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DRAFT
SOLVENT EXTRACTION BENCH-SCALE TREATABILITY STUDY WORK PLAN

ROCKY FLATS PLANT

Prepared for
U S Department of Energy
Rocky Flats Plant
Golden, Colorado

Environmental Restoration Program

June 1994

This document is intended to comply with the national environmental policy act of 1969

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ADMIN RECORD
SW-A-003757

1/310

Test Plan

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Title: Solvent Extraction Bench-Scale Treatability Study Work Plan

Effective Date: 5/6/94

Approved by:

_____ ____/____/____

Manager, Environmental Restoration Management — Date

_____ ____/____/____

Work Plan Manager — Date

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TABLE OF ACRONYMS

ATI	Analytical Technologies, Inc.
CFR	Code of Federal Regulations
COCs	Constituents of Concern
CTR	Contractors Technical Representative
HLA	Harding Lawson Associates
OU	Operable Unit
QC	Quality Control
QAPP	Quality Assurance Project Plan
RCC	Resources Conservation Company
RCRA	Resource Conservation and Recovery Act
RFP	Rocky Flats Plant
SOP	Standard Operating Procedure
TSBs	Treatability Study Benchmarks
m/	Milliliter
°F	Degrees Fahrenheit
pCi/g	Picocuries per Gram
cm	Centimeter
kg	Kilogram
HASP	Health and Safety Plan
PPE	Personal Protective Equipment
QAA	Quality Assurance Addendum
QC	Quality Control

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TEST PLAN

1.0 PROJECT DESCRIPTION

1.1 Introduction

This Test Plan has been prepared by Resources Conservation Company (RCC) and their subcontractor, Harding Lawson Associates (HLA) as a contract deliverable between EG&G Rocky Flats Plant (RFP) (for the Environmental Restoration Group) and RCC. The purpose of this Test Plan is to describe the objectives and technical approach for the solvent extraction bench-scale treatability study The scope of this Test Plan includes a generalized description of the project objectives, technical test approach, sampling and analysis, health and safety, and quality assurance

This Work Plan was prepared by HLA and RCC for EG&G No other party should rely on this document for any purpose other than was immediately intended without prior written consent from HLA and RCC.

1.2 Project Overview

The purpose of the Treatability Study is to provide data for evaluation of the effectiveness of solvent extraction technology in removing Constituents of Concern (COCs) (i.e., plutonium, americium, uranium) from RFP soil. In addition, the results of the bench-scale study will be used to support the Feasibility Study detailed analysis of alternatives by providing data for evaluation of the effectiveness, reduction in toxicity, mobility, volume, and cost critera.

Triethylamine has been shown to extract plutonium from soil A singular treatability test was performed by AWC-Lockheed in Las Vegas, Nevada, on Idaho National Engineering Laboratory Pit 9 soil during POP testing The test was performed using 500 milliliters (ml) on 250 grams of 50 mesh soil that contained 5860 picocuries per gram (pCi/g) of plutonium contamination. The mixture was contained in a glass beaker and agitated for two hours in a water bath maintained at approximately 40 degrees Fahrenheit (^{O}F). The result indicated that 26 percent of the plutonium was extracted from the soil using the triethylamine. The favorable, but limited, bench-scale results have led to the implementation of this solvent extraction bench-scale study

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Two soil samples and one vegetation sample were collected down-gradient of the 903 pad in Operable Unit (OU) 2 that contained concentrations of plutonium. These samples will be used in bench-scale tests to evaluate the effectiveness of solvent extraction to remediate radionuclide-contaminated soil and vegetation concentrations at or below the Treatability Study Benchmarks (TSBs) These samples were collected from locations that were selected on the basis of plutonium concentrations down-gradient of the 903 pad corresponding to plutonium concentrations from the 903 pad area. The purpose of this treatability study is to provide data to assist in screening and selecting potential technologies for remediating radionuclide-contaminated RFP soil and vegetation such as is found in OU 2.

RCC will perform a solvent extraction bench-scale treatability study at Analytical Technologies, Inc. (ATI), laboratory in Fort Collins, Colorado The bench-scale study will be performed to evaluate the feasibility of using the solvent triethylamine in combination with various feed pretreatment steps that may use oxidants, chelating agents, complexing agents, acid and caustic to remove radionuclides from contaminated soil and vegetation at RFP Triethylamine is a nonregulated, unlisted solvent under Resource Conservation and Recovery Act (RCRA) regulations

Bench-scale treatability testing at RFP will be performed in two phases. During Phase I, bench-scale testing will be performed to identify the optimum process parameters During Phase II, bench-scale testing will be performed using the optimum process parameters identified in Phase I for each of the three feed samples. In addition, Phase II testing will be performed to confirm the ability of solvent extraction to treat radionuclide-contaminated soil and vegetation to concentrations at or below the TSBs for the COCs.

1.3 Site History

Treatability Studies will be performed on soil and vegetation from the 903 Pad. The 903 Pad Area, encompassing the original 903 Drum Storage Site, was used from October 1958 to January 1967 for storage of radioactively contaminated oil drums whose contents were described by Calkins (1970) as follows

"Most of the drums transferred to the field were nominal 55-gallon drums, but a significant number were 30-gallon drums Not all were completely full. Approximately three-fourths of the drums were plutonium contaminated, while most of the balance contained uranium Of those containing plutonium,

most were lathe coolant consisting of a straight-chain hydrocarbon mineral oil (Shell Vitrea) and carbon tetrachloride in varying proportions. Other liquids were involved, however, including hydraulic oils, vacuum pump oil, trichloroethylene, perchloroethylene, silicone oils, acetone still bottoms, etc and in 1959 or possibly earlier, ethanolamine was added to the oil to reduce the corrosion rate of the steel drums."

An estimated 5,000 gallons of liquid (Freiberg, 1970) containing 86 g (5.3(Ci)) of plutonium leaked into the soil Site grading in preparation for applying an asphalt cap over the area included moving "slightly" contaminated soil. A total of 33 drums of radioactively contaminated rocks were removed, and two courses of clean fill material were placed over the site The asphalt covering was applied some two months later (Freiberg, 1970). The cover is approximately 8 centimeters (cm) thick and underlain by approximately 15 cm of loose gravel and 8 cm of fill dirt

The removal of drums and site grading resulted in contaminated soil particles being lifted into the air by turbulence due to wind or by other activities such as excavation or vehicle traffic. This suspension of particles was an important mechanism for release and redistribution of plutonium from the vicinity of the 903 pad. The movement of the suspended contaminants was generally in the direction of the prevailing winds.

