE OR SKIN IRRITATION AT THE USE CONCENTRATIONS.)
(A HIGH EFFICIENCY PARTICULATE FILTER MEANS 99.97% EFFICIENT AGAINST 0.3 MICRON PARTICLES.)

THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

LEAD, INORGANIC FUMES AND DUSTS (AS PB):

0.50 MG(PB)/M3- ANY SUPPLIED-AIR RESPIRATOR.
ANY AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SELF-CONTAINED BREATHING APPARATUS.

1.25 MG(PB)/M3- ANY POWERED AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

2.50 MG(PB)/M3- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY POWERED AIR-PURIFYING RESPIRATOR WITH A TIGHT-FITTING FACEPIECE AND A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A TIGHT-FITTING FACEPIECE OPERATED IN A CONTINUOUS FLOW MODE.

50.0 MG(PB)/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A HALF-MASK AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

100.0 MG(PB)/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A

HIGH-EFFICIENCY PARTICULATE FILTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

LEAD (ELEMENTAL, INORGANIC, AND SOAPS):
PROTECTIVE CLOTHING SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29CFR1910.1025(G).

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

LEAD (ELEMENTAL, INORGANIC & SOAPS):
PROTECTIVE GLOVES SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29CFR1910.1025(G).

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

LEAD (ELEMENTAL, INORGANIC, AND SOAPS):
PROTECTIVE EYE EQUIPMENT SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29CFR1910.1025(G).

AUTHORIZED BY- OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 12/10/84 REVISION DATE: 03/15/89

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MATERIAL SAFETY DATA SHEET OHS14020

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212) 967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615) 292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 7439-97-6
RTEC-NUMBER OV4550000

SUBSTANCE: MERCURY

TRADE NAMES/SYNONYMS:
COLLOIDAL MERCURY: METALLIC MERCURY: NCI-C60399: QUICKSILVER: INORGANIC MERCURY: RCRA U151: NA 2809: HYDRARGYRUM: ELEMENTAL MERCURY: M-141: M-139: M-140: UN 2809: HG: OHS14020

CHEMICAL FAMILY:
METAL

MOLECULAR FORMULA: HG MOLECULAR WEIGHT: 200.59

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: MERCURY PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
MERCURY, ALL FORMS EXCEPT ALKYL (AS HG):
0.05 MG/M3 OSHA TWA (VAPOR); 0.1 MG/M3 OSHA CEILING (SKIN)
0.05 MG/M3 ACGIH TWA (VAPOR); 0.10 MG/M3 ACGIH TWA (ARYL & INORGANIC)-(SKIN)
0.05 MG/M3 NIOSH RECOMMENDED 10 HOUR TWA

SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

MERCURY:
1 POUND CERCLA SECTION 103 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: ODORLESS, SILVERY LIQUID WITH A METALLIC LUSTER.

BOILING POINT: 674 F (357 C) MELTING POINT: -38 F (-39 C)

SPECIFIC GRAVITY: 13.5939 SOLUBILITY IN WATER: INSOLUBLE

VAPOR DENSITY: 7.0 VAPOR PRESSURE: 0.002 MMHG @ 25 C

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
SOLUBLE IN BOILING SULFURIC ACID, NITRIC ACID, LIPIDS;

INSOLUBLE IN ALCOHOL, ETHER, HYDROCHLORIC ACID, HYDROGEN BROMIDE, HYDROGEN IODIDE.

OTHER PHYSICAL DATA
VISCOSITY: 1.55 CPS @ 20 C

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 60).

USE AGENTS SUITABLE FOR TYPE OF FIRE; USE WATER IN FLOODING AMOUNTS AS A FOG. AVOID BREATHING CORROSIVE AND POISONOUS VAPORS, KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-B

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND SUBPART E:
NONE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.860
EXCEPTIONS: NONE

TOXICITY

MERCURY:
150 UG/M3/46 DAYS INHALATION-WOMAN TCLO; 29 MG/M3/30 HOURS INHALATION-RABBIT LCLO; 44,300 UG/M3/8 HOURS INHALATION-MAN TCLO; 129 MG/KG/5 HOURS CONTINUOUSLY SKIN-MAN TDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS).
CARCINOGEN STATUS: NONE.
MERCURY IS A SKIN AND RESPIRATORY TRACT SENSITIZER, NEUROTOXIN AND NEPHROTOXIN. PERSONS WITH CHRONIC RESPIRATORY DISEASE, NERVOUS SYSTEM DISORDERS AND KIDNEY DISEASE MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
MERCURY:
IRRITANT/SENSITIZER/NEUROTOXIN/NEPHROTOXIN.
28 MG/M3 IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INHALATION OF HIGH LEVELS OF MERCURY VAPOR MAY CAUSE ALMOST IMMEDIATE DYSPNEA, COUGH, FEVER, NAUSEA, VOMITING, DIARRHEA, HEADACHE, STOMATITIS, SALIVATION, GINGIVITIS, A METALLIC TASTE, AND CARDIAC ABNORMALITIES. RESPIRATORY IRRITATION MAY OCCUR WITH CHEST PAIN AND TIGHTNESS. SYMPTOMS MAY RESOLVE OR MAY PROGRESS TO NECROTIZING BRONCHIOLITIS, PNEUMONITIS, PULMONARY EDEMA, PNEUMOTHORAX, INTERSTITIAL FIBROSIS, AND DEATH. ACIDOSIS AND RENAL DAMAGE MAY ALSO OCCUR. ALLERGIC REACTIONS THAT MAY OCCUR IN PREVIOUSLY EXPOSED PERSONS INCLUDE DERMATITIS, ENCEPHALITIS, AND DEATH.
METAL FUME FEVER, AN INFLUENZA-LIKE ILLNESS, MAY OCCUR DUE TO THE INHALATION OF FRESHLY FORMED METAL OXIDE PARTICLES SIZED BELOW 1.5 MICRONS AND USUALLY BETWEEN 0.02-0.05 MICRONS. SYMPTOMS MAY BE DELAYED 4-12 HOURS AND BEGIN WITH A SUDDEN ONSET OF THIRST, AND A SWEET, METALLIC OR FOUL TASTE IN THE MOUTH. OTHER SYMPTOMS MAY INCLUDE UPPER RESPIRATORY TRACT IRRITATION ACCOMPANIED BY COUGHING AND A DRYNESS OF THE MUCOUS MEMBRANES, LASSITUDE AND A GENERALIZED FEELING OF MALAISE. FEVER, CHILLS, MUSCULAR PAIN, MILD TO SEVERE HEADACHE, NAUSEA, OCCASIONAL VOMITING, EXAGGERATED MENTAL ACTIVITY, PROFUSE SWEATING, EXCESSIVE URINATION, DIARRHEA AND PROSTRATION MAY ALSO OCCUR. TOLERANCE TO FUMES DEVELOPS RAPIDLY, BUT IS QUICKLY LOST. ALL SYMPTOMS USUALLY SUBSIDE WITHIN 24-36 HOURS.
CHRONIC EXPOSURE- INHALATION OF MERCURY VAPOR OVER A LONG PERIOD MAY CAUSE MERCURIALISM, WHICH IS CHARACTERIZED BY FINE TREMORS AND ERETHISM. TREMORS MAY AFFECT THE HANDS FIRST, BUT MAY ALSO BECOME EVIDENT IN THE FACE, ARMS, AND LEGS. ERETHISM MAY BE MANIFESTED BY ABNORMAL SHYNESS, BLUSHING, SELF-CONSCIOUSNESS, DEPRESSION OR DESPONDENCY, RESENTMENT OF CRITICISM, IRRITABILITY OR EXCITABILITY, HEADACHE, FATIGUE, AND INSOMNIA. IN SEVERE CASES, HALLUCINATIONS, LOSS OF MEMORY, AND MENTAL DETERIORATION MAY OCCUR. CONCENTRATIONS AS LOW AS 0.03 MG/M3 HAVE INDUCED PSYCHIATRIC SYMPTOMS IN HUMANS. RENAL INVOLVEMENT MAY BE INDICATED BY PROTEINURIA, ALBUMINURIA, ENZYMURIA, AND ANURIA. OTHER EFFECTS MAY INCLUDE SALIVATION, GINGIVITIS, STOMATITIS, LOOSENING OF THE TEETH, BLUE LINES ON THE GUMS, DIARRHEA, WEIGHT LOSS, ANOREXIA, SPEECH AND SENSORY DISORDERS, UNSTEADY GAIT, CHRONIC PNEUMONITIS AND MILD ANEMIA. REPEATED EXPOSURE TO MERCURY AND ITS COMPOUNDS MAY RESULT IN SENSITIZATION. INTRAUTERINE EXPOSURE MAY RESULT IN TREMORS AND INVOLUNTARY MOVEMENTS IN THE INFANTS. MERCURY IS EXCRETED IN BREAST MILK. PATERNAL REPRODUCTIVE EFFECTS AND EFFECTS ON FERTILITY HAVE BEEN REPORTED IN MALE RATS FOLLOWING REPEATED INHALATION EXPOSURES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
MERCURY:
SENSITIZER/NEUROTOXIN/NEPHROTOXIN.
ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID MAY CAUSE IRRITATION AND REDNESS. SMALL AMOUNTS OF MERCURY MAY BE ABSORBED THROUGH INTACT

SKIN. ALLERGIC REACTIONS THAT MAY OCCUR IN PREVIOUSLY EXPOSED PERSONS INCLUDE DERMATITIS, ENCEPHALITIS, AND DEATH. SUBCUTANEOUS INTRODUCTION, FROM HANDLING BROKEN THERMOMETERS, MAY RESULT IN LOCAL INFLAMMATION, GRANULOMATOUS SKIN REACTIONS, AND SLIGHT SIGNS OF MERCURY POISONING INCLUDING DIGESTIVE DISORDERS, METALLIC TASTE IN THE MOUTH, AND NEUROPSYCHIC DISORDERS.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY RESULT IN DERMAL SENSITIZATION AND SYSTEMIC EFFECTS AS DETAILED IN CHRONIC INHALATION EXPOSURE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
MERCURY:

ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID MAY CAUSE IRRITATION AND REDNESS. ANIMAL STUDIES INDICATE DIFFUSION AND ABSORPTION OF MERCURY INTO THE TISSUES OF THE EYE MAY OCCUR. NO CLINICAL SIGNS OF CONJUNCTIVITIS OR INFLAMMATION OCCURRED.

CHRONIC EXPOSURE- MERCURY EXPOSURE FROM INHALATION, INGESTION, OR SKIN CONTACT MAY BE INDICATED BY MERCURIALENTIS, DISCOLORATION OF THE CRYSTALLINE LENS, ON SLIT LAMP EXAMINATION OF THE EYE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
MERCURY:
NEUROTOXIN/NEPHROTOXIN.

ACUTE EXPOSURE- MAY CAUSE BURNING OF THE MOUTH AND THROAT, THIRST, NAUSEA AND VOMITING. METALLIC MERCURY IS NOT USUALLY ABSORBED SUFFICIENTLY FROM THE GASTROINTESTINAL TRACT TO INDUCE AN ACUTE TOXIC RESPONSE. RARELY, A LARGE SINGLE DOSE MAY RESULT IN SIGNS AND SYMPTOMS OF CHRONIC INHALATION IF SUFFICIENT AMOUNTS OF MERCURY ARE RETAINED IN THE BODY.

CHRONIC EXPOSURE- REPEATED INGESTION OF SMALL AMOUNTS OF MERCURY MAY RESULT IN THE ABSORPTION OF SUFFICIENT AMOUNTS TO PRODUCE TOXIC EFFECTS AS DETAILED IN CHRONIC INHALATION EXPOSURE.

FIRST AID- REMOVE BY GASTRIC LAVAGE OR EMESIS. MAINTAIN BLOOD PRESSURE AND AIRWAY. GIVE OXYGEN IF RESPIRATION IS DEPRESSED. DO NOT PERFORM GASTRIC LAVAGE OR EMESIS IF VICTIM IS UNCONSCIOUS. GET MEDICAL ATTENTION IMMEDIATELY. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.) ADMINISTRATION OF GASTRIC LAVAGE OR OXYGEN SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL.

ANTIDOTE:
THE FOLLOWING ANTI

DOTE HAS BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

MERCURY POISONING:
GIVE DIMERCAPROL, 3 MG/KG (OR 0.3 ML/KG) EVERY 4 HOURS FOR THE FIRST 2 DAYS AND THEN 2 MG/KG EVERY 12 HOURS FOR A TOTAL OF 10 DAYS. DIMERCAPROL IS AVAILABLE AS A 10% SOLUTION IN OIL FOR INTRAMUSCULAR ADMINISTRATION. HEMODIALYSIS WILL SPEED THE REMOVAL OF THE MERCURY-DIMERCAPROL COMPLEX. PENICILLAMINE IS ALSO EFFECTIVE. GIVE UP TO 100 MG/KG/DAY (MAXIMUM 1 GRAM/DAY) DIVIDED INTO 4 DOSES FOR NO LONGER THAN 1 WEEK. IF A LONGER ADMINISTRATION

PERIOD IS WARRANTED, DOSAGE SHOULD NOT EXCEED 40 MG/KG/DAY. GIVE THE DRUG ORALLY HALF AN HOUR BEFORE MEALS. A CHELATING AGENT SHOULD BE CONTINUED UNTIL THE URINE-MERCURY LEVEL FALLS BELOW 50 UG/24 HOURS (DREISBACH, HANDBOOK OF POISONING, 11TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
MERCURY:
- ACETYLENE: FORMATION OF EXPLOSIVE COMPOUND.
- ACETYLINIC COMPOUNDS: FORMATION OF EXPLOSIVE COMPOUND.
- ALUMINUM: CORRODES.
- AMINES: MAY FORM EXPLOSIVE COMPOUNDS.
- AMMONIA + MOISTURE: FORMS EXPLOSIVE COMPOUND.
- BORON DIIODPHOSPHIDE: IGNITES IN CONTACT WITH MERCURY VAPORS.
- BROMINE: VIOLENT REACTION.
- 3-BROMOPROPYNE: EXPLOSION HAZARD.
- CALCIUM: AMALGAM FORMATION @ 390 C IS VIOLENT.
- CHLORINE: IGNITES @ 200-300 C.
- CHLORINE DIOXIDE: EXPLODES.
- COPPER (AND ALLOYS): MAY BE ATTACKED.
- ETHYLENE OXIDE + TRACES OF ACETYLENE: MAY FORM EXPLOSIVE ACETYLIDES.
- LITHIUM: AMALGAM FORMATION IS VIOLENTLY EXOTHERMIC AND MAY BE EXPLOSIVE.
- METHYL AZIDE: PRODUCES SHOCK SENSITIVE MIXTURE.
- METHYLSILANE + OXYGEN: PRODUCES SHOCK SENSITIVE MIXTURE.
- NITRIC ACID + ALCOHOLS: FORMS FULMINATES CAPABLE OF DETONATION.
- OXALIC ACID: FORMS SHOCK SENSITIVE COMPOUND.
- OXIDANTS: VIOLENT REACTION.
- PEROXYFORMIC ACID: EXPLOSIVE REACTION.
- POTASSIUM: AMALGAM FORMATION IS VIGOROUSLY EXOTHERMIC AND MAY BE EXPLOSIVE.
- RUBIDIUM: VIOLENT EXOTHERMIC REACTION.
- SILVER PERCHLORATE + 3-HEXYNE: EXPLODES.
- SILVER PERCHLORATE + 2-PENTYNE: EXPLODES.
- SODIUM: AMALGAM FORMATION IS VIOLENTLY EXOTHERMIC.
- SODIUM CARBIDE: VIGOROUS REACTION.
- SULFURIC ACID (HOT): REACTS.
- TETRACARBONYLNICKEL + OXYGEN: PRODUCES SHOCK SENSITIVE MIXTURE.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE HIGHLY TOXIC VAPORS OF MERCURY AND MERCURY OXIDES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE

ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40CFR 262. EPA HAZARDOUS WASTE NUMBER U151.

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. MAY IGNITE COMBUSTIBLES (WOOD, PAPER, OIL, ETC.).

SPILLS AND LEAKS

OCCUPATIONAL-SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. A MERCURY SPILL KIT MAY ALSO BE USED FOR SMALL SPILLS IN THE WORKPLACE. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 1 POUND
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF

OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

MERCURY, ELEMENTAL:

0.5 MG/M3- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH CARTRIDGES PROVIDING PROTECTION AGAINST MERCURY.
ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

1.25 MG/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.
ANY POWERED AIR-PURIFYING RESPIRATOR WITH A CANISTER PROVIDING PROTECTION AGAINST MERCURY.