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2.0 TREATMENT TECHNOLOGY DESCRIPTION

The RCC B E.S.T process is a mobile batch solvent extraction process designed to extract hazardous contaminants from soils, sludge, and sediment. Unlike other solvent extraction and related soil washing systems, the B.E.S.T. process uses triethylamine to remove contaminants from these media. Triethylamine is an aliphatic amine that is produced by reacting ethyl alcohol with ammonia. Triethylamine's structure gives it dual polarity, which is responsible for its unique properties.

Characteristics that enhance triethylamine's use in a solvent extraction system include the following:

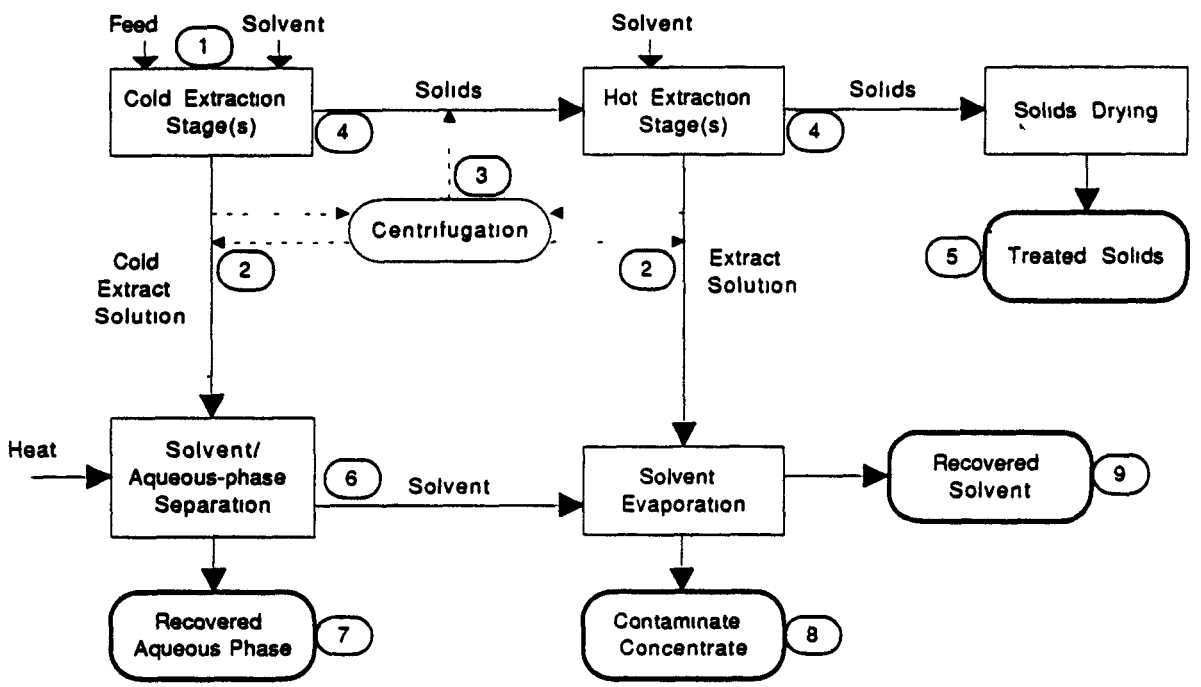
- A high vapor pressure (therefore, the solvent can be recovered from the extract by way of simple steam stripping)
- Formation of a low boiling azeotrope with water (therefore, the solvent can be recovered from the extract solution to very low residual levels)
- A heat of vaporization one-seventh of water (therefore, the solvent can be recovered from solids by simple heat with a low energy input)

There are four basic operations involved in the B E S T solvent extraction process. extraction, solvent recovery, solids drying, and water stripping. A process flow schematic for the B.E S T process is provided in Figure 2-1. However, modifications have been made to these four basic operations to assist in the removal of COCs For example, pretreatment steps may be necessary to solubilize the COCs and facilitate removal of the COCs by triethylamine In addition, this process uses the inverse miscibility property of triethylamine to create a single-phase extraction solution Triethylamine exhibits an inverse miscibility property by being completely miscible with water at or below 60°F However, when heated above 140°F, triethylamine and water are virtually immiscible The inverse miscibility property is used by extracting contaminated soil or vegetation with chilled (below 60°F) triethylamine to form a homogenous, single-phase extract solution. The extract solution is a homogenous solution of triethylamine, organic fraction, COCs, and water originally present in the feed sample or water present as a result of pretreatment of the feed sample Unlike other solvent extraction systems where extraction efficiencies are hindered by emulsions that have the effect of partially obstructing the solute, triethylamine can achieve intimate contact with solutes at nearly ambient temperatures and pressures. This allows the B E S.T process to handle feed samples with high water content without a reduction in extraction efficiency

Before the extraction process is begun, feed sample is screened to remove oversize debris. The feed sample is then introduced into a mixing tank and combined with triethylamine The mixture is agitated until equilibrium is reached After mixing, the solid material settles out.

Once the feed sample is extracted, the extracted solids are removed from the solvent by gravity settling and/or centrifugation. However, multiple extraction stages may be required to achieve treated solid contaminant concentrations at or below the TSBs. The solids are then dried to remove residual solvent. The extract solution is separated into its components. Solvent and water are removed from the extract solution by evaporation and condensation. The contaminants extracted from the feed sample are concentrated in the evaporator. After condensing, the solvent/water mixture is in the temperature range where the solvent and water are only partially miscible Because the solvent has a specific gravity of 0.72 as compared to water at 1 0, the solvent and water are easily separated by decantation. Traces of residual solvent that remain in the recovered water (approximately 2% by weight) are removed by steam stripping.