2.5 MG/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A TIGHT-FITTING FACEPIECE OPERATED IN A CONTINUOUS FLOW MODE.
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND CARTRIDGES PROVIDING PROTECTION AGAINST MERCURY.
ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST MERCURY.
ANY POWERED AIR-PURIFYING RESPIRATOR WITH A TIGHT-FITTING FACEPIECE AND A CANISTER PROVIDING PROTECTION AGAINST MERCURY.

28 MG/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A HALF-MASK AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST MERCURY.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE

EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED BY- OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 01/31/85 REVISION DATE: 04/12/89

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MATERIAL SAFETY DATA SHEET OHS20510

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NE RK, NEW YORK 10123
(8 445-MSDS (212) 967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615) 292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 7446-08-4
RTEC-NUMBER VS8575000

SUBSTANCE: SELENIUM DIOXIDE

TRADE NAMES/SYNONYMS:
SELENIOUS ANHYDRIDE: SELENIUM OXIDE: SELENIUM OXIDE DIMER:
SELENIUM(IV) DIOXIDE (1:2): U204: OHS20510

CHEMICAL FAMILY:
NON-METALLIC OXIDE

MOLECULAR FORMULA: SE-02 MOLECULAR WEIGHT: 110.09

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

CO ENT: SELENIUM DIOXIDE CAS 7446-08-4 PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
SELENIUM DIOXIDE:
0.2 MG(SE)/M3 OSHA TWA
0.2 MG(SE)/M3 ACGIH TWA

10 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: WHITE TO SLIGHTLY REDDISH, LUSTROUS CRYSTALLINE POWDER OR NEEDLES WITH AN ACIDIC TASTE.

MELTING POINT: 662 F (350 C) SUBL. SPECIFIC GRAVITY: 3.954 @ 15 C

SOLUBILITY IN WATER: 38.4 @ 14 CC VAPOR PRESSURE: 12.5 MMHG @ 70 C

PH: ACIDIC ODOR-THRESHOLD: 0.0002 MG/M3

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
AL .., METHANOL, ACETONE, ACETIC ACID, BENZENE.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 53).

EXTINGUISH USING AGENT SUITABLE FOR TYPE OF SURROUNDING FIRE. AVOID BREATHING VAPORS AND DUSTS. KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
POISON B

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND SUBPART E:

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.365
EXCEPTIONS: 49CFR173.364

TOXICITY

SELENIUM DIOXIDE:
5890 MG/M3/20 MINUTES INHALATION-RABBIT LCLO; 7500 UG/KG SUBCUTANEOUS-GERBIL
6590 MG/M3/10 MINUTES INHALATION-DOMESTIC ANIMAL LCLO; MUTAGENIC DATA (RTECS)
REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: HUMAN INADEQUATE EVIDENCE, ANIMAL INADEQUATE EVIDENCE (IARC CLASS-3).
SELENIUM DIOXIDE IS A SEVERE EYE, SKIN, AND MUCOUS MEMBRANE IRRITANT AND A SKIN SENSITIZER. POISONING MAY AFFECT THE LIVER AND KIDNEYS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
SELENIUM DIOXIDE:
CHRONIC:
ACUTE EXPOSURE- INHALATION MAY CAUSE IRRITATION OF THE NOSE AND THROAT FOLLOWED BY HEADACHE, TIGHTNESS IN THE CHEST, AND ANOSMIA. METALLIC TASTE, DYPSNEA, CHILLS, NAUSEA AND BRONCHITIS MAY ENSUE. AFTER A LATENT PERIOD OF

6 TO 8 HOURS, PULMONARY EDEMA AND DEATH MAY OCCUR.
CHRONIC EXPOSURE- SYMPTOMS OF CHRONIC EXPOSURE INCLUDE A GARLIC ODOR OF THE BREATH, METALLIC TASTE IN THE MOUTH, PALLOR, LASSITUDE, IRRITABILITY, VAGUE GASTROINTESTINAL SYMPTOMS (INDIGESTION), AND GIDDINESS. BASED ON RESULTS OF ANIMAL EXPERIMENTATION, LIVER AND KIDNEY DAMAGE SHOULD BE REGARDED AS POSSIBLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
SELENIUM DIOXIDE:
CORROSIVE/SENSITIZER.
ACUTE EXPOSURE- CONTACT MAY CAUSE SEVERE IRRITATION, EDEMA, PAIN, AND SKIN BURNS. SENSITIZATION DERMATITIS MAY OCCUR IN PREVIOUSLY EXPOSED PERSONS. ALLERGY TO SELENIUM DIOXIDE HAS BEEN REPORTED IN THE FORM OF AN URTICARIAL GENERALIZED RASH. SELENIUM OXIDE ALSO MAY PENETRATE UNDER THE FREE EDGE OF THE NAIL, CAUSING EXCRUCIATINGLY PAINFUL NAIL BEDS AND PAINFUL PARONYCHIA.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE SENSITIZATION DERMATITIS, VESICULATION AND SKIN DISCOLORATION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
SELENIUM DIOXIDE:
CORROSIVE.
ACUTE EXPOSURE- VAPORS ARE EXTREMELY IRRITATING TO THE EYES, CAUSING SEVERE IRRITATION AND LACRIMATION. DIRECT CONTACT WITH THE LIQUID MAY CAUSE BURNS OF THE EPITHELIUM AND CORNEA, AND TEMPORARY BLURRING OF VISION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO THE VAPORS MAY CAUSE A PINK DISCOLORATION OF THE EYELIDS AND PALPEBRAL CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
SELENIUM DIOXIDE:
CORROSIVE.
ACUTE EXPOSURE- INGESTION MAY CAUSE METALLIC TASTE, BURNING PAIN IN THE THROAT AND ABDOMEN, VOMITING AND DIARRHEA, STERNAL PAIN AND GARLIC BREATH. DEPENDENT ON THE AMOUNT INGESTED, LIVER, AND GASTROINTESTINAL TRACT DAMAGE MAY OCCUR.
CHRONIC EXPOSURE- CAUSES DIGESTIVE DISTURBANCES. IN ANIMALS, PROLONGED FEEDING OF SELENIUM IN AMOUNTS OF 5 TO 15 PPM CAUSED HEPATIC NECROSIS, HEMORRHAGE, AND CIRRHOSIS; MARKED AND PROGRESSIVE ANEMIA OCCURRED IN SOME SPECIES.

FIRST AID- DO NOT USE GASTRIC LAVAGE OR INDUCE VOMITING. DILUTE THE CORROSIVE IMMEDIATELY WITH LARGE QUANTITIES OF WATER OR MILK. INGESTED CORROSIVES SHOULD BE DILUTED APPROXIMATELY 100 TIMES TO RENDER THEM HARMLESS TO TISSUES. GET MEDICAL ATTENTION AS SOON AS POSSIBLE. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.)

NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
SELENIUM DIOXIDE:
PHOSPHOROUS TRICHLORIDE: VIGOROUS EXOTHERMIC REACTION.
OXIDIZERS: REACTS WITH EASILY OXIDIZABLE SUBSTANCES.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE ACRID SMOKE AND IRRITATING FUMES.

POLYMERIZATION:
NO DATA AVAILABLE.

CONDITIONS TO AVOID

AVOID HEATING TO DECOMPOSITION AND CONTACT WITH OR STORAGE WITH INCOMPATIBLE SUBSTANCES.

MA[illegible]RN BUT DOES NOT IGNITE READILY. AVOID CONTACT WITH STRONG OXIDIZERS, EX[illegible]IVE HEAT, SPARKS, OR OPEN FLAME.

SPILLS AND LEAKS

SOIL-RELEASE:
DIG A HOLDING AREA SUCH AS PIT, POND OR LAGOON TO CONTAIN SPILLED MATERIAL. USE PROTECTIVE COVER SUCH AS A PLASTIC SHEET TO PREVENT DISSOLVING IN FIREFIGHTING WATER OR RAIN.

WATER-SPILL:
ADD SUITABLE AGENT TO NEUTRALIZE SPILLED MATERIAL TO PH-7.

ALLOW SPILLED MATERIAL TO AERATE.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL-SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SP[illegible]REA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KE[illegible]NNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 10 POUNDS

THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF TH UBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CE MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

SELENIUM AND COMPOUNDS (AS SE):

FOR DUST OR MIST:
(SE)/M3- ANY DUST AND MIST RESPIRATOR WITH A FULL FACEPIECE.

5 MG(SE)/M3- ANY POWERED AIR-PURIFYING RESPIRATOR WITH A DUST AND MIST FILTER.

FOR DUST, MIST, OR FUME:
2 MG(SE)/M3- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

5 MG(SE)/M3- ANY SUPPLIED-ASIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

10 MG(SE)/M3- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

100 MG(SE)/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE EMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND

OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

C' 'NG:
EM. .EE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED BY- OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 03/11/85 REVISION DATE: 04/12/89

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MATERIAL SAFETY DATA SHEET OHS20819

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 20667-12-3
RTEC-NUMBER VW4900000

SUBSTANCE: SILVER OXIDE

TRADE NAMES/SYNONYMS:
SILVER(1+) OXIDE: ARGENTOUS OXIDE: DISILVER OXIDE: DISILVER MONOXIDE:
S-184: OHS20819

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: AG2-O MOLECULAR WEIGHT: 231.74

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: SILVER OXIDE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
SILVER OXIDE:
0.01 MG(AG)/M3 OSHA-TWA;
0.01 MG(AG)/M3 ACGIH TLV-TWA

PHYSICAL DATA

DESCRIPTION: ODORLESS, BROWNISH-BLACK, HEAVY POWDER OR CUBIC CRYSTALS WITH AMETALLIC TASTE.

MELTING POINT: 392 F (200 C)
DECOMPOSES SPECIFIC GRAVITY: > 0.2

SOLUBILITY IN WATER: VERY SLIGHTLY SOL.

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
DILUTE NITRIC ACID, AMMONIA, AMMONIUM HYDROXIDE, ACIDS,
POTASSIUM CYANIDE SOLUTION, SODIUM THIOSULFATE SOLUTION, INSOLUBLE IN ALCOHOL.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD

NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER. CONTACT WITH EASILY OXIDIZABLE, ORGANIC, OR OTHER COMBUSTIBLE MATERIALS MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE OR WATER SPRAY
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGE FIRES, USE WATER SPRAY OR FOG
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 35)

FLOOD WITH WATER. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS OR DUSTS. EVACUATE TO A RADIUS OF 2500 FEET FOR UNCONTROLLABLE FIRES.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
OXIDIZER

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
OXIDIZER

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.154
EXCEPTIONS: 49CFR173.153

TOXICITY

SILVER OXIDE:
2820 MG/KG ORAL-RAT LD50; CARCINOGEN STATUS: NONE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
SILVER OXIDE:
IRRITANT.
ACUTE EXPOUSRE- MAY CAUSE IRRITATION TO THE MUCOUS MEMBRANES WITH SORE THROAT, COUGHING, AND DIFFICULTY IN BREATHING.
CHRONIC EXPOSURE- MAY CAUSE GENERALIZED ARGYRIA WHICH IS CHARACTERIZED BY

A DARK SLATE-GRAY DICOLORATION OF THE CONJUNCTIVA, MUCOUS MEMBRANES OF THE MOUTH AND SKIN. THERE IS USUALLY A UNIFORM DISTRIBUTION OVER THE FACE, FOREHEAD, NECK, HANDS AND FOREARMS. THE FINGERNAILS MAY ALSO BE A DEEP CHOCOLATE BROWN COLOR AND SLIGHT DISCOLORATION MAY BE SEEN IN THE COVERED PARTS OF THE SKIN. THIS CONDITION USUALLY ONLY DEVELOPS AFTER 2-25 YEARS OF EXPOSURE. THE DUST MAY ALSO BECOME DEPOSITED IN THE LUNGS AND MAY BE REGARDED AS A FORM OF PNEUMOCONIOSIS. HOWEVER, THERE ARE NO CONSTITUTIONAL SYMPTOMS AND NO PHYSICAL DISABILITY.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
SILVER OXIDE:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION WITH REDNESS AND PAIN.
CHRONIC EXPOSURE- MAY CAUSE DERMATITIS AFTER REPEATED OR PROLONGED EXPOSURE. A CONDITION TERMED LOCALIZED ARGYRIA MAY OCCUR WHEN SMALL METALLIC PARTICLES PENETRATE THE SKIN CAUSING A LOCAL PIGMENTATION AT THE SITE OF INJURY. HOWEVER, MORE COMMON IS GENERALIZED ARGYRIA WHICH OCCURS AS A SYSTEMIC AFFECT AFTER PROLONGED INHALATION AND IS CHARACTERIZED BY A SLATE-GRAY DISCOLORATION OF THE FACE, FOREHEAD, NECK, HANDS AND FOREARMS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
SILVER OXIDE:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION WITH REDNESS, PAIN, AND BLURRED VISION.
CHRONIC EXPOSURE- MAY CAUSE CONJUNCTIVITIS AFTER REPEATED OR PROLONGED EXPOSURE. ARGYRIA, A PERMANENT DISCOLORATION OF THE CONJUNCTIVA MAY ALSO OCCUR AFTER PROLONGED EXPOSURE TO EYES OR AFTER PROLONGED INHALATION OF VAPORS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
SILVER OXIDE:
ACUTE EXPOSURE- NO DATA AVAILABLE. SOME SILVER SALTS CAUSE SEVERE GASTROENTERITIS WITH NAUSEA, VOMITING, AND DIARRHEA. SHOCK MAY ALSO OCUCR.
CHRONIC EXPOSURE- PROLONGED INGESTION MAY CAUSE GENERALIZED ARGYRIA WHICH IS CHARACTERIZED BY A PERMANENT DISCOLORATION OF THE CONJUNCTIVA, MUCOUS MEMBRANES OF THE MOUTH AND GUMS AND THE SKIN. THE PIGMENTATION IS USUALLY A SLATE-GRAY AND OCCURS ONLY AFTER 2-25 YEARS OF EXPOSURE.

FIRST AID- TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

MAY DECOMPOSE ON EXPOSURE TO LIGHT.

INCOMPATIBILITIES:
SILVER OXIDE:
- AMMONIA: MAY EXPLODE ON CONTACT.
- AMMONIA + ETHANOL: SLOWLY FORMS EXPLOSIVE SILVER NITRATE AND MAY ALSO FORM EXPLOSIVE SILVER FULMINATE.
- ANTIMONY TRISULFIDE: IGNITES.
- BORON TRIFLUORIDE ETHERATE IN NITROBENZENE: MAY CAUSE VIOLENT SPONTANEOUS EXPLOSION DURING PRECIPITATION OF THE SALT FROM SILVER OXIDE.
- CARBON MONOXIDE: EXOTHEMICALLY OXIDIZED AND MAY REACH A TEMPERATURE OF 300 C.
- CHLORINE + ETHYLENE: MAY CAUSE IGNITION OR EXPLOSION BY SUNLIGHT OR AMBIENT TEMPERATURES.
- DICHLORO(METHYL)SILANE: MAY IGNITE ON IMPACT.
- HYDRAZINE + ETHANOL: SLOWLY FORMS EXPLOSIVE SILVER NITRATE AND MAY ALSO FORM EXPLOSIVE SILVER FULMINATE.
- HYDROGEN SULPHIDE: MAY IGNITE ON CONTACT.
- MAGNESIUM: MAY EXPLODE WHEN WARMED IN A SEALED TUBE.
- MERCURIC SULFIDE: IGNITES.
- NITROALKANES: LOWERS THE IGNITION TEMPERATURE.
- POTASSIUM (SODIUM ALLOY): SHOCK SENSITIVE.
- PHOSPHORUS: MAY IGNITE ON GRINDING.
- SELENIUM: MAY IGNITE ON GRINDING.
- SELENIUM CHLORIDE: MAY CAUSE AN INCANDESCENT REACTION.
- SELENIUM DISULFIDE: A MIXTURE MAY IGNITE UNDER IMPACT.
- SULPHUR: MAY IGNITE ON GRINDING.

DECOMPOSITION:
MAY RELEASE HAZARDOUS SILVER OXIDE FUMES UNDER THERMAL DECOMPOSITION.

POLYMERIZATION:
NO DATA AVAILABLE.

CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTION WITH FUELS MAY BE VIOLENT. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

SPILLS AND LEAKS

OCCUPATIONAL-SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE

MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; MOVE CONTAINERS FROM SPILL AREA. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND, EARTH OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON THE CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON THE DATA FOUND IN THE PHYSICAL DATA, HEALTH EFFECTS AND TOXICITY SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION:

CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE(S) WITH A HIGH-EFFICIENCY PARTICULATE FILTER AND FULL FACEPIECE.

HIGH-EFFICIENCY PARTICULATE RESPIRATOR WITH A FULL FACEPIECE.

POWERED AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY FILTER WITH A FULL FACEPIECE.

TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:

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EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 02/05/85 REVISION DATE: 12/30/87

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OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 56-23-5
RTEC-NUMBER FG4900000

SUBSTANCE: CARBON TETRACHLORIDE

TRADE NAMES/SYNONYMS:
TETRACHLOROMETHANE: PERCHLOROMETHANE: CARBON CHLORIDE: TETRACHLOROCARBON: METHANE TETRACHLORIDE: CARBON TET: FREON 10: HALON 104: BENZINOFORM: STCC 4940320: UN 1846: C-186: C-187: C-199: C-570: C-612: OHS04310

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

MOLECULAR FORMULA: C-CL4 MOLECULAR WEIGHT: 153.84

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: CARBON TETRACHLORIDE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
CARBON TETRACHLORIDE:
10 PPM OSHA TWA; 25 PPM OSHA CEILING;
200 PPM/5 MINUTES IN ANY 4 HOURS OSHA PEAK
5 PPM (30 MG/M3) ACGIH TWA (SKIN)
ACGIH A2-SUSPECTED HUMAN CARCINOGEN.
2 PPM NIOSH RECOMMENDED 60 MINUTE CEILING (45 LITER SAMPLE)

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH AN ETHEREAL ODOR.

BOILING POINT: 172 F (78 C) MELTING POINT: -9 F (-23 C)

SPECIFIC GRAVITY: 1.58 EVAPORATION RATE: (BUTYL ACETATE=1) 12.8

SOLUBILITY IN WATER: 0.08% VAPOR DENSITY: 5.3

VAPOR PRESSURE: 91.3 MMHG @ 20 C ODOR-THRESHOLD: 10-50 PPM

OTHER SOLVENTS (SOLVENT - SOLUBILITY):

ALCOHOL, ETHER, CHLOROFORM, BENZENE, CARBON DISULFIDE,
OILS, PETROLEUM NAPHTHA,

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. FIGHT FIRE FROM MAXIMUM DISTANCE. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL. DO NOT SCATTER MATERIAL (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 55).

USE SUITABLE AGENT FOR SURROUNDING FIRE. AVOID BREATHING VAPORS OR DUSTS, KEEP UPWIND.

FIRE FIGHTING PHASES: WHEN INVOLVED IN FIRE, CARBON TETRACHLORIDE EMITS HIGHLY TOXIC AND IRRITATING FUMES (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

CARBON TETRACHLORIDE:
4 MG SKIN-RABBIT MILD IRRITATION; 2200 UG/30 SECONDS EYE-RABBIT MILD IRRITATION; 500 MG/24 HOURS EYE-RABBIT MILD IRRITATION; 43 MG/KG ORAL-HUMAN LDLO; 20 PPM INHALATION-HUMAN TCLO; 1800 MG/KG ORAL-WOMAN TDLO; 1700 MG/KG ORAL-MAN TDLO; 1000 PPM INHALATION-HUMAN LCLO; 45 PPM/3 DAYS INHALATION-HUMAN TCLO; 317 PPM/30 MINUTES INHALATION-HUMAN TCLO; 5 PPH/5 MINUTES INHALATION-HUMAN LCLO; 93 MG/KG UNREPORTED-MAN LDLO; 2800 MG/KG ORAL-RAT LD50; 8000 PPM/4 HOURS INHALATION-RAT LC50; 5070 MG/KG SKIN-RAT LD50; 1500 MG/KG INTRAPERITONEAL-RAT LD50; 8263 MG/KG ORAL-MOUSE LD50; 9526 PPM/8 HOURS INHALATION-MOUSE LC50; 572 MG/KG INTRAPERITONEAL-MOUSE LD50; 31 GM/KG SUBCUTANEOUS-MOUSE LDLO; 1000 MG/KG ORAL-DOG LDLO; 14,620 PPM/8 HOURS INHALATION-DOG LCLO; 1500 MG/KG INTRAPERITONEAL-DOG LD50; 125 MG/KG INTRAVENOUS-DOG LDLO; 38,110 PPM/2 HOURS INHALATION-CAT LCLO; 300 MG/KG SUBCUTANEOUS-CAT LDLO; 5760 MG/KG ORAL-RABBIT LD50; 478 MG/KG

INTRAPERITONEAL-RABBIT LDLO; 3000 MG/KG SUBCUTANEOUS-RABBIT LDLO; 5840 MG/KG INTRAVENOUS-RABBIT LD50; 5760 MG/KG ORAL-GUINEA PIG LD50; 20,000 PPM/2 HOURS INHALATION-GUINEA PIG LCLO; 34,500 MG/M3 INHALATION-MAMMAL LC50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS); POSITIVE ANIMAL CARCINOGEN (IARC); SUSPECT HUMAN CARCINOGEN (IARC, NTP). THERE IS SUFFICIENT EVIDENCE THAT CARBON TETRACHLORIDE IS CARCINOGENIC IN EXPERIMENTAL ANIMALS. THERE ARE SUGGESTIVE CASE REPORTS OF LIVER CANCER IN HUMANS. IN THE ABSENCE OF ADEQUATE DATA IN HUMANS, IT IS REASONABLE, FOR PRACTICAL PURPOSES, TO REGARD CARBON TETRACHLORIDE AS IF IT PRESENTED A CARCINOGENIC RISK TO HUMANS.

CARBON TETRACHLORIDE IS A CENTRAL NERVOUS SYSTEM DEPRESSANT, NEPHROTOXIN, AND HEPATOTOXIN. CONSUMPTION OF ALCOHOL MAY INCREASE THE SYSTEMIC TOXICITY. STIMULANTS SUCH AS EPINEPHRINE OR EPHEDRINE MAY INDUCE VENTRICULAR FIBRILLATION. PERSONS WITH A HISTORY OF LIVER, KIDNEY, CENTRAL NERVOUS SYSTEM DISEASE, OR ALCOHOLISM MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CARBON TETRACHLORIDE:
NARCOTIC/NEPHROTOXIN/HEPATOTOXIN.
300 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- ABOVE 10 PPM, RESPIRATORY TRACT IRRITATION MAY OCCUR. POISONING MAY CAUSE IMMEDIATE NAUSEA, VOMITING, ABDOMINAL PAIN, CYANOSIS, AND CENTRAL NERVOUS SYSTEM DEPRESSION WITH HEADACHE, DIZZINESS, CONFUSION, DROWSINESS, UNCONSCIOUSNESS, COMA, AND DEATH FROM RESPIRATORY ARREST, CIRCULATORY COLLAPSE, OR VENTRICULAR FIBRILLATION. OTHER EFFECTS MAY INCLUDE DYSPNEA, HYPOTENSION, CONVULSIONS, SPASMS OF THE HANDS AND FEET, OPTIC NEURITIS, TOXIC AMBLYOPIA, AND OPTIC ATROPHY. IF DEATH IS NOT IMMEDIATE, AN ASYMPTOMATIC PERIOD, OR THE ABOVE SYMPTOMS MAY BE FOLLOWED IN 1-2 DAYS BY KIDNEY DAMAGE WITH ALBUMINURIA, UREMIA, OLIGURIA OR ANURIA, EDEMA, AND WEIGHT GAIN. ANOREXIA, JAUNDICE, AND HEPATOMEGALY INDICATE LIVER DAMAGE.

CHRONIC EXPOSURE- FATIGUE, ANOREXIA, WEIGHT LOSS, VOMITING, ABDOMINAL PAIN, ANEMIA, WEAKNESS, NAUSEA, BLURRED VISION, AMNESIA, PARESTHESIAS, TREMORS, AND LOSS OF PERIPHERAL COLOR VISION MAY INDICATE CHRONIC POISONING. CASE REPORTS HAVE DESCRIBED LIVER TUMORS ASSOCIATED WITH CIRRHOSIS IN CARBON TETRACHLORIDE-EXPOSED HUMANS. A MORTALITY STUDY OF LAUNDRY AND DRY CLEANING WORKERS EXPOSED TO A VARIETY OF SOLVENTS SUGGEST AN EXCESS OF RESPIRATORY CANCERS, LIVER TUMORS, AND LEUKEMIA.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
CARBON TETRACHLORIDE:
NARCOTIC/NEPHROTOXIN/HEPATOTOXIN.

ACUTE EXPOSURE- CONTACT WITH THE LIQUID MAY CAUSE MILD IRRITATION. MAY BE ABSORBED, CAUSING SYMPTOMS AS IN ACUTE INHALATION POISONING, WITH COMA, OLIGURIA, AND JAUNDICE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY DEFAT THE SKIN, CAUSING IRRITATION AND DERMATITIS. ABSORPTION MAY PRODUCE SYSTEMIC EFFECTS AS IN CHRONIC INHALATION POISONING.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED

AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CARBON TETRACHLORIDE:
ACUTE EXPOSURE- CONTACT WITH LIQUID OR VAPOR MAY CAUSE PAIN AND MINOR CONJUNCTIVAL INJURY.
CHRONIC EXPOSURE- NO DATA AVAILABLE. DIMINISHED VISUAL ACUITY AND COLOR VISION LOSS FOLLOWING INHALATION OR SKIN ABSORPTION HAS BEEN REPORTED.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CARBON TETRACHLORIDE:
NARCOTIC/NEPHROTOXIN/HEPATOTOXIN.
ACUTE EXPOSURE- TOXIC AMOUNTS WILL RESULT IN SYMPTOMS AS IN ACUTE INHALATION POISONING, WITH HEMATEMESIS AND DIARRHEA.
CHRONIC EXPOSURE- HAS NOT BEEN REPORTED IN HUMANS. TUMORS OF THE LIVER WERE REPORTED IN MICE, RATS, HAMSTERS, AND TROUT FOLLOWING REPEATED ORAL ADMINISTRATION.

FIRST AID- REMOVE BY GASTRIC LAVAGE OR EMESIS. MAINTAIN BLOOD PRESSURE AND AIRWAY. DO NOT PERFORM GASTRIC LAVAGE OR EMESIS IF VICTIM IS UNCONSCIOUS. DO NOT GIVE STIMULANTS WHICH MAY INDUCE VENTRICULAR FIBRILLATION. GET MEDICAL ATTENTION IMMEDIATELY. (DREISBACH, HANDBOOK OF POISONING, 11TH EDITION) ADMINISTRATION OF GASTRIC LAVAGE SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL.

ANTIDOTE:
NO SPECIFIC ANTIDOTE FOR CARBON TETRACHLROIDE POISONING. MAINTAIN BLOOD PRESSURE. DO NOT GIVE STIMULANTS! MAINTAIN URINE OUTPUT. DO NOT GIVE DIURETICS. TREAT ACUTE RENAL SHUTDOWN AND HEPATIC COMA. GIVE POTASSIUM CHLORIDE FOR ALKALOSIS. CONTROL BLOOD ELECTROLYTES WITH HEMODIALYSIS.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
CARBON TETRACHLORIDE:
ALLYL ALCOHOL: FORMS EXPLOSIVE DI- AND TRI-CHLOROBUTYLENE EPOXIDES.
ALUMINUM (POWDER): EXPLOSIVE ON HEATING OR IMPACT.
BARIUM (FINELY DIVIDED): VIOLENT REACTION OR POSSIBLE EXPLOSION.
BERYLLIUM (POWDER): FLASH OR SPARK ON HEAVY IMPACT.
BROMINE TRIFLUORIDE: IGNITION REACTION.
CALCIUM DISILICATE: POSSIBLE EXPLOSION ON IMPACT.
CALCIUM HYPOCHLORITE: EXPLOSIVE REACTION ON HEATING.
CHLORINE TRIFLUORIDE: PROBABLE EXPLOSION.
DECABORANE: FORMS IMPACT-SENSITIVE EXPLOSIVE COMPOUND.
DIBORANE (BURNING): VIOLENT EXPLOSION.
DIMETHYLACETAMIDE: EXOTHERMIC REACTION WITH INCREASE IN PRESSURE OR VIGOROUS REACTION IN PRESENCE OF IRON.
DIMETHYL FORMAMIDE: VIOLENT REACTION IN PRESENCE OF IRON OR AT TEMPERATURES

ABOVE 65 C.
DINITROGEN TETRAOXIDE: EXPLOSION BY SHOCK OR HEATING TO 150 C.
DISILANE: PROBABLE EXPLOSION.
ETHYLENE: EXPLOSION WHEN UNDER HIGH PRESSURE IN PRESENCE OF ORGANIC PEROXIDE CATALYSTS.
ETHYLENE WITH BENZOYL PEROXIDE: EXPLOSION.
FLUORINE: VIOLENT REACTION OR POSSIBLE EXPLOSION.
HEXACHLOROCYCLOHEXANE: POSSIBLE VIOLENT REACTION IN PRESENCE OF IRON.
IRON: CORRODES WHEN IN CONTACT WITH WATER, ESPECIALLY @ HIGH TEMPERATURES.
LITHIUM: VIOLENT EXPLOSIVE REACTION.
MAGNESIUM: EXPLOSIVE REACTION.
METALS: POSSIBLE EXPLOSION ON HEATING OR IMPACT.
OXYGEN (LIQUID): VIOLENT REACTION OR MILD EXPLOSION WHEN IGNITED.
PLASTICS, RUBBER, COATINGS: MAY BE ATTACKED.
PLUTONIUM: IGNITION OR POSSIBLE EXPLOSION.
POTASSIUM AND POTASSIUM ALLOYS: FORMS EXPLOSIVE MIXTURES.
POTASSIUM TERT-BUTOXIDE: IGNITION REACTION.
SILVER PERCHLORATE: REACTS IN PRESENCE OF HYDROGEN CHLORIDE AND YIELDS TRICHLOROMETHYL PERCHLORATE WHICH DETONATES AT 40 C.
SODIUM: VIOLENT REACTION WHEN HOT OR EXPLOSION ON IMPACT.
SODIUM-POTASSIUM ALLOY: VIOLENT EXPLOSION ON LIGHT IMPACT.
TRIETHYLDIALUMINUM SESQUICHLORIDES: DARKENED AND EXPLODED AT ROOM TEMPERATURE.
TETRAETHYLENEPENTAMINE: EXPLOSIVE REACTION.
TRISILANE: EXPLODES IN AIR ON CONTACT.
TETRASILANE, OXYGEN: EXPLOSIVE REACTION.
TRICHLOROMETHYL PERCHLORATE WHICH DETONATES AT 40 C.
URANIUM (BURNING): EXPLOSIVE REACTION.
WAX (BURNING): EXPLOSIVE REACTION.
ZIRCONIUM: EXPLOSIVE REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITON PRODUCTS MAY INCLUDE TOXIC AND HAZARDOUS PHOSGENE, OXIDES OF CARBON, AND CORROSIVE CHLORINE AND HYDROCHLORIC ACID.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

STORAGE: PROTECT AGAINST PHYSICAL DAMAGE. STORE IN A COOL, DRY WELL VENTILATED LOCATION, AWAY FROM ANY AREA WEHRE THE FIRE HAZARD MAY BE ACUTE (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. CONTAINERS MAY EXPLODE IN HEAT OF FIRE.

SPILLS AND LEAKS

SOIL-RELEASE:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

USE CEMENT POWDER OR FLY ASH TO ABSORB LIQUID MASS.

IMMOBILIZE SPILL WITH UNIVERSAL GELLING AGENT.

AIR-RELEASE:
KNOCK DOWN VAPORS WITH WATER SPRAY. KEEP UPWIND.

WATER USED TO KNOCK DOWN VAPORS MAY BECOME CORROSIVE OR TOXIC AND SHOULD BE CONTAINED PROPERLY FOR LATER DISPOSAL.