Figure 2-1 B E S T● Bench-scale Process Flow Schematic



Sample	Location
1	Feed Material
2	Centrate/Extract
3	Centrifuge Cake
4	Resin Kettle Solids
5	Dried Treated Solids
6	Cold Extract Solvent Phase
7	Cold Extract Aqueous Phase
8	Boiling Flask Concentrate
9	Recovered Solvent

3.0 TEST OBJECTIVES

The solvent extraction bench-scale treatability study program was designed with the following objectives:

- Generate performance data to evaluate the feasibility of solvent extraction for treating COCs in soil and vegetation.

- Identify and confirm near optimum operating parameters (i e., number of extraction stages, extraction temperature, pH, solvent ratios, and pretreatment requirements) for removing COCs from contaminated RFP soil and vegetation using triethylamine

- Develop sufficient data to calculate a plutonium and solids mass balance for each of the tests performed during Phase I and Phase II testing.

- Evaluate the effectiveness of triethylamine to remove COCs from the soil and vegetation samples to concentrations at or below the TSBs shown in Table 3-1

Table 3-1. Treatability Study Benchmarks (TSBs)

Radionuclides		
Gross alpha (α)*	5 0	pCi/g
Gross beta (β)*	50 0	pCi/g
Americium 241#	2.38	pCi/g
Plutonium 239+240#	3.65	pCi/g
Uranium 233, 234, 235, 238 (Total)	144	pCi/g

* Potential Applicable or Relevant and Appropriate Requirement (ARAR)

Programmatic Preliminary Remediation Goal (PRG) - Draft

4.0 EXPERIMENTAL DESIGN AND PROCEDURES

4.1 Feed Sample Preparation

4.1.1 Surficial Soil Test Sample Preparation

Two composite untreated surficial soil samples weighing 20 kilograms (kg) each will be submitted to ATI by EG&G for use in the bench-scale tests The analytical laboratory will prepare the samples by screening, blending, and dividing each composite sample to create seven separate subsamples of at least 1 25 kg in weight each Six of these subsamples will be used as feed for the six test runs conducted during Phase I and Phase II testing. The seventh subsample will be used to establish baseline contaminant concentrations prior to testing. Three 250 gram samples will be drawn from this subsample. These samples will be characterized as discussed in Section 4 3.1

The screening process will be performed using a U S Standard Sieve Number 6 to remove material greater than one-fourth-inch in diameter. The screened test samples of minus 0.25 in will then be ~~crushed and~~ blended. The blending processes will involve splitting the composite samples using a riffle splitter or equivalent process and recombining each composite sample to ensure that the soil is thoroughly blended. The material retained on the Number 6 sieve will be containerized and stored until completion of the task.

4.1.2 Vegetation Test Sample Preparation

Vegetation samples will be shredded to the minimum particle size possible. Shredding can be accomplished with a standard blender or equivalent device The screened or shredded feed samples will then be thoroughly homogenized.

4.2 Experimental Test Design Objectives

Phase I optimization tests will be performed to evaluate the removal of plutonium from the feed soil and vegetation samples as a function of process operating parameters described below Five test runs will be performed on each of three feed samples during Phase I testing Phase I analytical and process tests results will be evaluated to determine the apparent optimum process operating parameters required to

reduce plutonium concentrations below the TSBs. The first test run in Phase I will be performed using the standard B E S T. process test protocol. However, the last four test runs will be performed with modifications to the standard test protocol. Modification to the standard test protocol will include pH adjustment, addition of oxidant, complexing agent, chelating agent, and/or cosolvent. Since only five Phase I test runs will be conducted with each sample, in some cases two or more of these parameters may be evaluated in a single test run. Plutonium removal will be evaluated as a function of the following process operating parameters: pH, feed load, solids settling characteristics, extraction time, extraction temperature, oxidant addition, complexing and chelating agent addition, and cosolvent addition.

Phase II confirmation tests will be performed to evaluate the removal of COCs from the feed soil and vegetation samples using the apparent optimized process operating parameters identified in Phase I optimization testing. One test run will be performed on each of three feed samples during Phase II tests. The results from the Phase II tests, which include feed, interstage, and product sample characterization analyses, and plutonium mass balance calculation will be evaluated with operating data to assess the ability of the solvent extraction process to treat RFP soil containing COCs

4.3 Experimental Design Procedures

4 3.1 Feed Sample Characterization

Prior to conducting bench-scale treatability testing, feed sample characterization will be conducted. Characterization will include select radionuclide analyses, pH studies and titration curve construction, total solids analysis, oil and grease analysis, and metals analysis. The analyses that will be conducted to characterize the feed samples are summarized in Table 4-1 This characterization will provide initial process parameters to be used in Phase I testing and possible feed pretreatment steps required.

4.3.2 Solvent Extraction Standard Test Protocol

The solvent extraction standard test protocol involves addition of less than 40°F triethylamine to RFP samples in the initial extraction stages In the final extraction stages, triethylamine will be added at temperatures of about 150°F Following each extraction stage, solids will be separated from the extract solution by gravity settling or centrifugation, if required. The solids are dried following the final extraction stage

In addition, the extract solution from each extraction stage will be evaporated to concentrate the extracted contaminants. Samples collected for analysis during each test run are summarized in Tables 4-2 and 4-3

4.3.3 Feed Sample Pretreatment Approach

Modification to the standard test protocol will include pretreatment procedures. Feed sample pretreatment procedures are based on the results of the feed sample characterization. Feed pretreatment steps will include, but may not be limited to, addition of oxidants, chelating agents, complexing agents, acid or caustic, and water. The compounds, which may be used for feed pretreatment, are presented in Section 5.0

Table 4-1. Summary of Feed Sample Analytical Work

PHASE 1 FEED SAMPLE ANALYSES*

Isotopes	Others
Gross Alpha/beta	pH, titration curve
Gamma Spectrometry	Total Solids
Plutonium-238,239,240	Oil & Grease
Uranium (total)	

PHASE 2 FEED SAMPLE ANALYSES*

Isotopes	Others
Gross Alpha/beta	pH, titration curve
Gamma Spectrometry	Total Solids
Plutonium-238,239,240	Oil & Grease
Uranium (total)	
Americium	