WATER-SPILL:
TRAP SPILLED MATERIAL AT BOTTOM IN DEEP WATER POCKETS, EXCAVATED HOLDING AREAS OR WITHIN SAND BAG BARRIERS.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

IF DISSOLVED, APPLY ACTIVATED CARBON AT TEN TIMES THE SPILLED AMOUNT IN THE REGION OF 10 PPM OR GREATER CONCENTRATION.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL-SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINERS AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROCESS ENCLOSURE RECOMMENDED TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

CARBON TETRACHLORIDE:
AT ANY DETECTABLE CONCENTRATION
- SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
- SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION

- WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 10/24/84 REVISION DATE: 09/15/87

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MATERIAL SAFETY DATA SHEET OHS22900

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 127-18-4
RTEC-NUMBER KX3850000

SUBSTANCE: TETRACHLOROETHYLENE

TRADE NAMES/SYNONYMS:
PERCHLOROETHYLENE: 1,1,2,2-TETRACHLOROETHYLENE: NEMA: ETHYLENE TETRACHLORIDE: CARBON DICHLORIDE: CARBON BICHLORIDE: PERCLENE: PERC: ANKILOSTIN: TETRACHLORETHYLENE: PERCHLORETHYLENE: TETRALEX: TETRACHLOROETHENE: DIDAKENE: U210: NCI-C04580: ENT 1,860: UN 1897: O-4586: C-182: OHS22900

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

MOLECULAR FORMULA: C2-CL4 MOL WT: 165.82

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=2
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: TETRACHLOROETHYLENE PERCENT: 100

OTHER CONTAMINANTS: AMINE AND/OR PHENOLIC STABILIZERS

EXPOSURE LIMIT:
TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
100 PPM OSHA TWA; 200 PPM OSHA CEILING; 300 PPM/5 MINUTES OSHA 3 HOUR PEAK
50 PPM ACGIH TWA; 200 PPM ACGIH STEL
LOWEST FEASIBLE LIMIT NIOSH RECOMMENDED EXPOSURE CRITERIA

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH A MILD CHLOROFORM-LIKE ODOR.

BOILING POINT: 250 F (121 C) MELTING POINT: -9 F (-23 C)

SPECIFIC GRAVITY: 1.6 EVAPORATION RATE: (CCL4=1) 0.27

SOLUBILITY IN WATER: 0.04% VAPOR DENSITY: 5.8

VAPOR PRESSURE: 15.0 MMHG @ 20 C ODOR-THRESHOLD: 50 PPM

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
ALCOHOL, ETHER, AND BENZENE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
STAY AWAY FROM STORAGE TANK ENDS. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 74).

USE AGENTS SUITABLE FOR TYPE OF SURROUNDING FIRE. AVOID BREATHING HAZARDOUS VAPORS, KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
810 MG/24 HOURS SKIN-RABBIT SEVERE IRRITATION; 162 MG EYE-RABBIT MILD IRRITATION; 96 PPM/7 HOURS INHALATION-HUMAN TCLO; 280 PPM/2 HOURS INHALATION-MAN TCLO; 600 PPM/10 MINUTES INHALATION-MAN TCLO; 3005 MG/KG ORAL-RAT LD50; 4000 PPM/4 HOURS INHALATION-RAT LCLO; 2100 MG/KG INTRAPERITONEAL-DOG LD50; 2200 MG/KG SUBCUTANEOUS-RABBIT LDLO; 8100 MG/KG ORAL-MOUSE LD50; 85 MG/KG INTRAVENOUS-DOG LDLO; 2857 MG/KG INHALATION-MAN LDLO; 5200 PPM/4 HOURS INHALATION-MOUSE LC50; 4000 MG/KG ORAL-CAT LDLO; 4000 MG/KG ORAL-DOG LDLO; 5000 MG/KG ORAL-RABBIT LDLO; 65 GM/KG SUBCUTANEOUS-MOUSE LD50; 4643 MG/KG INTRAPERITONEAL-MOUSE LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS); SUSPECT ANIMAL CARCINOGEN (IARC). TETRACHLOROETHYLENE PRODUCED HEPATOCELLULAR TUMORS IN MICE BY ORAL ADMINISTRATION. NTP STUDIES REPORTS LEUKEMIA AND KIDNEY NEOPLASMS IN RATS AND LIVER CARCINOMAS IN MICE BY INHALATION. (NTP TR 311)

TETRACHLOROETHYLENE IS AN EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT, CENTRAL NERVOUS SYSTEM DEPRESSANT, AND HEPATOTOXIN. POISONING MAY PRODUCE PERIPHERAL NEUROPATHY. ALCOHOLIC BEVERAGES MAY ENHANCE THE SYSTEMIC EFFECTS. EPINEPHRINE OR OTHER STIMULANTS MAY CAUSE VENTRICULAR ARRHYTHMIAS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
IRRITANT/NARCOTIC/HEPATOTOXIN.
500 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- VAPORS MAY CAUSE IRRITATION. 2000 PPM CAUSED MILD CENTRAL NERVOUS SYSTEM DEPRESSION WITHIN 5 MINUTES OF EXPOSURE. 600 PPM CAUSED NUMBNESS AROUND THE MOUTH, DIZZINESS, AND SOME INCOORDINATION AFTER 10 MINUTES. 500 PPM PRODUCED SALIVATION AND A METALLIC TASTE IN THE MOUTH. OTHER SYMPTOMS OF EXPOSURE MAY BE NAUSEA, GASTROINTESTINAL UPSET, VERTIGO, SINUS INFLAMMATION, HEADACHE, ANOREXIA, GIDDINESS, INEBRIATION, IRRESPONSIBLE BEHAVIOR, LOSS OF INHIBITIONS, PREMATURE VENTRICULAR BEATS, AND UNCONSCIOUSNESS. HEPATIC NECROSIS AND OLIGURIC UREMIA HAVE BEEN REPORTED. MASSIVE EXPOSURES MAY RESULT IN DEATH FROM RESPIRATORY ARREST. HUMANS EXPOSED EXHIBITED BOTH LOCAL AND GENERAL ANESTHESIA AND HALLUCINATIONS. HUMAN EXPOSURE TO 2857 MG/KG HAS BEEN REPORTED TO CAUSE CHANGES IN THE LUNGS, COMA AND DEATH. TETRACHLOROETHYLENE MAY BE EXCRETED IN HUMAN MILK AND CAUSE OBSTRUCTIVE JAUNDICE IN INFANTS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE IMPAIRED MEMORY, PARALYSIS, AND PERIPHERAL NERVE DAMAGE EVIDENCED BY TINGLING, NUMBNESS, MUSCLE WEAKNESS, AND IMPAIRED VISION. LIVER AND KIDNEY DAMAGE ARE POSSIBLE. EXPOSURE OF PREGNANT RATS RESULTED IN MUSCULOSKELETAL ABNORMALITIES, FETOTOXICITY, AND VARIOUS EFFECTS ON THE NEWBORN. MALE RATS EXPOSED BEFORE MATING DEVELOPED EFFECTS ON THE REPRODUCTIVE ORGANS. NTP INHALATION STUDIES INDICATE AN INCREASED INCIDENCE OF LEUKEMIA AND KIDNEY NEOPLASMS IN RATS AND LIVER CARCINOMAS IN MICE FOLLOWING REPEATED EXPOSURES.

FIRST AID: REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
IRRITANT/NARCOTIC.

ACUTE EXPOSURE- VAPORS MAY BE IRRITATING. BRIEF IMMERSION OF THE HANDS IN THE LIQUID USUALLY CAUSES ONLY MILD SKIN IRRITATION. HOWEVER, THE LIQUID ON THE SKIN FOR 40 MINUTES RESULTED IN A PROGRESSIVELY SEVERE BURNING SENSATION, BEGINNING WITHIN 5-10 MINUTES, AND MARKED ERYTHEMA, WHICH SUBSIDED AFTER 1-2 HOURS. ABSORPTION MAY OCCUR BUT ONLY TO A MINIMAL EXTENT POSSIBLY CAUSING CENTRAL NERVOUS SYSTEM DEPRESSION WITH LIGHTHEADEDNESS, CONFUSION AND NARCOSIS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED SKIN CONTACT MAY PRODUCE DERMATITIS BY THE DEFATTING OF THE SKIN.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
TETRACHLOROETYLENE (PERCHLOROETHYLENE):
IRRITANT.

ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE PAIN, LACRIMATION, AND BURNING. VAPORS ABOVE 200 PPM MAY CAUSE MILD IRRITATION, CONJUNCTIVITIS, AND LACRIMATION, BUT SERIOUS INJURY IS NOT LIKELY. APPLICATION TO RABBIT EYES FROM A PRESSURIZED FIRE EXTINGUISHER CAUSED IMMEDIATE PAIN AND BLEPHAROSPASM. THE CORNEAL EPITHELIUM BECAME GRANULAR AND OPTICALLY IRREGULAR AND PATCHES OF THE EPITHELIUM WERE LOST, BUT THE EYES RECOVERED COMPLETELY WITHIN 2 DAYS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS AND LACRIMAL DUCT DISEASE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
TETRACHLOROETHYLENE (PERCHLOROETHYLENE):
NARCOTIC/CARCINOGEN.
ACUTE EXPOSURE- ALTHOUGH POORLY ABSORBED BY THE GASTROINTESTINAL SYSTEM, NARCOSIS IS POSSIBLE, WITH HEADACHE, DIZZINESS, DELIRIUM, NAUSEA, VOMITING, DIARRHEA WITH BLOODY STOOLS, IRRESPONSIBLE BEHAVIOR AND LOSS OF INHIBITIONS. PERIPHERAL NERVE DAMAGE MAY OCCUR AND IS INDICATED BY TINGLING, NUMBNESS, AND MUSCLE WEAKNESS. TETRACHLOROETHYLENE MAY BE EXCRETED IN HUMAN MILK TO CAUSE OBSTRUCTIVE JAUNDICE IN NEWBORN INFANTS. THERAPEUTICALLY, IT IS USED IN HUMANS AND ANIMALS AS AN ANTHELMINTIC.
CHRONIC EXPOSURE- CHRONIC INGESTION HAS NOT BEEN REPORTED IN HUMANS. TETRACHLOROETHYLENE HAS PRODUCED HEPATOCELLULAR CARCINOMAS IN LABORATORY MICE.

FIRST AID- IF CONSCIOUS, REMOVE CHEMICAL BY GASTRIC LAVAGE OR EMESIS, PROTECTING AGAINST ASPIRATION. MAINTAIN BLOOD PRESSURE AND AIRWAY. GIVE ARTIFICIAL RESPIRATION IF BREATHING HAS STOPPED. GIVE OXYGEN IF RESPIRATION IS DEPRESSED. DO NOT GIVE EPINEPHRINE OR OTHER STIMULANTS THAT MAY CAUSE VENTRICULLAR ARRHYTHMIAS. GET MEDICAL ATTENTION. LAVAGE AND OXYGEN MUST BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.)

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. DO NOT GIVE STIMULANTS. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.)

REACTIVITY SECTION

REACTIVITY:
PROLONGED EXPOSURE TO SUNLIGHT (UV) CAN DEGRADE UNSTABILIZED MATERIAL.

INCOMPATIBILITIES:
TETRACHLOROETYLENE (PERCHLOROETHYLENE):
LITHIUM SHAVINGS: FORMS EXPLOSIVE MIXTURE.
BARIUM SHAVINGS: FORMS EXPLOSIVE MIXTURE.
ALUMINUM POWDER: EXPLOSIVE REACTION ON HEATING.
DINITROGEN TETROXIDE: FORMS EXPLOSIVE COMPOUND.
METALS (FINELY DISPERSED): EXPLOSIVE REACTION.
SODIUM HYDROXIDE: POSSIBLE EXPLOSIVE REACTION.
BERYLLIUM POWDER: FLASH OR SPARK ON HEAVY IMPACT.
EXCESS HYDROGEN: IN THE PRESENCE OF REDUCED NICKEL CATALYST PRODUCES TOTAL DECOMPOSITION TO HYDROGEN CHLORIDE AND CARBON.
NITRIC ACID (CONCENTRATED): VIOLENT REACTION.

DECOMPOSITION:
PROLONGED EXPOSURE TO SUNLIGHT (UV) CAN DEGRADE UNSTABLIZED MATERIAL. VAPOR EXPOSURE TO HIGH TEMPERATURE OR ELECTRIC ARCS MAY CAUSE DECOMPOSITION TO CORROSIVE HYDROGEN CHLORIDE, PHOSGENE, AND TOXIC CARBON MONOXIDE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

STORAGE: STORE IN A COOL, DRY, WELL-VENTILATED LOCATION, AWAY FROM ANY AREA WHERE THE FIRE HAZARD MAY BE ACUTE (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.
CONTAINER MAY EXPLODE IN HEAT OF FIRE.
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3)

SPILLS AND LEAKS

SOIL-RELEASE:
DIG A HOLDING AREA SUCH AS PIT, POND OR LAGOON TO CONTAIN SPILLED MATERIAL. USE PROTECTIVE COVER SUCH AS A PLASTIC SHEET TO PREVENT DISSOLVING IN FIREFIGHTING WATER OR RAIN.

WATER-SPILL:
TRAP SPILLED MATERIAL AT BOTTOM IN DEEP WATER POCKETS, EXCAVATED HOLDING AREAS OR WITHIN SAND BAG BARRIERS.

USE ACTIVATED CARBON TO ABSORB SPILLED SUBSTANCE THAT IS DISSOLVED.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL-SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND, EARTH OR OTHER ABSORBENT MATERIAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

AT ANY DETECTABLE CONCENTRATION:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 10/25/84 REVISION DATE: 09/15/87

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MATERIAL SAFETY DATA SHEET OHS23850

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 79-01-6
RTEC-NUMBER KX4550000

SUBSTANCE: TRICHLOROETHYLENE

TRADE NAMES/SYNONYMS:
ACETYLENE TRICHLORIDE: ETHYLENE TRICHLORIDE: ALGYLEN: 1-CHLORO-2,2-DICHLOROETHYLENE: 1,1-DICHLORO-2-CHLOROETHYLENE: TCE: ANAMENTH: ETHINYL TRICHLORIDE: TRICHLOROETHENE: 1,1,2-TRICHLOROETHYLENE: TRI: CHLORYLEN: 1,1,2-TRICHLOROETHENE: DENSINFLUAT: CHLORILEN: GEMALGENE NARCOGEN: TRILEN: U228: STCC 4941171: UN 1710; T-340; T-341; T-403: OHS23850

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

MOLECULAR FORMULA: C2-H-CL3 MOL WT: 131.40

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=1 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=1 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: TRICHLOROETHYLENE PERCENT: >99

OTHER CONTAMINANTS: MAY CONTAIN ANTIOXIDANTS SUCH AS AMINES OR EPOX- IDES AND ESTERS TO STABILIZE

EXPOSURE LIMIT:
TRICHLOROETHYLENE:
100 PPM OSHA TWA; 200 PPM OSHA CEILING; 300 PPM/5 MINUTE OSHA PEAK IN ANY 2 HOURS
50 PPM ACGIH TWA; 200 PPM ACGIH STEL
25 PPM NIOSH RECOMMENDED 10 HOUR TWA

PHYSICAL DATA

DESCRIPTION: COLORLESS, HEAVY, MOBILE LIQUID WITH A MILD CHLOROFORM-LIKE ODOR

BOILING POINT: 188 F (87 C) MELTING POINT: -99 F (-73 C)

SPECIFIC GRAVITY: 1.5 EVAPORATION RATE: (CCL4=1) 0.69

SOLUBILITY IN WATER: 0.1% VAPOR DENSITY: 4.5

VAPOR PRESSURE: 58 MMHG @ 20 C ODOR-THRESHOLD: 20 PPM

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
ALCOHOL, ETHER, ACETONE, CHLOROFORM, BENZENE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
SLIGHT FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

UPPER EXPLOSION LIMIT: 10.5 @ 25 C LOWER EXPLOSION LIMIT: 8.0 @ 25 C

AUTOIGNITION TEMP.: 770 F (410 C) FLAMMIBILITY CLASS (OSHA): IC

FIREFIGHTING MEDIA:
DRY CHEMICAL OR CARBON DIOXIDE
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
STAY AWAY FROM STORAGE TANK ENDS. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 74).