* Sample Location 1 from Figure 2-1

Table 4-2. Phase I Sample Collection

Sample Location*	When Sample Taken	Samples to be Analyzed
1 Feed Sample	1 Prior to the initiation of Phase I testing	1 Refer to Section 4 1
2 Centrate/extract Solution	1 After each extraction stage	1 After first hot extraction stage 2 All others held for future analysis, if required
3 Centrifuge Cake	1 After final cold extraction stage 2 After final hot extraction stage	1 After first cold extraction stage, if centrifugation was performed 2 After first hot extraction stage, if centrifugation was performed
4 Inter Stage Solids Sample	1 After final cold extraction stage 2 After final hot extraction stage	1 After final cold extraction stage 2 After final hot extraction stage
5 Dried Treated Solids	1 After solids drying 2 After solids pH treatment, if performed	1 After solids drying 2 At least one Phase I test will require analysis of pH adjusted solids
6 Cold Extract Solution (Solvent Phase)	1 After separating cold extract solvent and aqueous phases	1 After separating cold extract solution and aqueous phases
7 Cold Extract Solution (Aqueous Phase)	1 After separating cold extract solvent and aqueous phases	1 After separating cold extract solution and aqueous phases
8 Boiling Flask Concentrate Contaminant	1 After concentrating all extract solutions	1 After concentrating all extract solutions
9 Recovered Solvent	1 After concentrating all extract solutions	1 At least one Phase I test will require analysis of recovered solvent

* Sample locations per Figure 2-1

Table 4-3. Phase II Sample Collection

Sample Location*	When Sample Taken	Samples to be Analyzed
1 Feed Sample	1 Prior to Phase I testing	1 Refer to Section 4 1
2 Centrate/extract	1 After each extraction stage	1 After first hot extraction stage 2 All others held for future analysis, if required
3 Centrifuge Cake	1 After final cold extraction stage 2 After final hot extraction stage	1 After first cold extraction stage, if centrifugation was performed 2 After first hot extraction stage, if centrifugation was performed
4 Inter Stage Solids Sample	1 After each extraction stage	1 After each extraction stage
5 Dried Treated Solids	1 After solids drying 2 After solids pH treatment	1 After solids drying 2 After solids pH treatment
6 Cold Extract Solution (Solvent Phase)	1 After separating cold extract solvent and aqueous phases	1 After separating cold extract solution and aqueous phases
7 Cold Extract Solution (Aqueous Phase)	1 After separating cold extract solvent and aqueous phases	1 After separating cold extract solution and aqueous phases
8 Boiling Flask Concentrate Contaminant	1 After concentrating all extract solutions	1 After concentrating all extract solutions
9 Recovered Solvent	1 After concentrating all extract solutions	1 After concentrating all extract solutions

* Sample locations per Figure 2-1

5.0 EQUIPMENT AND MATERIALS

5.1 Glassware Apparatus

a Extraction vessels, 4-liter glass kettles

b. Erlenmeyer flasks, various sizes

c Beakers, various sizes

d. Graduated cylinders

e Funnels

f Centrifuge bottles

g Rotovap® components, including:

- Condensers
- Boiling flasks
- Receiving flasks
- Steam ducts

h Filter apparatus

i Pipets, and other small glassware items

5.2 Reagents

a. Triethylamine, pure

b Sodium hydroxide (NaOH), 50 wt% solution, 5 wt% solution

c Chelating and complexing agents (EDTA, carbonates, bicarbonates, hydroxyl sulfates, phosphates, and fluorides)

d Oxidants (peroxide, hypochlorite, or permanganate)

e Deionized, distilled water

f Acetone, technical grade

g Methylene chloride, technical grade

h. pH meter standardization solutions, pH 4, 7, and 10

i High temperature oil for Rotovap oil bath

j HNO_3

5.3 Other Large Equipment

a Floor mounted centrifuge

b. Forced-draft oven and ducting

c Water heater

d. Chiller bath

e Vacuum pump

f. Rotovap distillation apparatus

g Hotplate/stirrers

h Electronic balance

i pH meter

j Bottle heater

k Support equip for all items above. This includes tubing, clamps, etc

5.4 Miscellaneous Test Equipment

Many smaller items of laboratory equipment will be used. These items include thermometers, filters, logbooks, spatulas, sample collection tools, carboys, stir bars, pipettors, mortar and pestle, and others.

5.5 Personal Protective Equipment

The Health and Safety Plan (HASP) specifies the personal protective equipment (PPE) that will be required during testing. This includes general laboratory wear (leather shoes, safety glasses, etc), respiratory

protection equipment, nitrile gloves, splash protective gear (for transferring solvent), and other PPE as specified in the HASP

5.6 Sample Containers

Sample containers will be provided as specified in Section 4.0 Experimental Design and Procedures The sample containers will generally be glass jars of various sizes up to 1 liter, with Teflon closures

6.0 SAMPLING AND ANALYSIS

The feed material to be tested will be collected from Rocky Flats by EG&G using EG&G Standard Operating Procedures referenced in the Quality Assurance Addendum (QAA). ATI will take custody of the feed materials, and will track the materials during the testing program. Materials will be handled, stored, and tracked per the ATI Radiation Safety Manual, Attachment 1 of Appendix A, and the ATI Chemical Hygiene Plan, Attachment 5 of Appendix A ATI will screen and homogenize the feed material prior to testing as described in Section 4.1

Samples of the feed material will be issued to RCC as needed for performing treatability testing. During the bench testing, RCC personnel will be collecting samples The specific types of samples to be collected for analysis during Phase I and Phase II testing are presented in Tables 4-2 and 4-3 ATI will analyze the samples using the analytical methods and quality assurance protocols specified in the QAA, and per Table 6-1 Analyses to be performed on Phase I and Phase II samples are presented in Tables 6-2 and 6-3, respectively.