USE AGENT SUITABLE FOR TYPE OF FIRE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

TRICHLOROETHYLENE:
20 MG/24 HOURS EYE-RABBIT MODERATE IRRITATION; 500 MG/24 HOURS SKIN-RABBIT SEVERE IRRITATION; 7 GM/KG ORAL-HUMAN LDLO; 2143 MG/KG ORAL-MAN TDLO; 160 PPM/83 MINUTES INHALATION-HUMAN TCLO; 6900 MG/M3/10 MINUTES INHALATION-HUMAN TCLO; 812 MG/KG INHALATION-HUMAN TCLO; 110 PPM/8 HOURS INHALATION-MAN TCLO; 2900 PPM INHALATION-MAN LCLO; 3670 MG/KG ORAL-RAT LD50; 32500 MG/KG INHALATION-CAT LCLO; 8000 PPM/4 HOURS INHALATION-RAT LC50; 8450 PPM/4 HOURS INHALATION-MOUSE LCLO; 5864 MG/KG ORAL-CAT LDLO; 2402 MG/KG ORAL-MOUSE LD50; 7330 MG/KG ORAL-RABBIT LDLO; 37200 PPM/40 MINUTES INHALATION-GUINEA PIG LCLO; 1900 MG/KG INTRAPERITONEAL-DOG LD50; 1831 MG/KG INTRAPERITONEAL-MOUSE LD50; 150 MG/KG INTRAVENOUS-DOG LDLO; 34 MG/KG INTRAVENOUS-MOUSE LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS); SUSPECT ANIMAL CARCINOGEN (IARC);

INDEFINITE HUMAN CARCINOGEN (IARC). TRICHLOROETHYLENE PRODUCED LIVER AND LUNG NEOPLASMS IN MICE AFTER ORAL ADMINISTRATION. ADMINISTRATION BY INHALATION WAS ASSOCIATED WITH AN INCREASED INCIDENCE OF LYMPHOMAS IN FEMALE MICE, BUT NOT IN RATS OR HAMSTERS.

TRICHLOROETHYLENE IS AN EYE, MUCOUS MEMBRANE AND SKIN IRRITANT AND A CENTRAL NERVOUS SYSTEM DEPRESSANT. POISONING MAY AFFECT THE LIVER, KIDNEYS, AND HEART. THE PRESENCE OF TETRACHLOROETHANE AS AN IMPURITY, OR THE COMSUMPTION OF ALCOHOLIC BEVERAGES, MAY ENHANCE THE SYSTEMIC TOXICITY.

EPINEPHRINE OR OTHER STIMULANTS MAY INDUCE VENTRICULLAR ARRHYTHMIAS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
TRICHLOROETHYLENE:
IRRITANT/NARCOTIC. 1000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- LEVELS OF 90-130 PPM FOR 8 HOURS HAVE RESULTED IN DECREASED PERFORMANCE IN TESTS OF PERCEPTION, MEMORY, COMPLEX REACTION TIME AND MANUAL DEXTERITY. ADDICTION HAS OCCURRED FROM DELIBERATE INHALATION OF MODERATE AMOUNTS WHICH CAUSE EUPHORIA, DISORIENTATION, VISUAL HALLUCINATIONS, DELUSIONS, AND OTHER PSYCHOTIC SYMPTOMS. MILD RESPIRATORY IRRITATION, DROWSINESS, DIZZINESS, HEADACHE, EXCITATION, VOMITING, ABDOMINAL CRAMPS, AND FLUSHED SKIN MAY OCCUR. ABOVE 1000 PPM, PULMONARY EDEMA, NARCOSIS, ANESTHESIA, AND COMA ARE POSSIBLE. IF CONSCIOUSNESS IS REGAINED, NAUSEA AND VOMITING MAY FOLLOW FOR SEVERAL HOURS. ANEMIA AND DAMAGE TO THE LIVER, KIDNEYS, AND LUNGS HAVE OCCURRED. ANIMAL STUDIES HAVE SHOWN SPLEEN DAMAGE ALSO. DEATH MAY OCCUR FROM RESPIRATORY ARREST OR VENTRICULLAR FIBRILLATION AND PRIMARY CARDIAC FAILURE.

CHRONIC EXPOSURE- REPEATED EXPOSURE TO LEVELS BELOW 300 PPM HAVE CAUSED NAUSEA, VOMITING, ABDOMINAL CRAMPS, SLEEPINESS, DRUNKENNESS, FLUSHING, ANOREXIA, SWELLING OF THE EYES, FACE, AND HANDS, AND MILD CARDIAC ARRYTHMIA. OTHER POSSIBLE SYMPTOMS ARE WHEEZING, FACIAL NERVE PARALYSIS, LOSS OF COORDINATION AND SENSE OF SMELL AND TASTE, IMPAIRMENT OF TACTILE AND AUDITORY SENSES, DOUBLE VISION, CHANGES IN COLOR PERCEPTION, BLINDNESS AND JOINT AND MUSCLE PAIN. INTOLERANCE TO ALCOHOL, TREMOR, GIDDINESS, BRADYCARDIA, AND ANXIETY HAVE BEEN FOUND IN WORKERS CHRONICALLY EXPOSED TO 5-630 PPM. LIVER, KIDNEY, AND BRAIN DAMAGE MAY ALSO OCCUR. PREGNANT RATS CHRONICALLY EXPOSED EXHIBITED POST-IMPLANTATION MORTALITIES, FETOTOXICITY, AND MUSCULOSKELETAL AND UROGENITAL SYSTEM ABNORMALITIES OF THE FETUSES. ADMINISTRATION BY INHALATION WAS ASSOCIATED WITH AN INCREASED INCIDENCE OF LYMPHOMAS IN FEMALE MICE, BUT NOT IN RATS OR HAMSTERS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
TRICHLOROETHYLENE:
IRRITANT.

ACUTE EXPOSURE- CONTACT MAY CAUSE IRRITATION. IT MAY BE ABSORBED, HOWEVER, DERMAL ABSORPTION IS NOT LIKELY TO BE OF TOXICOLOGICAL SIGNIFICANCE UNDER NORMAL USE.

CHRONIC EXPOSURE- MAY CAUSE A DEFATTING TYPE OF DERMATITIS AND VESICULATION. REPEATED CONTACT HAS RESULTED IN PARALYSIS OF THE FINGERS. CHRONIC ABSORPTION MAY PRODUCE WEIGHT LOSS, NAUSEA, ANOREXIA, FATIGUE, VISUAL

IMPAIRMENT, JOINT PAIN, WHEEZING, AND DERMATITIS. JAUNDICE IS RARE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
TRICHLOROETHYLENE:
IRRITANT.
ACUTE EXPOSURE- INCIDENCES FROM ACUTE EXPOSURE HAVE BEEN REPORTED AND RESULTED IN LOSS OF SENSATION IN THE DISTRIBUTION OF THE TRIGEMINAL NERVE ON ONE OR BOTH SIDES. THESE CASES WERE OCCASIONALLY COMPLICATED BY CORNEAL EPITHELEAL ULCERATION, WHICH DID NOT CAUSE DISCOMFORT BECAUSE OF THE CORNEAL ANESTHESIA DUE TO PARALYSIS OF THE SENSORY NERVE. OCULOMOTOR PARALYSIS ACCOMPANIED THE TRIGEMINAL PALSIES IN A FEW OF THESE CASES. DIRECT EXTERNAL CONTACT WITH THE VAPOR OR LIQUID WITH THE EYE HAS CAUSED CHEMICAL BURNS OF THE LIDS, CONJUNCTIVA, AND CORNEA IN SEVERAL INSTANCES. A SPLASH IN THE EYE CAUSED SMARTING PAIN, AND INJURED CORNEAL EPITHELIUM IN A MANNER SIMILAR TO CHLOROFORM. COMPLETE SPONTANEOUS RECOVERY IS USUAL. EPITHELIUM MAY BE LOST, BUT RAPIDLY REGENERATES.
CHRONIC EXPOSURE- REPEATED OR PROLONGED VAPOR CONTACT MAY PRODUCE CONJUNCTIVITIS. CHRONIC INTOXICATION MAY CAUSE OPTIC NEURITIS, DOUBLE VISION, NYSTAGMUS, CHANGES IN COLOR PERCEPTION AND BLINDNESS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
TRICHLOROETHYLENE:
NARCOTIC/CARCINOGEN.
ACUTE EXPOSURE- LARGE AMOUNTS MAY CAUSE DIARRHEA, INEBRIATION, CONFUSION, TACHYCARDIA, AND CENTRAL NERVOUS SYSTEM DEPRESSION WITH DIZZINESS, NAUSEA, VOMITING, HEADACHE, COLLAPSE, CONVULSIONS AND RARELY COMA FOLLOWEDBY DEATH FROM RESPIRATORY FAILURE, CARDIAC ARREST, OR HEPATORENAL FAILURE. IN NON-LETHAL EXPOSURE, TRANSIENT NEUROLOGICAL SEQUELAE MAY INCLUDE HEADACHE, AMNESIA, NUMBNESS, WEAKNESS OF THE EXTREMITIES, HEMIPARESIS, AND PSYCHOSIS. ASPIRATION MAY CAUSE CHEMICAL PNEUMONIA.
CHRONIC EXPOSURE- STUDIES ON PREGNANT RATS RESULTED IN EFFECTS ON NEWBORN BEHAVIOR AND THE NUMBER OF NEONATES ALIVE AT WEANING AS COMPARED TO THE NUMBER OF NEONATES ALIVE AT DAY 4. TRICHLOROETHYLENE PRODUCED LIVER AND LUNG NEOPLASMS IN MICE AFTER REPEATED ORAL ADMINISTRATION.

FIRST AID- IF CONSCIOUS, REMOVE CHEMICAL BY GASTRIC LAVAGE OR EMESIS, PROTECTING AGAINST ASPIRATION. MAINTAIN BLOOD PRESSURE AND AIRWAY. GIVE ARTIFICIAL RESFIRATION IF BREATHING HAS STOPPED. GIVE OXYGEN IF RESPIRATION IS DEPRESSED. DO NOT GIVE EPINEPHRINE OR OTHER STIMULANTS THAT MAY CAUSE VENTRICULLAR ARRHYTHMIAS. GET MEDICAL ATTENTION. LAVAGE AND OXYGEN MUST BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.)

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. DO NOT GIVE STIMULANTS. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.)

REACTIVITY SECTION

REACTIVITY:
TRICHLOROETHYLENE:
SLOWLY DECOMPOSES BY LIGHT (UV) WHEN MOIST WITH THE FORMATION OF HYDROGEN CHLORIDE.

INCOMPATIBILITIES:
TRICHLOROETHYLENE:
- PRESSURIZED OXYGEN GAS: EXPLOSIVE REACTION.
- LIQUID OXYGEN WHEN IGNITED: EXPLOSIVE REACTION.
- BORON + POTASSIUM NITRATE + LAMINAC: EXPLOSIVE REACTION.
- PERCHLORIC ACID: VIOLENT REACTION.
- ALUMINUM: INTENSE EXOTHERMIC POLYMERIZATION.
- DILUTE HYDROCHLORIC ACID: INTENSE EXOTHERMIC POLYMERIZATION.
- SODIUM OR POTASSIUM HYDROXIDE: MAY FORM SPONTANEOUSLY FLAMMABLE AND HIGHLY TOXIC DICHLOROACETYLENE.
- ALUMINUM: VIOLENT REACTION.
- BARIUM: VIOLENT REACTION.
- LITHIUM: VIOLENT REACTION.
- NITROGEN TETROXIDE: VIOLENT REACTION.
- SODIUM: VIOLENT REACTION.
- POWDERED BERYLLIUM: FLASHES OR SPARKS ON IMPACT.
- MAGNESIUM: FLASHES OR SPARKS ON IMPACT.
- TITANIUM: FLASHES OR SPARKS ON IMPACT.

DECOMPOSITION:
TRICHLOROETHYLENE:
UPON CONTACT WITH CERTAIN METALS, HIGH TEMPERATURES, OPEN FLAME, OR ULTRAVIOLET LIGHT, DECOMPOSES INSTANTLY TO HIGHLY TOXIC AND CORROSIVE FUMES OF PHOSGENE AND/OR HYDROGEN CHLORIDE, CHLORINE, AND DICHLOROACETYL CHLORIDE. ABOVE 700 C VAPORS DECOMPOSE TO A MIXTURE OF DICHLORETHYLENE, TETRACHLORETHYLENE, CARBON TETRACHLORIDE, CHLOROFORM, AND METHYLCHLORIDE.

POLYMERIZATION:
TRICHLOROETHYLENE:
MAY POLYMERIZE WHEN CATALYZED BY ALUMINUM CHLORIDE IN A SELF-SUSTANING REACTION WHICH MAY DEVELOP TEMPERATURES UP TO 1350 C. A STABILIZER IS REQUIRED TO PREVENT POLYMERIZATION WHEN HEATED OR EXPOSED TO SUNLIGHT.

STORAGE-DISPOSAL

STORAGE: STORE IN A COOL, DRY, WELL-VENTILATED LOCATION, AWAY FROM ANY AREA WHERE THE FIRE HAZARD MAY BE ACUTE (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.
CONTAINER MAY EXPLODE IN HEAT OF FIRE.
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3)

STORE IN A COOL, DRY, WELL-VENTILATED LOCATION, AWAY FROM ANY AREA WHERE THE FIRE HAZARD MAY BE ACUTE. (NFPA, FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, 8TH ED.)

SPILLS AND LEAKS

SOIL-RELEASE:
DIG A HOLDING AREA SUCH AS A PIT, POND OR LAGOON TO CONTAIN SPILL AND DIKE SURFACE FLOW USING BARRIER OF SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB LIQUID MASS WITH FLY ASH OR CEMENT POWDER.

AIR-RELEASE:
APPLY WATER SPRAY TO KNOCK DOWN AND REDUCE VAPORS. KNOCK-DOWN WATER IS CORROSIVE AND TOXIC AND SHOULD BE DIKED FOR CONTAINMENT.

WATER-SPILL:
USE ACTIVATED CARBON TO ABSORB SPILLED SUBSTANCE THAT IS DISSOLVED.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL-SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND, EARTH OR OTHER ABSORBENT MATERIAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

FOR TRICHLOROETHYLENE:

500 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE.
SUPPLIED-AIR RESPIRATOR.
SELF-CONTAINED BREATHING APPARATUS.

1000 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE WITH A FULL FACEPIECE.
GAS MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER).
SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

ESCAPE- GAS MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER).
SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 10/24/84 REVISION DATE: 09/02/87

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MATERIAL SAFETY DATA SHEET OHS14370

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 71-55-6
RTEC-NUMBER KJ2975000

SUBSTANCE: METHYL CHLOROFORM

TRADE NAMES/SYNONYMS:
1,1,1-TRICHLOROETHANE: CHLOROETHENE: CHLOROTHENE: AEROTHENE TT: ETHYLIDINE CHLORIDE: METHYLTRICHLOROMETHANE: METHYLCHLOROFORM: TRICHLOROMETHYLMETHANE: TRICHLOROETHANE: ALPHA-TRICHLOROETHANE: U226: UN 2831: T-391: T-398: OHS14370

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

MOLECULAR FORMULA: C2-H3-CL3 MOLECULAR WEIGHT: 133.41

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=1 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=1 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: METHYL CHLOROFORM PERCENT: 100.0

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
350 PPM (1900 MG/M3) OSHA TWA
350 PPM (1900 MG/M3) ACGIH TWA; 450 PPM (2450 MG/M3) ACGIH STEL
350 PPM NIOSH RECOMMENDED 15 MINUTE CEILING

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH A MILD CHLOROFORM-LIKE ODOR.

BOILING POINT: 165 F (74 C) MELTING POINT: -36 F (-32 C)

SPECIFIC GRAVITY: 1.32 EVAPORATION RATE: (CCL4=1) 1

SOLUBILITY IN WATER: 0.09% VAPOR DENSITY: 4.55

VAPOR PRESSURE: 100 MMHG @ 20 C ODOR-THRESHOLD: 100 PPM

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
ACETONE, BENZENE, METHANOL, ETHER, CARBON TETRACHLORIDE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
NEGLIGIBLE FIRE HAZARD AND EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

THIS MATERIAL IS NEARLY NONFLAMMABLE. HIGH ENERGY, SUCH AS AN ELECTRIC ARC, IS NEEDED FOR IGNITION, AND THE FLAME TENDS TO GO OUT WHEN THE IGNITION SOURCE IS REMOVED.

FLASH POINT: NONE

UPPER EXPLOSION LIMIT: 12.5%

LOWER EXPLOSION LIMIT: 7.5%

AUTOIGNITION TEMP.: 998 F (537 C)

FIREFIGHTING MEDIA:
DRY CHEMICAL OR CARBON DIOXIDE
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
STAY AWAY FROM STORAGE TANK ENDS. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 74).