During the testing program, sample collection activities will be in accordance with this work plan and the requirements of the ATI Radiation Safety Manual and the ATI Chemical Hygiene Plan Sample collection will involve thorough mixing and compositing protocols to assure the analysis of representative, homogeneous samples An initial sample Chain-Of-Custody form will be completed for each Phase I and Phase II test, and will be used to transfer custody of the test samples from RCC to ATI The Chain-of-Custody will include process stream and treated samples from each test that are to be analyzed by ATI In contrast to the process stream and treated samples, untreated feed samples that are to be analyzed by ATI will be collected directly by ATI, and will never be in the possession of RCC

Table 6-1. Analytical Methods and Detection Limits

Analytes	Analytical Method*	Detection Limit (mg/kg)
Total solids	SW846-3550	N/A
pH	SW846-9040/9045	N/A
Oil and grease	SW846-3540/3520	ATI to Provide
Gross alpha/beta	EPA-600/4-80-032	ATI to Provide
Gamma spectrometry	EPA-600/4-80-032	ATI to Provide
Plutonium-238,239,240	U S A C. Reg. Guide 45	ATI to Provide
Uranium (total)	RFP 4-16200-RHL-0013	ATI to Provide
Americium	U S A C Reg Guide 45	ATI to Provide

* Methods used will be ATI standard operating procedures based on the methods listed below (see Section 5 12 of the QAA).

Table 6-2. Phase I Analytical Program

Sample Location*	Sample Matrix	Total Solids	pH Study	Oil & Grease	Gross Alpha/ Beta	Gamma Spectrometry	Plutonium 238, 239, 240	Uranium (total)	Americium
1 Feed Sample		✓	✓	✓	✓	✓	✓	✓	
2 Centrate/ Extract Solution	Liquid (Solvent)						✓	✓	
3 Centrifuge Cake	Solid	✓					✓	✓	
4 Inter Stage Solids	Solid	✓					✓	✓	
5 Dried Treated Solids	Solid		✓				✓	✓	
6 Cold Extract Solution Solvent Phase	Liquid (Solvent)						✓	✓	
7 Cold Extract Solution Aqueous Phase	Liquid (Water)						✓	✓	
8 Contaminant Concentrate	Liquid (Solvent)	✓					✓	✓	
9 Recovered Solvent	Liquid (Solvent)						✓	✓	

* Sample Locations per Figure 2-1

Table 6-3. Phase II Analytical Program

Sample Location*	Sample Matrix	Total Solids	pH Study	Oil & Grease	Gross Alpha/ Beta	Gamma Spectrometry	Plutonium 238, 239, 240	Uranium (total)	Americium
1 Feed Sample		✓	✓	✓	✓	✓	✓	✓	✓
2 Centrate/ Extract Solution	Liquid (Solvent)						✓	✓	✓
3 Centrifuge Cake	Solid	✓					✓	✓	✓
4 Inter Stage Solids	Solid	✓					✓	✓	✓
5 Dried Treated Solids	Solid		✓	✓	✓	✓	✓	✓	✓
6 Cold Extract Solution Solvent Phase	Liquid (Solvent)						✓	✓	✓
7 Cold Extract Solution Aqueous Phase	Liquid (Water)						✓	✓	✓
8 Contaminant Concentrate	Liquid (Solvent)	✓					✓	✓	✓
9 Recovered Solvent	Liquid (Solvent)						✓	✓	✓

* Sample Locations per Figure 2-1

7.0 DATA MANAGEMENT

The specific procedures and observations from the solvent extraction treatability study will be documented in detail by RCC in bound, project-specific notebooks and/or data sheets. Analytical data will be reported in hardcopy summary reports by ATI, and will be entered into electronic data spreadsheets for review and reporting by RCC. Test data and analytical data will be summarized in RCC's interim and final reports to EG&G. Additionally, project raw data and supporting documentation will be submitted to the ERM Records Center in a timely fashion and comply with the Quality Assurance Project Plan (QAPP) and QAMS-005/80. Samples received and generated during the study will be labeled with unique sample identification numbers. In addition to the unique sample numbers, the source of each sample will be documented. Samples collected during testing will be documented on Chain-Of-Custody sheets. The Chain-Of-Custody sheets will include the sample description, technician collecting sample, date and time of sampling, preservation (if any), containers used, analysis to be made, etc.

A complete history of each feed sample containing radioactive isotopes will be maintained. The history of each sample will be maintained per the ATI Radiation Safety Manual, Attachment 1 of Appendix A. ATI will maintain custody of radioactive materials during the entire test

8.0 DATA ANALYSIS AND INTERPRETATION

Data assessments will also include data quality reviews. These reviews will consist of cursory evaluations of the summarized quality control (QC) results provided by ATI, which will accompany the test sample results. Data quality will be evaluated per the QAA, which describes data usability criteria. The evaluation of data quality will be included in the final reports.

In addition, the results of treatability testing, in conjunction with feed sample characteristics, will be used to assess the preferred process operating conditions for a particular matrix or feed

Results of Phase II treatability tests will be used to evaluate the effectiveness of the treatment process The final residual levels of radioactive isotopes in comparison to the TSBs, the total removal efficiency, and material and contaminant mass balances will be used in the evaluation

9.0 HEALTH AND SAFETY

Health and Safety procedures are included in Appendix C, the Health and Safety Plan.

10.0 RESIDUALS MANAGEMENT

10.1 Waste Feed and Other Process Waste

ATI will maintain control of radioactive samples during the testing. The feed material will be received by ATI. Small portions of feed will be issued to RCC for testing, as it is needed. The feed issued to RCC will immediately be used for testing or in the treatability process.

As samples are taken of in-process streams, and when end products are generated, RCC will properly document their collection. RCC will perform analyses required on the samples taken, and then turn them over, including analysis residuals, to ATI ATI will perform the analyses per Section 4 0 of this Test Plan, and then properly dispose of all samples, including analysis residuals. ATI will collect and segregate samples per ATI Standard Operating Procedure (SOP) 015FCO Samples and analysis residuals which are proven to be non-contaminated may be disposed of by ATI Samples and analysis residuals which are contaminated will be transferred from ATI back to EG&G for disposal by EG&G at RFP.

Residuals anticipated to be generated include unused soils, unused vegetation, soils contacted with triethylamine, vegetation contacted with triethylamine, aqueous solutions, and triethylamine potentially containing unknown constituents.

As with the feed material, Chains-of-Custody shall be maintained on samples, residuals, and waste throughout the entire treatability study.

10.2 Contaminated or Potentially Contaminated Debris

Efforts will be taken to minimize the quantity of contaminated or potentially contaminated debris. Minimization efforts will be performed by limiting the use of disposable materials. Glassware, which can normally be decontaminated and reused for other treatability studies, will be used for bench-scale testing Porous media such as clothing and paper towels will be evaluated for disposal as low level radioactive waste.

Debris which is potentially, but not confirmed to be contaminated, will be kept in separate disposal containers These items will be surveyed by ATI personnel and if found to be clean can be disposed of as unrestricted material. Residual debris anticipated to be generated include· Used PPE, paper towels, and uncleanable glassware.

Debris which is known to be contaminated, as well as debris which is found to be contaminated by testing, will be transferred from ATI to EG&G for disposal by EG&G at RFP at the end of testing.

10.3 Waste Management by RFP

Residuals and investigatory materials will be characterized by process knowledge or assay to establish handling requirements. At RFP, residuals are covered in EMD Operating Procedures Manual (5-21000-OPS-FO. Rev. 51, 07/26/93) or according to building specific requirements for waste disposition.

10.4 Shipping Criteria

The shipping criteria listed below will be followed·

- Solids shall be individually labeled and packaged by U.S. Department of Transportation -certified personnel to ship radionuclide contaminated materials, specifically those regulations found at 49 Code of Federal Rregulations.

- Individual packages shall be uniquely labeled. For example, the plus 0.25-inch soil residuals generated from screening/sample preparation, shall be contained in poly bags of sufficient strength and labeled with a unique number An inventory shall be maintained for each shipping pail containing the individual bags with corresponding characterization data

- Individual packages shall be inventoried and characterized. Proof of characterization shall be supplied from either historical process knowledge or direct laboratory analyses.

- The waste shipper shall certify that no materials have been added to the waste that would render them RCRA waste forms.

- Individual waste packages (bags) of solids shall contain no free liquids.

- The used triethylamine shall be sampled on a drum-by-drum basis for RCRA constituents to verify that the material does not contain RCRA constituents that would render the waste triethylamine a RCRA hazardous waste.

11.0 REPORTS

An interim draft report will be prepared in accordance with Section 3.12 of The Guidance for Conducting Treatability Studies Under CERCLA (U.S. Environmental Protection Agency, 1992) following the completion of each phase of treatability testing, and will document the results of the separation procedures used. A final treatability testing report will be prepared after the study is complete. The final report will incorporate information from the interim draft reports. The following outline will be used as a guide when preparing the final report

Outline for Phase I Interim Report

1 0 Introduction

- 1.1 Phase I Bench-scale Testing Purpose and Objectives

2 0 Process Description and Test Design

- 2.1 Process Design
- 2 2 Phase I Bench-scale Test Design
- 2.3 Phase I Analytical Program Design
- 2 4 QA/QC Program Design

3 0 Results and Discussion

- 3 1 Phase I Bench-scale Testing
  - 3 1 1 Soil Sample #1 Test Results
  - 3 1 2 Soil Sample #2 Test Results
  - 3.1 3 Vegetation Sample Test Results
- 3 2 Evaluation of Phase I Analytical Results
  - 3.2.1 Mass Balance Calculations
  - 3 2 2 Percent Removals
- 3 3 Summary and Recommendations

Outline for Phase II Interim Report

1 0 Introduction

1 1 Phase II Bench-scale Testing Purpose and Objectives

2.0 Process Description and Test Design

2 1 Process Description

2 2 Phase II Bench-scale Test Design

2.3 Phase II Analytical Program Design

2 4 QA/QC Program Design

3 0 Results and Discussion

3 1 Phase II Bench-scale Testing

3 1 1 Soil Sample #1 Test Results

3 1 2 Soil Sample #2 Test Results

3.1 3 Vegetation Sample Test Results

3 2 Evaluation of Phase I Analytical Results

3.3.1 Mass Balance Calculations

3 3.2 Percent Removals

3 3 Summary and Recommendations

Outline for Technical Report Phase I and II

Executive Summary

1.0 Introduction

- 1.1 Overview of B.E.S.T.® Solvent Extraction Process
- 1.2 Side Stream Description
- 1 3 Bench-scale Testing Program Purpose and Objectives

2 0 Process Description and Test Design

- 2 1 Process Description
- 2 2 Phase I Bench-scale Test Design
- 2.3 Phase II Bench-scale Test Design
- 2.4 Analytical Program Design
- 2.5 QA/QC Program Design

3.0 Results and Discussion

- 3.1 Phase I Bench-scale Testing
  - 3.1.1 Soil Sample #1 Test Results
  - 3 1 2 Soil Sample #2 Test Results
  - 3.1 3 Vegetation Sample Test Results
- 3.2 Phase II Bench-scale Testing
  - 3 2 1 Soil Sample #1 Test Results
  - 3 2 2 Soil Sample #2 Test Results
  - 3 2 3 Vegetation Sample Test Results
- 3.3 Evaluation of Analytical Results
  - 3 3.1 Mass Balance Calculations
  - 3.3 2 Percent Removals
- 4 0 Full-scale Solvent Extraction Cost Estimate
- 5 0 Summary and Conclusions
- 6.0 Acronyms
- 7 0 References