USE AGENTS SUITABLE FOR TYPE OF SURROUNDING FIRE. AVOID BREATHING HAZARDOUS VAPORS, KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
450 PPM/8 HOURS EYE-MAN IRRITATION; 5 GM/12 DAYS INTERMITTENT SKIN-RABBIT MILD IRRITATION; 500 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 100 MG EYE-RABBIT MILD IRRITATION; 2 MG/24 HOURS EYE-RABBIT SEVERE IRRITATION; 27 GM/M3/10 MINUTES INHALATION-MAN LCLO; 350 PPM INHALATION-MAN TCLO; 670 MG/KG ORAL-HUMAN TDLO; 920 PPM/70 MINUTES INHALATION-HUMAN TCLO; 200 PPM/4 HOURS INHALATION-MAN TCLO; 5100 MG/KG INTRAPERITONEAL-RAT LD50; 10,300 MG/KG ORAL-RAT LD50; 18000 PPM/4 HOURS INHALATION-RAT LC50; 11,240 MG/KG ORAL-MOUSE LD50; 4700 MG/KG INTRAPERITONEAL-MOUSE LD50; 3911 PPM/2 HOURS INHALATION-MOUSE LC50; 750 MG/KG ORAL-DOG LD50; 95 MG/KG INTRAVENOUS-DOG LDLO; 5660 MG/KG ORAL-RABBIT LD50; 500 MG/KG SUBCUTANEOUS-RABBIT LDLO; 16 GM/KG SUBCUTANEOUS-MOUSE LD50; 1 GM/KG SKIN-RABBIT LDLO; 600 MG/M3/4 HOURS INHALATION-CAT LCLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); INDEFINITE ANIMAL CARCINOGEN (IARC). METHYL CHLOROFORM WAS TESTED IN

ATTENTION IMMEDIATELY.

EYE CONTACT
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
IRRITANT.
ACUTE EXPOSURE- CONCENTRATIONS OF 1000 PPM HAVE CAUSED IRRITATION AND REDNESS. DIRECT CONTACT OF THE LIQUID MAY CAUSE TEMPORARY INJURY WITH COMPLETE RECOVERY EXPECTED IN 48 HOURS. DIRECT APPLICATION TO THE EYES OF RABBITS HAS CAUSED CONJUNCTIVAL IRRITATION, BUT NO CORNEAL DAMAGE.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
NARCOTIC.
ACUTE EXPOSURE- HAS CAUSED NAUSEA, VOMITING, DIARRHEA, GASTROINTESTINAL DISTURBANCES AND ABDOMINAL PAIN FOLLOWED BY CENTRAL NERVOUS SYSTEM DEPRESSION WITH HEADACHE, DIZZINESS, WEAKNESS, INCOORDINATION, VENTRICULAR FIBRILLATIONS, MENTAL CONFUSION AND UNCONSCIOUSNESS. DEATH MAY OCCUR FROM RESPIRATORY FAILURE. MYOCARDIAL SENSITIZATION TO EPINEPHRINE AND SUBSEQUENT DEATH DUE TO CARDIAC ARREST MAY OCCUR. ORGANIC SOLVENTS OF THIS NATURE PRESENT AN ASPIRATION HAZARD WITH POSSIBLE PULMONARY EDEMA OR CHEMICAL PNEUMONITIS.
CHRONIC EXPOSURE- FEEDING STUDIES ON PREGNANT RATS RESULTED IN FETAL DEVELOPMENTAL ABNORMALITIES OF THE CARDIOVASCULAR SYSTEM.

FIRST AID- IF CONSCIOUS, REMOVE CHEMICAL BY GASTRIC LAVAGE OR EMESIS, PROTECTING AGAINST ASPIRATION. MAINTAIN BLOOD PRESSURE AND AIRWAY. GIVE ARTIFICIAL RESPIRATION IF BREATHING HAS STOPPED. GIVE OXYGEN IF RESPIRATION IS DEPRESSED. DO NOT GIVE EPINEPHRINE OR OTHER STIMULANTS THAT MAY CAUSE VENTRICULLAR ARRHYTHMIAS. GET MEDICAL ATTENTION. LAVAGE AND OXYGEN MUST BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.)

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY SECTION

REACTIVITY:
SLOWLY DECOMPOSES OVER TIME YIELDING HYDROGEN CHLORIDE. AN INHIBITOR IS ADDED TO SCAVENGE THE ACID THAT IS FORMED AND PREVENT CORROSION TO METALS. WATER MAY REACT WITH THE INHIBITOR AND ALLOW THE NATURAL DECOMPOSITION TO OCCUR.

INCOMPATIBILITIES:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
ACETONE: EXPLOSION WHEN EXPOSED TO A BASE.
OXYGEN (LIQUID): EXPLOSION.
OXYGEN (GAS): EXPLOSION IF SUBJECTED TO EXTREME HEAT AND PRESSURE.
SODIUM-POTASSIUM ALLOY: EXPLOSION.
POTASSIUM: POSSIBLE EXPOLSION.
STRONG CAUSTICS: VIOLENT REACTION.
ALUMINUM POWDER: POSSIBLE EXPLOSION UPON HEATING IN A CLOSED SYSTEM.

ONE EXPERIMENT IN MICE AND IN ONE IN RATS BY ORAL ADMINISTRATION AND IN ONE EXPERIMENT BY INHALATION EXPOSURE IN RATS. ALTHOUGH A FEW LIVER TUMORS WERE OBSERVED IN MALE MICE, THESE EXPERIMENTS WERE CONSIDERED TO BE INADEQUATE. THE AVAILABLE DATA DO NOT PERMIT AN EVALUATION OF CARCINOGENICITY.

METHYL CHLOROFORM IS AN EYE, MUCOUS MEMBRANE AND SKIN IRRITANT AND A TOXIC CENTRAL NERVOUS SYSTEM DEPRESSANT. POISONING MAY AFFECT THE HEART AND POSSIBLY LIVER AND KIDNEYS. ALCOHOL MAY POTENTIATE BOTH CARDIAC AND HEPATIC TOXICITY. INHALATION STUDIES WITH COMBINATIONS OF METHYL CHLOROFORM AND PERFLUOROALKYL RESINS INDICATE THAT THE MIXTURES ARE MUCH MORE TOXIC THAN METHYL CHLOROFORM ALONE. EPINEPHRINE OR OTHER STIMULANTS MAY INDUCE VENTRICULLAR ARRHYTHMIAS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
METHYL CHLOROFORM (1,1,1-TRICHLORETHANE):
IRRITANT/NARCOTIC/TOXIC. 1000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- CONCENTRATIONS APPROACHING 1000 PPM HAVE CAUSED IRRITATION, NAUSEA AND VOMITING FOLLOWED BY CENTRAL NERVOUS SYSTEM DEPRESSION WITH HEADACHE, DIZZINESS, WEAKNESS, INCOORDINATION, MENTAL CONFUSION AND UNCONSCIOUSNESS. DEATH MAY OCCUR FROM RESPIRATORY FAILURE. EXPOSURE TO EXCESSIVE CONCENTRATIONS MAY CAUSE MYOCARDIAL SENSITIZATION TO EPINEPHRINE AND SUBSEQUENT DEATH DUE TO CARDIAC ARREST. CONCENTRATIONS BETWEEN 10,000 AND 26,000 PPM CAN CAUSE ANESTHESIA. EXAMINATION OF A FATALITY FROM AN ESTIMATED EXPOSURE OF 60,000 PPM SHOWED PETECHIAL HEMORRHAGING IN THE LUNGS AND BRAIN. ANIMAL STUDIES INDICATE THAT LIVER AND KIDNEY DAMAGE IS MINIMAL. ANIMAL STUDIES WITH MIXTURES OF METHYL CHLOROFORM AND PERFLUOROALKYL RESINS INDICATE THAT THE MIXTURES ARE MUCH MORE TOXIC THAN THE METHYL CHLOROFORM ALONE.

CHRONIC EXPOSURE- A STUDY OF INDUSTRIAL WORKERS EXPOSED TO CONCENTRATIONS OF UP TO 200 PPM FOR SEVERAL MONTHS TO 6 YEARS SHOWED NO ADVERSE EFFECTS RELATED TO EXPOSURE. EXPOSURE TO 500 PPM FOR 7 HOURS A DAY, 5 DAYS A WEEK FOR 6 MONTHS CAUSED NO TOXIC CHANGES IN SEVERAL ANIMAL SPECIES, HOWEVER EXPOSURE OF ANIMALS FOR 3 MONTHS AT CONCENTRATIONS FROM 1000 TO 10,000 PPM CAUSED SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION AND SOME PATHOLOGICAL CHANGES IN THE LIVERS AND LUNGS OF SOME SPECIES. PREGNANT RATS EXPOSED TO CONCENTRATIONS OF 2100 PPM FOR 20 DAYS SHOWED FETAL DEVELOPMENTAL ABNORMALITIES OF THE MUSCULOSKELETAL AND UROGENITAL SYSTEMS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. DO NOT GIVE EPINEPHRINE OR OTHER STIMULANTS THAT MAY CAUSE VENTRICULAR ARRHYTHMIAS. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.). GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
IRRITANT.

ACUTE EXPOSURE- CONTACT WITH THE LIQUID MAY CAUSE IRRITATION AND REDNESS. ANIMAL STUDIES INDICATE THAT SKIN ABSORPTION IS USUALLY MINIMAL, HOWEVER ONE STUDY INDICATED THAT LETHAL AMOUNTS MAY BE ABSORBED THROUGH THE SKIN.

CHRONIC EXPOSURE- REPEATED SKIN CONTACT MAY PRODUCE A DRY, SCALY, FISSURED DERMATITIS DUE TO THE DEFATTING PROPERTIES OF THE LIQUID.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL

MAGNESIUM: VIOLENT DECOMPOSION WITH RELEASE OF HYDROGEN CHLORIDE.
NATURAL RUBBER: DECOMPOSES.
SODIUM: SPONTANEOUSLY FLAMMABLE COMPOUND FORMED.
SODIUM HYDROXIDE: SPONTANEOUSLY FLAMMABLE COMPOUND FORMED.
NITROGEN TETRAOXIDE: EXPLOSION IF SUBJECTED TO SHOCK.
POTASSIUM HYDROXIDE: SPONTANEOUSLY FLAMMABLE COMPOUND FORMED.
STRONG OXIDIZERS: VIOLENT REACTION.

DECOMPOSITION:
THE SUBSTANCE WILL DECOMPOSE AT HIGH TEMPERATURES UPON CONTACT WITH HOT METAL OR UNDER ULTRAVIOLET RADIATION TO PRODUCE TOXIC AND CORROSIVE GASES SUCH AS HYDROGEN CHLORIDE, DICHLOROACETYLENE, CHLORINE, AND SOME PHOSGENE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

STORAGE: STORE IN A COOL, DRY, WELL-VENTILATED LOCATION, AWAY FROM ANY AREA WHERE THE FIRE HAZARD MAY BE ACUTE (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.
CONTAINER MAY EXPLODE IN HEAT OF FIRE.
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3)

SPILLS AND LEAKS

OCCUPATIONAL-SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND, EARTH OR OTHER ABSORBENT MATERIAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR,

29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):

1000 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE.
ANY SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 10/25/84 REVISION DATE: 11/06/87

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MATERIAL SAFETY DATA SHEET OHS08980

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 60-29-7
RTEC-NUMBER KI5775000

SUBSTANCE: ETHYL ETHER

TRADE NAMES/SYNONYMS:
DIETHYL ETHER: ETHOXYETHANE: ETHER: ETHYL OXIDE: DIETHYL OXIDE: SURFURIC ETHER: U117: STCC 4908157: UN 1155: E-194: E-193: E-138: E-133: E-492: OHS08980

CHEMICAL FAMILY:
ETHER, ALIPHATIC

MOLECULAR FORMULA: C4-H10-O MOLECULAR WEIGHT: 74.0

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=1 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=4 REACTIVITY=1

COMPONENTS AND CONTAMINANTS

COMPONENT: ETHYL ETHER PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
ETHYL ETHER:
400 PPM OSHA TWA
400 PPM ACGIH TWA; 500 PPM ACGIH STEL

PHYSICAL DATA

DESCRIPTION: COLORLESS, VOLATILE, MOBILE LIQUID WITH AN ETHEREAL ODOR AND ABURNING SWEET TASTE.

BOILING POINT: 95 F (35 C) MELTING POINT: -190 F (-123 C)

SPECIFIC GRAVITY: 0.7 EVAPORATION RATE: (BU ACETATE=1) 37.5

SOLUBILITY IN WATER: 6.9% VAPOR DENSITY: 2.6

VAPOR PRESSURE: 442 MMHG @ 20 C ODOR-THRESHOLD: 0.33 PPM

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
ALCOHOL, ACETONE, BENZENE, CHLOROFORM, SOLVENT NAPHTHA

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
DANGEROUS FIRE AND EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.
MAY ACCUMULATE STATIC ELECTRIC CHARGES THAT RESULT IN IGNITION OF ITS VAPORS.
VAPOR-AIR MIXTURES ARE EXPLOSIVE. MAY FORM EXPLOSIVE PEROXIDES IF EXPOSED
TO AIR OR LIGHT FOR LONG PERIODS OF TIME. VAPORS ARE HEAVIER THAN AIR AND MAY
TRAVEL A CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASHBACK.

FLASH POINT: -49 F (-45 C) (CC) UPPER EXPLOSION LIMIT: 48%

LOWER EXPLOSION LIMIT: 1.9% AUTOIGNITION TEMP.: 356 F (180 C)

FLAMMIBILITY CLASS (OSHA): IA

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH
WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE
AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA
AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING
SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY
RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING QUANTITIES AS A
FOG, SOLID STREAMS MAY SPREAD FIRE. COOL CONTAINERS WITH FLOODING AMOUNTS OF
WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS
KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES.
EVACUATE DOWNWIND FOR LEAKS.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS,
EIGHTH EDITION).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH
EDITION).

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: NONE

TOXICITY

ETHYL ETHER:
100 PPM EYE-HUMAN IRRITATION; 360 MG OPEN SKIN-RABBIT MILD IRRITATION; 100 MG EYE-RABBIT MODERATE IRRITATION; 50 MG/24 HOURS SKIN-GUINEA PIG SEVERE IRRITATION; 420 MG/KG ORAL-HUMAN LDLO; 260 MG/KG ORAL-MAN LDLO; 200 PPM INHALATION-HUMAN TCLO; 1215 MG/KG ORAL-RAT LD50; 73,000 PPM/2 HOURS INHALATION-RAT LC50; 6500 PPM/99 MINUTES INHALATION-MOUSE LC50; 2420 MG/KG INTRAPERITONEAL-MOUSE LD50; 8 MG/KG SUBCUTANEOUS-MOUSE LDLO; 996 MG/KG INTRAVENOUS-MOUSE LD50; 76,000 PPM INHALATION-DOG LCLO; >20 ML/KG SKIN-RABBIT LD50 (38MKAJ); MUTAGENIC DATA (RTEC); CARCINOGEN STATUS: NONE.

ETHYL ETHER IS AN EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT. PERSONS WITH A HISTORY OF CHRONIC SKIN OR RESPIRATORY DISEASE MAY BE AT INCREASED RISK FROM EXPOSURE. THE USE OF ALCOHOLIC BEVERAGES ENHANCES THE TOXIC EFFECT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ETHYL ETHER:
IRRITANT/NARCOTIC. 19,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- INHALATION OF VAPORS MAY CAUSE IRRITATION TO THE RESPIRATORY TRACT. HUMAN ODOR DETECTION MAY BEGIN AT 0.7 PPM. NASAL IRRITATION MAY OCCUR AT 200 PPM. HIGHER CONCENTRATIONS MAY BEGIN TO PRODUCE CENTRAL NERVOUS SYSTEM DEPRESSION WITH DROWSINESS, DIZZINESS, NAUSEA, HEADACHE, STUPOR, AND UNCONSCIOUSNESS. HOWEVER, CONCENTRATIONS OF 7000 PPM HAVE BEEN TOLERATED BY SOME WORKERS WITHOUT UNTOWARD EFFECTS. INITIAL SYMPTOMS MAY INCLUDE VOMITING, PALLOR, EXCITEMENT TO DROWSINESS, LOWERING OF THE PULSE AND BODY TEMPERATURE, IRREGULAR RESPIRATION, MUSCULAR RELAXATION, AND EXCESSIVE SALIVATION. TEMPORARY AFTER EFFECTS OF EXPOSURE MAY INCLUDE VOMITING, SALIVATION, IRRITATION OF RESPIRATORY PASSAGES, HEADACHES, AND DEPRESSION OR EXCITATION. ALBUMIN MAY APPEAR IN THE URINE AND POLYCYTHEMIA IN THE BLOOD. 19,000 PPM IS CONSIDERED THE LOWEST ANESTHESIA-PRODUCING DOSE. THEREFORE, THERE IS A LARGE MARGIN OF SAFETY BETWEEN THE CONCENTRATIONS CAUSING NASAL IRRITATION AND THOSE CAUSING ANESTHESIA, PERMANENT DAMAGE OR DEATH. DEATH HAS BEEN REPORTED FROM RESPIRATORY PARALYSIS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE ANOREXIA, EXHAUSTION, HEADACHE, DROWSINESS, DIZZINESS, EXCITATION, AND PSYCHIC DISTURBANCES. DAMAGE TO THE LIVER AND KIDNEY MAY OCCUR. TOLERANCE MAY BE ACQUIRED THROUGH REPEATED EXPOSURES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
ETHYL ETHER:
IRRITANT.

ACUTE EXPOSURE- CONTACT WITH THE SKIN MAY CAUSE IRRITATION BY DEFATTING AND DRYING OF THE SKIN. ABSORPTION THROUGH HUMAN SKIN IS NOT GREAT ENOUGH TO CAUSE A DELETERIOUS EFFECT. HOWEVER, >20 MG/KG CAUSED DEATH IN ANIMALS TESTED.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DERMATITIS WITH CRACKING AND DRYING OF THE SKIN DUE TO THE EXTRACTION OF OILS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
ETHYL ETHER:
IRRITANT.
ACUTE EXPSOURE- VAPORS MAY CAUSE IRRITATION. THE UNDILUTED LIQUID MAY CAUSE PAINFUL INFLAMMATION OF A TRANSITORY NATURE. AN EXAMINATION OF A HUMAN EYE AFTER A GENEROUS SPLASH SHOWED DULLING OF THE CORNEA.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
ETHYL ETHER:
NARCOTIC.
ACUTE EXPOSURE- INGESTION MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION WITH NAUSEA, VOMITING, DROWSINESS, AND DIZZINESS. THE FATAL AMOUNT IS ESTIMATED AT 1 OR 2 OUNCES. SYMPTOMS MAY BE SIMILAR TO ETHANOL INTOXICATION EXCEPT THAT ONSET IS MORE RAPID AND DURATION IS SHORTER. BECAUSE OF ITS VOLATILITY, THE STOMACH MAY BECOME PROMPTLY DISTENDED WHICH MAY HINDER BREATHING.
CHRONIC EXPOSURE- REPEATED DRINKING OF ETHER HAS BEEN REPORTED RESULTING IN THE DEVELOPMENT OF THE "ETHER HABIT" AND GENERAL DEBILITY.

FIRST AID- ESTABLISH AIRWAY AND MAINTAIN RESPIRATION. REMOVE VOLATILE ANESTHETICS BY FORCED VENTILATION. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.) GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY SECTION

REACTIVITY:
IN THE PRESENCE OF OXYGEN, OR ON LONG STANDING, OR WHEN CONTAINED IN BOTTLES AND EXPOSED TO SUNLIGHT, UNSTABLE PEROXIDES SOMETIMES FORM WHICH MAY EXPLODE SPONTANEOUSLY OR WHEN HEATED.

INCOMPATIBILITIES:
ETHYL ETHER:
ACETYL PEROXIDE: POSSIBLE VIOLENT EXPLOSION.
AIR: VIGOROUS REACTION.
BROMINE: VIOLENT REACTION.
BROMINE AZIDE: FORMATION OF EXPLOSIVE SOLUTION.
BROMINE PENTAFLURIDE: FIRE AND EXPLOSION HAZARD.
BROMINE TRIAZIDE: DETONATION.
BROMINE TRIFLUORIDE: EXPLOSION.
CHLORINE: IGNITION.
CHROMIC ANHYDRIDE: VIOLENT REACTION.
CHROMYL CHLORIDE: IGNITION.
FLUORINE NITRATE: EXPLOSION HAZARD.
HYDROGEN PEROXIDE: VIOLENT DETONATION.

IODINE HEPTAFLUORIDE: IGNITION.
IODINE (VII) OXIDE: EXPLOSION HAZARD.
LIQUID AIR: VIGOROUS REACTION.
LITHIUM ALUMINUM HYDRIDE: EXPLOSION HAZARD.
NITRIC ACID: EXPLOSION HAZARD.
NITROSYL PERCHLORATE: EVOLVES GAS THEN EXPLODES.
NITRYL PERCHLORATE + BENZENE: EXPLOSION HAZARD.
OZONE: EXPLOSION HAZARD.
PEAT SOILS: EXPLOSION HAZARD.
PERCHLORIC ACID: EXPLOSION HAZARD.
PERMANGANIC ACID: EXPLOSION HAZARD.
PEROXODISULFURIC ACID: EXPLOSION HAZARD.
POTASSIUM PEROXIDE: SPONTANEOUSLY FLAMMABLE.
SILVER PERCHLORATE: VIOLENT EXPLOSION.
SODIUM PEROXIDE: IGNITION.
SULFONYL CHLORIDE: VIGOROUS DECOMPOSITION.
SULFUR: EXPLOSION HAZARD.
THIOTRIAZYL PERCHLORATE: EXPLOSION HAZARD.
TRIETHYLALUMINUM DIETHYL ETHERATE: SPONTANEOUSLY FLAMMABLE.
URANYL NITRATE: POSSIBLE DETONATION.
WOOD PULP EXTRACTS: EXPLOSION HAZARD.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

STORAGE: PROTECT AGAINST PHYSICAL DAMAGE. DETACHED OUTSIDE STORAGE IS PREFERRED. INSIDE STORAGE SHOULD BE IN A STANDARD FLAMMABLE LIQUIDS STORAGE ROOM OR CABINET. ISOLATE FROM OTHER COMBUSTIBLE MATERIALS. AVOID DIRECT SUNLIGHT. PROTECT AGAINST STATIC ELECTRICITY AND LIGHTNING. FOR LARGE QUANTITY STORAGE ROOMS, PROTECT WITH AUTOMATIC SPRINKLER SYSTEMS AND TOTAL FLOODING CARBON DIOXIDE SYSTEMS. THE REACTIVITY HAZARD MAY BE INCREASED TO 3 ON LONG STANDING DUE TO PEROXIDE FORMATION. SEPARATE FROM OXIDIZING MATERIALS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

ETHERS WHICH CONTAIN PEROXIDES MAY EXPLODE WHEN THE CAPS OR STOPPERS OF THEIR CONTAINERS ARE REMOVED.

SPILLS AND LEAKS

OCCUPATIONAL-SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

ETHYL ETHER:

1000 PPM- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).
ANY POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).

4000 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

10,000 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

19,000 PPM- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 09/28/84 REVISION DATE: 12/29/87

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MATERIAL SAFETY DATA SHEET OHS09570

OCCUPATIONAL HEALTH SERVICES, INC.
450 SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212)-967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615)292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 60-00-4
RTEC-NUMBER AH4025000

SUBSTANCE: ETHYLENEDIAMINETETRAACETIC ACID

TRADE NAMES/SYNONYMS:
EDTA: VERSENE: ETHYLENEDINITRILOTETRAACETIC ACID: ENDRATE: SEQUESTRIC ACID: QUESTREX 4H: EDETIC ACID: CHEELOX: TITRIPLEX: PERMA KLEER 50 ACID: CHEMCOLOX 340: GLYCINE, N,N'-1,2-ETHANEDIYLBIS(N-(CARBOXYMETHYL)-: ACETIC ACID, (ETHYLENEDINITRILO)TETRA-: SEQUESTRENE AA: N,N'-1,2-ETHANEDIYLBIS(N-(CARBOXYMETHYL)GLYCINE): (ETHYLENEDINITRILO)TETRAACETIC ACID: EDATHAMIL: NULLAPON B ACID: NA 9117: E-478: OHS09570

CHEMICAL FAMILY:
EDETATE

MOLECULAR FORMULA: C10-H16-N2-08 MOLECULAR WEIGHT: 292.28

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=U REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=U REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: ETHYLENEDIAMINETETRAACETIC ACID PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
NO OCCUPATIONAL EXPOSURE LIMITS ESTABLISHED BY OSHA, ACGIH, OR NIOSH.

PHYSICAL DATA

DESCRIPTION: ODORLESS, COLORLESS TO WHITE CRYSTALS OR CRYSTALLINE POWDER.

MELTING POINT: 428 F (220 C)
(DECOMPOSES) SPECIFIC GRAVITY: 0.86 @ 20 C

EVAPORATION RATE: NOT AVAILABLE SOLUBILITY IN WATER: 0.05%

PH: 2.8 (SATD AQ SOLN)

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
SOLUBLE IN SOLUTIONS OF ALKALI HYDROXIDES; INSOLUBLE IN COMMON ORGANIC SOLVENTS

OTHER PHYSICAL DATA
DECOMPOSES @ 464 F (240 C)

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
UNKNOWN FIRE AND EXPLOSION HAZARD.

DUST-AIR MIXTURES MAY IGNITE OR EXPLODE.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. DO NOT SCATTER SPILLED MATERIAL WITH MORE WATER THAN NEEDED FOR FIRE CONTROL. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 31).

USE AGENTS SUITABLE FOR TYPE OF SURRONDING FIRE. AVOID BREATHING CORROSIVE DUSTS OR VAPORS, KEEP UPWIND.

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-E

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

ETHYLENEDIAMINETETRAACETIC ACID:
2000 MG/KG ORAL-RAT LD50 (DPIRDU); 397 MG/KG INTRAPERITONEAL-RAT LD50; 250 MG/KG INTRAPERITONEAL-MOUSE LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); CARCINOGEN STATUS: NONE.

ETHYLENEDIAMINETETRAACETIC ACID IS AN EYE, SKIN AND MUCOUS MEMBRANE IRRITANT. POISONING MAY AFFECT THE KIDNEYS. PERSONS WITH RENAL DISEASE OR HEART DISEASE; THOSE WITH A HISTORY OF SEIZURES OR INTRACRANIAL LESIONS; POTASSIUM DEFICIENCY; OR INSULIN-DEPENDENT DIABETICS MAY BE AT INCREASED RISK FROM EXPOSURE. PARENTERAL ADMINISTRATION OF EDTA OR ITS SALTS IN HIGH DOSES MAY CAUSE SEVERE RENAL LESIONS AND TUBULAR NECROSIS, INTERNAL HEMORRHAGE, TRANSIENT BONE MARROW DEPRESSION AND LIFE-THREATENING HYPOCALCEMIA. DEATH MAY OCCUR. PROLONGED PARENTERAL EXPOSURE MAY LEAD TO HYPOKALEMIA, AND ELECTROLYTIC IMBALANCE AND POSSIBLE CARDIAC ARRHYTHMIAS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ETHYLENEDIAMINETETRAACETIC ACID:
IRRITANT.
  ACUTE EXPOSURE- INHALATION MAY CAUSE MUCOUS MEMBRANE IRRITATION WITH SORE THROAT AND COUGHING.
  CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
ETHYLENEDIAMINETETRAACETIC ACID:
IRRITANT.
  ACUTE EXPOSURE- CONTACT MAY CAUSE IRRITATION WITH REDNESS AND PAIN.
  CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH WET SKIN MAY CAUSE MODERATE IRRITATION AND POSSIBLY A MILD BURN.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
ETHYLENEDIAMINETETRAACETIC ACID:
IRRITANT.
  ACUTE EXPOSURE- CONTACT MAY CAUSE IRRITATION WITH REDNESS AND PAIN. MAY CAUSE SOME TRANSIENT CORNEAL INJURY.
  CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH IRRITANTS MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
ETHYLENEDIAMINETETRAACETIC ACID:
  ACUTE EXPOSURE- ALTHOUGH POORLY ABSORBED FROM THE GASTROINTESTINAL TRACT, EDTA MAY BE HARMFUL IF EXCESSIVE QUANTITIES OF LEAD ARE ALSO PRESENT. THERE IS A POSSIBILITY THAT TOTAL BODY STORES OF LEAD MAY BE INCREASED DUE TO ITS CHELATING ACTION.
  CHRONIC EXPOSURE- IN FEEDING STUDIES, RATS FED 250 MG/KG FOR 2 YEARS SHOWED NO EFFECTS AND DOGS FED 250 MG/KG FOR 1 YEAR SHOWED NO EFFECT. EFFECTS ON FEMALE FERTILITY AND ON THE EMBRYO OR FETUS AND FETAL DEVELOPMENTAL ABNORMALITIES HAVE BEEN REPORTED FROM INGESTION ON DAY 7 THROUGH 14 OF PREGNANCY IN RATS.

FIRST AID- TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD LOWER THAN HIPS TO PREVENT ASPIRATION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY SECTION

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
ETHYLENEDIAMINETETRAACETIC ACID:
  CHROMIC ACID: MAY DEGRADE EDTA.
  COPPER: CORROSIVE.
  HYDROGEN PEROXIDE: HIGH CONCENTRATIONS MAY DEGRADE EDTA.
  POTASSIUM PERMANGANATE: MAY DEGRADE EDTA.
  NICKEL: CORROSIVE.
  OXIDIZING AGENTS (STRONG): MAY DEGRADE EDTA.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE TOXIC OXIDES OF CARBON AND NITROGEN.
WHEN HEATED ABOVE 150 C, TENDS TO DECARBOXYLATE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

STORAGE

STORE IN A COOL, DRY, WELL VENTILATED AREA

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

CONDITIONS TO AVOID

AVOID FLAMMABLE MATERIALS AND SOURCES OF HEAT OR FLAME

SPILLS AND LEAKS

SOIL-RELEASE:
DIG A PIT, POND, LAGOON OR HOLDING AREA TO CONTAIN LIQUID OR SOLID MATERIAL. COVER SOLIDS WITH A PLASTIC SHEET TO PREVENT DISSOLVING IN RAIN OR FIREFIGHTING WATER.

WATER-SPILL:
NEUTRALIZE WITH CAUSTIC SODA.

ADD SUITABLE AGENT TO NEUTRALIZE SPILLED MATERIAL TO PH-7.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL-SPILL:
STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CLEAN, DRY CONTAINERS FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON THE CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON THE DATA FOUND IN THE PHYSICAL DATA, HEALTH EFFECTS AND TOXICITY SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION:

CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE(S) WITH A HIGH-EFFICIENCY PARTICULATE FILTER AND FULL FACEPIECE.

HIGH-EFFICIENCY PARTICULATE RESPIRATOR WITH A FULL FACEPIECE.

POWERED AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY FILTER WITH A FULL FACEPIECE.

TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:

28
88

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 01/23/85 REVISION DATE: 12/09/87

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E M SCIENCE
A DIVISION OF E M INDUSTRIES, INC.
111 WOODCREST DRIVE, CHERRY HILL, N.J. 08034
PHONE (609) 354-9200

MSDS # 1279

MATERIAL SAFETY DATA SHEET
ESSENTIALLY SIMILAR TO U.S. DEPARTMENT OF LABOR FORM OSHA-20
DATE OF PREP. 12/10/85

SECTION 1 NAME & PRODUCT

CHEMICAL NAME: ISO-PROPYL ALCOHOL

CATALOG NUMBER: PX1830 PX1834 PX1835

TRADE NAME: ISOPROPANOL, 2-PROPANOL MOLECULAR
CAS #: 67-63-0 CHEMICAL FAMILY: ALIPHATIC ALCOHOL WEIGHT
FORMULA: CH3CHOHCH3 60.10

SECTION 2 PHYSICAL DATA

BOILING POINT 760 MM HG 82.3C | SPECIFIC GRAVITY (H2O=1) 0.7854
MELTING POINT -88.5C | SOLUBILITY IN H2O,% BY WT @20 C MISCIBLE
VAPOR PRES. @ 20C 33 MM HG | EVAPORATION RATE (BUTYL ACETATE=1) 2.4
VAPOR DENSITY (AIR=1) 2.07 | APPEARANCE AND ODOR CLEAR, COLORLESS LIQUID
% VOLATILES BY VOLUME 100 | WITH CHARACTERISTIC ODOR

SECTION 3 FIRE & EXPLOSION HAZARD DATA

FLASH POINT/TEST METHOD: 53F (TCC) FLAMMABLE LIMITS:LEL% 2 UEL% 12

EXTINGUISHING MEDIA:
DRY CHEMICAL, CO2, "ALCOHOL" FOAM, WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS AND DISPERSE VAPORS

SPECIAL HAZARDS:
WEAR SELF-CONTAINED BREATHING APPARATUS, PROTECTIVE CLOTHING

UNUSUAL FIRE AND EXPLOSION HAZARDS:
DANGEROUS HAZARD WHEN EXPOSED TO HEAT, FLAME

SECTION 4 REACTIVITY DATA

STABLE X CONDITIONS TO AVOID:
HEAT, FLAME, IGNITION SOURCE

MATERIALS TO AVOID:
( ) WATER (X) ACIDS ( ) BASES ( ) CORROSIVES (X) OXIDIZERS
(X) OTHER:HALOGENS AND HALOGEN COMPOUNDS

CONTINUED ON PAGE 2

MSDS # 1279

ISO-PROPYL ALCOHOL
MATERIAL SAFETY DATA SHEET

SECTION 7 SPECIAL PROTECTION INFORMATION

VENTILATION, RESPIRATORY PROTECTION, PROTECTIVE CLOTHING, EYE PROTECTION:
PROVIDE ADEQUATE GENERAL MECHANICAL & LOCAL EXHAUST VENTILATION.
PROTECT EYES AND SKIN WITH SAFETY GOGGLES AND GLOVES.
AIR-SUPPLIED MASK MAY BE NECESSARY.