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A Data Summaries

12.0 SCHEDULE

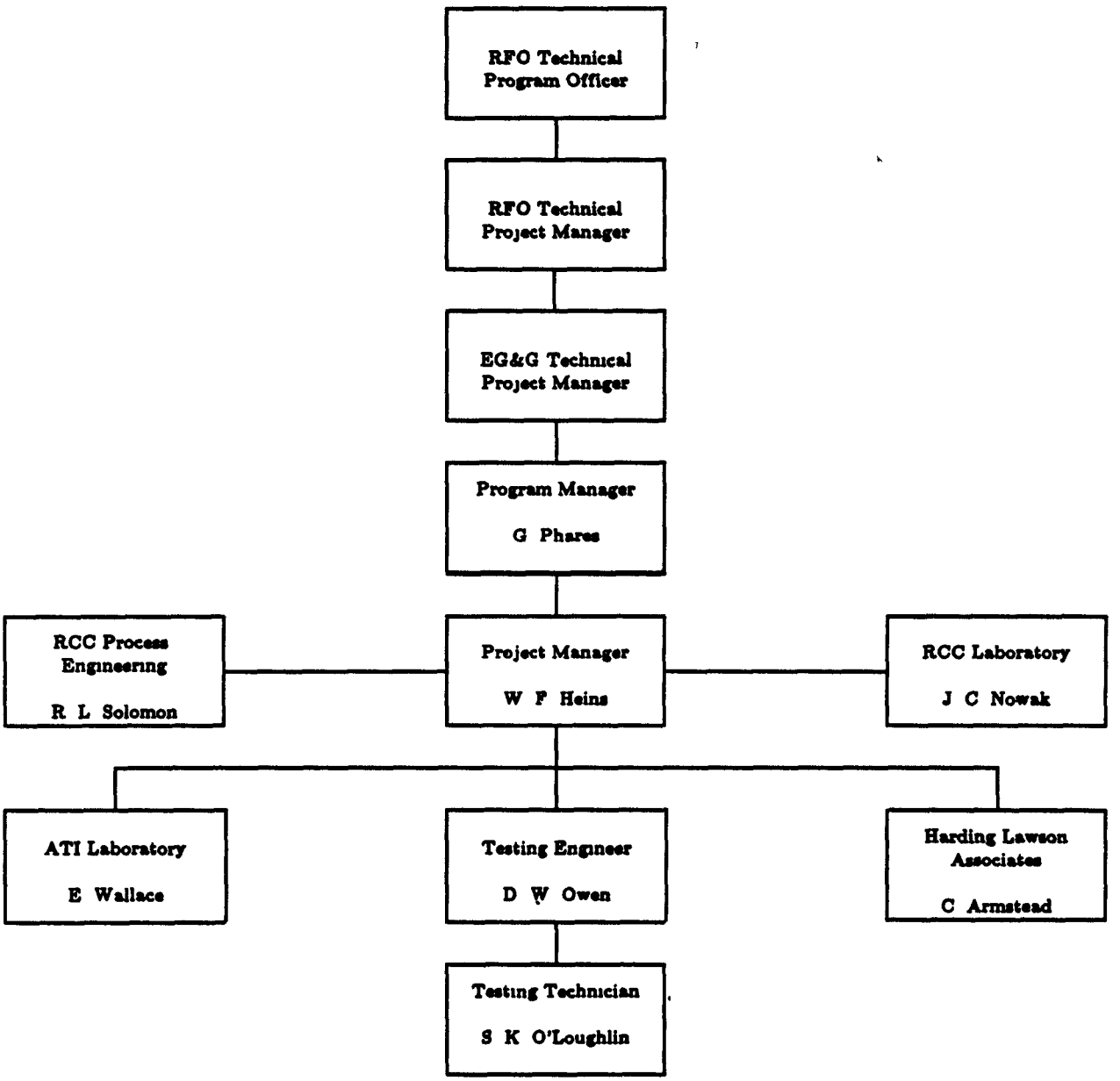
RCC estimates that the bench-scale treatability study will take approximately 27 weeks to complete. The study starts on June 6, 1994, and ends on December 14, 1994. Phase I testing will be conducted between July 18, 1994, and August 29, 1994. The Phase I Results Report will be issued on September 12, 1994. Phase II testing will be conducted between September 26, 1994, and October 10, 1994. The Phase II Results Report will be issued on October 20, 1994. RCC has assumed that the Phase II Results Report is the critical milestone. RCC understands that the data in this report must be available to EG&G by November 14, 1994, for an EPA deliverable The Final Report will be issued on December 13, 1994.

Within 15 work days of EG&G's receipt of the Work Plan and the Quality Assurance Plan, Phase I bench-scale treatability tests will be initiated. The Phase I bench-scale treatability tests will require 10 working days per sample type (for a total of 30 working days). ATI will perform analytical services on a quick turnaround basis (5 working days) to support the Phase I testing. The draft Phase I Results Report will be issued to the Contractors Technical Representative (CTR) within 5 working days of the receipt of analytical radiological data. Phase II bench-scale treatability testing will require 3 working days per sample type (for a total of 9 working days) The draft Phase II Results Report will be issued to the CTR within 5 working days of the receipt of analytical radiological data. A draft Final Report will be issued within 10 working days of receipt of EG&G's comments regarding the draft Phase II Results Report The Final Report will be issued within 10 working days of receipt of EG&G's comments regarding the draft Final Report

13.0 MANAGEMENT AND STAFFING

Personnel involved in the management of the treatability tests includes members from EG&G RFP RCC. William F Heins of RCC will be the Project Manager/Engineer. Mr Heins will be supported by Mr Dale Owen and Mr. Steven O'Loughlin from RCC. Ms. Jodie Barr of ATI will coordinate analytical activities. Ms. Catherine Armstead of HLA will coordinate test documentation and results report preparation. The project will be performed under the direction of EG&G RFP. The organizational chart presented in Figure 13-1 shows the assigned personnel and their lines of communication.

Figure 13-1. Organizational Chart for Bench-scale Solvent Extraction Treatability Study



14.0 QUALITY ASSURANCE ADDENDUM

This section has been included in this plan as Appendix B.

APPENDIX A

Health and Safety Plan
Solvent Extraction Treatability Study Work Plan

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2 Material Safety Data Sheets for Chemicals Used by Resources Conservation Company
3 Employee Signoff
4 Form 533 (Record of Hazardous Waste Field Activity)
5 Analytical Technologies, Inc., Chemical Hygiene Plan

IONICS

RCC Resources Conservation Company

3006 Northup Way
Bellevue, WA 98004-1407

Phone 206 828-2400
Fax 206 828-0526

A Division of Ionics, Incorporated

EGG-002
June 28, 1994

Mr William Roushey
EG&G Rocky Flats, Inc
Rocky Flats Plant
P O Box 464, Building 080
Golden, CO 80402-0464

Subject: B.E.S.T ® Solvent Extraction Process
Rocky Flats Plant
Draft Bench Scale Work Plan

Reference. Modified Proposal to Conduct Solvent Extraction Treatability Study
Bench Scale Treatability Testing with Soils and Vegetation
from the Rocky Flats Plant, dated May 11, 1994, R. Vandenberg to J. Line

Dear Mr. Roushey:

Please find enclosed one disk in Word Perfect 5.1/5.2 and Excel 4.0 format and ten hard copies of the Draft Bench Scale Work Plan, including Health and Safety Plan and Quality Assurance Plan, for the B E.S T. bench scale study of soil and vegetation samples from the Rocky Flats Plant.