SECTION 8 SPECIAL HANDLING AND STORING PRECAUTIONS

SPECIAL HANDLING AND STORING PRECAUTIONS:
KEEP CONTAINER TIGHTLY CLOSED
STORE IN A COOL, WELL-VENTILATED, FIRE-PROOF AREA
STORE AWAY FROM COMBUSTIBLES, ACIDS AND OXIDIZING MATERIAL

SECTION 9 HAZARDOUS INGREDIENTS

HAZARDOUS INGREDIENTS:
UNKNOWN

SECTION 10 OTHER INFORMATION

NFPA 704 : 1 3 0
HEALTH FLAMMABILITY REACTIVITY

COMMENTS:

MATERIAL SAFETY DATA SHEET ORG00120

OCCUPATIONAL HEALTH SERVICES, INC.
SEVENTH AVENUE, SUITE 2407
NEW YORK, NEW YORK 10123
(800) 445-MSDS (212) 967-1100

EMERGENCY CONTACT:
JOHN S. BRANSFORD, JR. (615) 292-1180

SUBSTANCE IDENTIFICATION

CAS-NUMBER 64-19-7
RTEC-NUMBER AF1340000

SUBSTANCE: ACETIC ACID, GLACIAL

OTHER NAMES/SYNONYMS:
ACETIL ACID; GLACIAL ACLITIC ACID; ETHANOIC ACID; VINEGAR ACID; GLACIAL ACID; PYROLIGNEOUS ACID; METHANECARBOXYLIC ACID; STCC 4731303; UN 2789; A-32; A-34; A-38; A-39-P; A-39-S; A-39-S; A-507; A-465; C-24402; ORG00120

CHEMICAL FAMILY:
CARBOXYLIC ACID, ALIPHATIC

MOLECULAR FORMULA: C2H4O2 MOLECULAR WEIGHT: 60.05

HMIS RATINGS (SCALE 0-3): HEALTH=2, FIRE=2 REACTIVITY=1 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=2 REACTIVITY=1

COMPONENTS AND CONTAMINANTS

COMPONENT: ACETIC ACID, GLACIAL PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMIT:
ACETIC ACID, GLACIAL:
10 PPM (25 MG/M3) OSHA TWA
10 PPM (25 MG/M3) ACGIH TWA; 15 PPM (37 MG/M3) ACGIH STEL

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS LIQUID WITH A STRONG, PUNGENT, CHARACTERISTIC ODOR OF VINEGAR AND WHEN WELL DILUTED WITH WATER, AN ACID TASTE.

BOILING POINT: 244 F (118 C) MELTING POINT: 62 F (17 C)

SPECIFIC GRAVITY: 1.0492 EVAPORATION RATE: (BUTYL ACETATE=1) 0.97

SOLUBILITY IN WATER: VERY SOLUBLE VAPOR DENSITY: 2.07

VAPOR PRESSURE: 11.6 MMHG @ 20 C PH: 2.4 (1.0 M SOL.)

ODOR-THRESHOLD: 1.0 PPM

OTHER SOLVENTS (SOLVENT - SOLUBILITY):
SOLUBLE IN ETHANOL, GLYCEROL, ETHER, ACETONE, BENZENE, CARBON TETRACHLORIDE; INSOLUBLE IN CARBON DISULFIDE, CHLOROFORM, DIMETHYL SULFOXIDE

OTHER PHYSICAL DATA
VISCOSITY: 1.22 CPS @ 20 C

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD
MODERATE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 103 F (39 C) (CC)

UPPER EXPLOSION LIMIT: 19.9% @ 200 F

LOWER EXPLOSION LIMIT: 4.0%

AUTOIGNITION TEMP.: 867 F (464 C)

FLAMMABILITY CLASS (OSHA): II

FIRE-FIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. DO NOT GET WATER INSIDE CONTAINER. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE. (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 29).

USE FLOODING AMOUNTS OF WATER AS A FOG; SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. USE WATER SPRAY TO ABSORB CORROSIVE VAPORS. AVOID BREATHING CORROSIVE VAPORS; KEEP UPWIND.

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

FIRE FIGHTING MEDIA: USE WATER SPRAY, DRY CHEMICAL, ALCOHOL FOAM, OR CARBON DIOXIDE. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL. IF A LEAK OR SPILL HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE THE VAPORS AND TO PROTECT THE MEN ATTEMPTING TO STOP A LEAK. WATER SPRAY MAY BE USED TO FLUSH SPILLS AWAY FROM EXPOSURES AND TO DILUTE SPILLS TO NONFLAMMABLE MIXTURES (NFPA 49, HAZARDOUS CHEMICAL DATA, 1975).

TRANSPORTATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101: CORROSIVE MATERIAL

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402: CORROSIVE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.245
EXCEPTIONS: 49CFR173.244

TOXICITY

ACETIC ACID, GLACIAL:
IRRITATION DATA: 50 MG/24 HOURS SKIN-HUMAN MILD; 525 MG OPEN SKIN-RABBIT SEVERE; 50 MG/24 HOURS SKIN-RABBIT MILD; 50 UG OPEN EYE-RABBIT SEVERE; 20 MG/24 HOURS SKIN-RABBIT MODERATE; 5 MG/30 SECONDS RINSED EYE-RABBIT MILD
TOXICITY DATA: 816 PPM/3 MINUTES INHALATION-HUMAN TCLO; 16,000 PPM/4 HOURS INHALATION-RAT LCLO; 5620 PPM/1 HOUR INHALATION-MOUSE LC50; 1060 MG/KG SKIN-RABBIT LD50; 1470 UG/KG ORAL-HUMAN TDLO; 3530 MG/KG ORAL-RAT LD50; 1760 MG/KG ORAL-RABBIT LDLO; 525 MG/KG INTRAVENOUS-MOUSE LD50; 308 MG/KG UNREPORTED-MAN LDLO; 1200 MG/KG SUBCUTANEOUS-MOUSE LDLO; 1200 MG/KG RECTAL-RABBIT LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
TARGET EFFECTS: CORROSIVE- EYE, SKIN, MUCOUS MEMBRANES.
ACUTE TOXICITY LEVEL: MODERATELY TOXIC BY INHALATION, DERMAL ABSORPTION, INGESTION.
TARGET EFFECTS: POISONING MAY AFFECT THE LIVER, KIDNEYS, AND CARDIOVASCULAR SYSTEM.
MEDICAL INCREASED RISK: PERSONS WITH A HISTORY OF RESPIRATORY, SKIN OR EYE DISEASE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ACETIC ACID, GLACIAL:
CORROSIVE. 1000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- MAY CAUSE SEVERE IRRITATION OF THE RESPIRATORY TRACT. 50 PPM OR MORE IS INTOLERABLE TO MOST PERSONS AND RESULTS IN PHARYNGEAL EDEMA AND CHRONIC BRONCHITIS. OTHER SYMTPOMS MAY INCLUDE COUGHING, DYSPNEA, SHORTNESS OF BREATH, LARYNGITIS, PULMONARY EDEMA, BRONCHOPNEUMONIA AND HYPOTENSION.
CHRONIC EXPOSURE- WORKERS REPEATEDLY EXPOSED TO CONCENTRATIONS UP TO 200 PPM HAVE BEEN FOUND TO SUFFER FROM PALPEBRAL EDEMA WITH HYPERTROPHY OF THE LYMPH NODES, CHRONIC PHARYNGITIS, CHRONIC BRONCHITIS AND IN SOME CASES, ASTHMATIC BRONCHITIS AND TRACES OF EROSION OF THE TEETH. COMPLAINTS OF DIGESTIVE DISORDERS WITH PYROSIS AND CONSTIPATION HAVE ALSO BEEN REPORTED.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING IS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN

SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
ACETIC ACID, GLACIAL:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE SEVERE IRRITATION WITH PAIN, BURNS, ERYTHEMA, BLISTERS AND SUPERFICIAL DESTRUCTION OF THE SKIN WITH SLOW HEALING. THE SKIN MAY BECOME BLACKENED, HYPERKERATOTIC AND FISSURED.
CHRONIC EXPOSURE- REPEATED AND PROLONGED CONTACT MAY CAUSE DARKENING OF THE SKIN, IRRITATION AND DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
ACETIC ACID, GLACIAL:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT CAUSES SEVERE IRRITATION, LACRIMATION, CORNEAL EROSION, OPACIFICATION, IRITIS AND POSSIBLY LOSS OF SIGHT IN HUMANS. REGENERATION OF THE EPITHELIUM MAY TAKE MANY MONTHS, BUT CORNEAL ANESTHESIA AND OPACITY WILL USUALLY BE PERMANENT. IN LESS SEVERE CASES, CONJUNCTIVITIS, PHOTOPHOBIA AND HYPEREMIA OF THE CONJUNCTIVA OCCURRED. THE VAPOR AND DILUTE SOLUTIONS MAY CAUSE CONJUNCTIVAL HYPEREMIA AND SOMETIMES INJURY TO THE CORNEAL EPITHELIUM.
CHRONIC EXPOSURE- DEPENDING ON THE CONCENTRATION AND DURATION OF EXPOSURE, EFFECTS SIMILAR TO ACUTE EXPOSURE MAY OCCUR.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
ACETIC ACID, GLACIAL:
CORROSIVE.
ACUTE EXPOXURE- IN CASES OF ACCIDENTAL INGESTION, SEVERE ULCERONECROTIC LESIONS OF THE UPPER DIGESTIVE TRACT, STRICTURE OF THE ESOPHAGUS, AND PERFORATION OF THE ESOPHAGUS AND PYLORUS HAVE BEEN OBSERVED WITH HEMATEMESIS, DIARRHEA, SHOCK, HEMOGLOBINURIA FOLLOWED BY ANURIA AND UREMIA. OTHER SYMPTOMS MAY INCLUDE VOMITING, ABDOMINAL SPASMS, THIRST, DIFFICULTY IN SWALLOWING, HYPOTHERMIA, RAPID AND WEAK PULSE, SLOW AND SHALLOW BREATHING, LARYNGITIS, BRONCHITIS, PULMONARY EDEMA, PNEUMONIA, HEMOLYSIS, ALBUMINURIA, HEMATURIA, TWITCHING, CONVULSIONS, CARDIOVASCULAR COLLAPSE, SHOCK AND DEATH. EFFECTS ON THE NEWBORN HAVE BEEN REPORTED IN RATS FROM 700 MG/KG, ADMINISTERED 18 DAYS AFTER GESTATION.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- DO NOT USE GASTRIC LAVAGE OR EMESIS. DILUTE THE ACID IMMEDIATELY BY DRINKING LARGE QUANTITIES OF WATER OR MILK. IF VOMITING PERSISTS, ADMINISTER FLUIDS REPEATEDLY. INGESTED ACID MUST BE DILUTED APPROXIMATELY 9 TIMES TO RENDER IT HARMLESS TO TISSUES. MAINTAIN AIRWAY AND TREAT SHOCK. (GREENBERG, HANDBOOK OF POISONING, 11TH ED.). GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY SECTION

REACTIVITY:
REACTS EXOTHERMICALLY WITH WATER.

INCOMPATIBILITIES:
ACETIC ACID, GLACIAL:
ACETALDEHYDE: VIOLENT, EXOTHERMIC POLYMERIZATION REACTION.
ACETIC ANHYDRIDE + WATER: VIOLENT, EXOTHERMIC REACTION.
2-AMINOETHANOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
AMMONIUM NITRATE: IGNITES ON WARMING, ESPECIALLY IF CONCENTRATED.
5-AZIDOTETRAZOLE: POSSIBLE EXPLOSIVE REACTION.
BASES: EXOTHERMIC REACTION.
BROMINE PENTAFLUORIDE: FIRE AND EXPLOSION HAZARD.
CARBONATES: INCOMPATIBLE.
CHLORINE TRIFLUORIDE: VIOLENT, POSSIBLY EXPLOSIVE REACTION.
CHLOROSULFONIC ACID: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CHROMIC ACID: EXPLOSIVE REACTION IF NOT KEPT COLD.
CHROMIUM TRIOXIDE: POSSIBLE FIRE AND EXPLOSION HAZARD.
DIALLYL METHYL CARBINOL AND OZONE: EXPLOSIVE REACTION.
ETHYLENE DIAMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ETHYLENEIMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
HYDROGEN PEROXIDE: EXOTHERMIC REACTION ON HEATING WITH THE PRODUCTION OF PERACETIC ACID WHICH WILL EXPLODE AT 110 C.
HYDROXIDES: INCOMPATIBLE.
LEAD: CORRODES.
METALS: ATTACKS MOST METALS, INCLUDING ZINC.
NITRIC ACID: EXPLOSIVE REACTION IF NOT KEPT COLD.
NITRIC ACID AND ACETONE: EXPLOSIVE REACTION (DELAYED) IN CLOSED CONTAINER.
OLEUM: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
OXIDIZERS: VIOLENT REACTION.
PERCHLORIC ACID: EXPLOSIVE REACTION.
PERMANGANATES: EXPLOSIVE REACTION IF NOT KEPT COLD.
PHOSPHATES: INCOMPATIBLE.
PHOSPHORUS ISOCYANATE: VIOLENT REACTION.
PHOSPHORUS TRICHLORIDE: EXPLOSIVE REACTION.
POTASSIUM HYDROXIDE: VIOLENT REACTION.
POTASSIUM PERMANGANATE: POSSIBLE EXPLOSION IF INADEQUATELY COOLED.
POTASSIUM TERT-BUTOXIDE: IGNITION REACTION.
SODIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
SODIUM PEROXIDE: EXPLOSIVE REACTION IF NOT KEPT COLD.
XYLENE: FORMS EXPLOSIVE COMPOUND UNLESS WATER IS PRESENT.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE-DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

PROTECT AGAINST PHYSICAL DAMAGE. DETACHED STORAGE IS PREFERRED. SEPARATE FROM OXIDIZING MATERIALS AND AVOID STORAGE NEAR COMBUSTIBLE MATERIALS. KEEP ABOVE ITS FREEZING POINT (62 F) TO AVOID RUPTURE OF CARBOYS AND GLASS CONTAINERS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983, RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

SPILLS AND LEAKS

SOIL-RELEASE:
DIG A HOLDING AREA SUCH AS A PIT, POND OR LAGOON TO CONTAIN SPILL AND DIKE SURFACE FLOW USING BARRIER OF SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB LIQUID MASS WITH FLY ASH OR CEMENT POWDER.

NEUTRALIZE WITH CAUSTIC SODA (NAOH) OR SODA ASH (NA2CO3).

AIR-RELEASE:
KNOCK DOWN VAPORS WITH WATER SPRAY. KEEP UPWIND.

WATER USED TO KNOCK DOWN VAPORS MAY BECOME CORROSIVE OR TOXIC AND SHOULD BE CONTAINED PROPERLY FOR LATER DISPOSAL.

WATER-SPILL:
NEUTRALIZE WITH CAUSTIC SODA.

OCCUPATIONAL-SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. DO NOT GET WATER INSIDE CONTAINER. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT SECTION

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

ACETIC ACID, GLACIAL:

250 PPM- SUPPLIED-AIR RESPIRATOR OPERATED IN CONTINUOUS FLOW MODE.
POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).

500 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH FULL FACEPIECE AND ORGANIC VAPOR CARTRIDGE(S).
SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE.
SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE.
AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
POWERED AIR-PURIFYING RESPIRATOR WITH TIGHT-FITTING FACEPIECE AND ORGANIC VAPOR CARTRIDGE(S).

1000 PPM- SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT

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[illegible]

[illegible] AGENCY WASH FACILITIES:
IF THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED BY - OCCUPATIONAL HEALTH SERVICES, INC.

CREATION DATE: 07/06/84 REVISION DATE: 12/08/86

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