These documents satisfy the requirements for submittal of a Draft Work Plan, Health and Safety Plan, and Quality Assurance Plan as specified on pages 4-7 of the technical volume and pages 33-35 of the cost volume of the referenced document.

Please call me at (206) 828-2400 if you have any questions

Sincerely,

RESOURCES CONSERVATION COMPANY

William F Heins
Project Manager

WFH

Enclosures

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APPENDIX A
Health and Safety Plan
Solvent Extraction Bench-scale Treatability Study

1.0 PROJECT INFORMATION AND DESCRIPTION

Operator: Analytical Technologies, Inc. (ATI)

Resources Conservation Company (RCC) Project No:

Project Manager William F. Heins (RCC) Office:

Site Name· Analytical Technologies, Inc. (ATI)

Site Address. Fort Collins, Colorado

Date of Initial Visit

Date of Site Work

Date Health and Safety Plan Prepared

Location Rocky Flats Plant (RFP) is a government owned, contractor-operated facility that manufactured nuclear weapon components from plutonium, uranium, and other nonradioactive materials (beryllium and stainless steel) RFP will supply feed material to ATI for RCC's use The feed material will be received at the ATI facility in Fort Collins, Colorado, and prepared by ATI and RCC

2.0 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

2.1 Project Organization

RCC will perform a bench-scale treatability study to evaluate the use of Triethylamine as a solvent to extract radionuclides from contaminated soil and vegetation at RFP (Triethylamine is a nonregulated, unlisted solvent Triethylamine has been shown to extract plutonium from soil A single treatability test was performed by AWC-Lockheed in Las Vegas, Nevada, on Idaho National Engineering Laboratory (INEL) Pit 9 soil during proof-of-principal (POP) testing. The test was performed using 500 milliliters (ml) of triethylamine on 250 grams of -50-mesh soil contaminated with 5860 picocuries per gram (pCi/g) of plutonium. The mixture was contained in a glass beaker and agitated for two hours in a water bath maintained at approximately 40 degrees Fahrenheit (°F) The results indicated that the triethylamine extracted 26 percent of the plutonium from the soil.

Bench-scale treatability testing on RFP material will be performed on two soil samples and one vegetation sample to evaluate the use of triethylamine to extract radionuclides. The objective of this study is to evaluate the efficiency of triethylamine when used as a solvent to extract the contaminants of concern (COCs) (americium, plutonium, and uranium) from soil and vegetation at RFP The testing will determine if the B E S T solvent extraction process can reduce the COC concentrations to levels below the Treatability Study Benchmarks (TSBs)

The study will be conducted in two phases. During Phase I, bench-scale treatability testing will be conducted to assess near optimum operating parameters for the solvent extraction process. During Phase II, bench-scale treatability testing will be conducted using the two soil samples and one vegetation sample at the near optimum operating parameters defined during Phase I Phase II testing will be evaluated to assess the solvent extraction process' ability to attain the regulatory TSBs for the identified COCs.

Solvent is used to remove contaminants from soil and vegetation through a sequence of activities including pretreatment, extraction, solids separation, solids drying, and solvent recovery The primary operating parameters investigated during the bench-scale treatability testing include chemical additives,

pH, solvent temperature, solvent-to-feed ratio, number of extraction cycles, extraction cycle times, and efficiency in removing contaminants from soil and vegetation

RFP will provide feed samples to RCC at the ATI facility in Fort Collins, Colorado. These samples will be screened by RFP and verified to contain less than 2 nanocuries per gram (nCi/g) prior to shipment ATI and RCC will prepare the samples at ATI to RCC specifications. ATI will be responsible for radiological monitoring and receiving, tracking, and control of sample material from RFP RCC will be using ATI's facility to perform the bench-scale treatability test Two soil samples and one vegetation sample will be tested. Testing will require approximately 20 kilograms (kg) total material for each sample

2.2 Description of Tasks

The basic tasks that RCC will perform under bench-scale testing include collecting samples for analysis, preparing feed material for testing, mixing reagents and samples in laboratory glassware using a pneumatic mixer, centrifuging and decanting mixtures, drying solids in a forced draft oven, and heating mixtures in a hot water bath or in a Rotovapor boiling flask.

Sampling will be performed at all stages of the bench-scale study Potential hazards that may be encountered during sample collection include skin exposure/splashes, inhalation of airborne contaminants, exposure to ionizing radiation, fire or explosion hazard (if triethylamine is present), and contact with hot surfaces.

Preparation of feed material (sieving soil and grinding vegetation) may present potential hazards such as skin exposure, inhalation of airborne contaminants, and exposure to ionizing radiation. Laboratory activities involving feed material will be performed inside a laboratory ventilation hood equipped with a high-efficiency particulate air (HEPA) filter approved for use with radionuclides.

When adding reagents and samples to glassware, potential hazards that may exist include splash/skin exposure, inhalation of airborne contaminants, exposure to ionizing radiation, and fire or explosion hazard (if triethylamine is present).

Using the pneumatic mixer can present potential hazards, including splash/skin exposure, inhalation of airborne contaminants, and exposure to ionizing radiation. Centrifuging and decanting operations can present potential hazards, including splash/skin exposure, inhalation of airborne contaminants, exposure to ionizing radiation, and fire or explosion hazard (if triethylamine is present).

Drying solids using a forced air oven can present potential hazards, including splash/skin exposure, inhalation of airborne contaminants, exposure to ionizing radiation, and fire or explosion hazard (if triethylamine is present) Heating mixtures can present potential hazards, including splash/skin exposure, inhalation of airborne contaminants, exposure to ionizing radiation, and fire or explosion hazard (if triethylamine is present)

3.0 HAZARD EVALUATION AND CONTROL

This section outlines hazards that may be encountered during laboratory work performed at the ATI facility and describes procedures to mitigate these hazards.

3.1 Physical Hazards and Controls

Physical hazards that may be encountered during this bench-scale study include exposure to ionizing radiation, fire or explosion hazards, electrical hazards, slip, trip, or fall hazards, and hot surfaces hazards.

3.1.1 Ionizing Radiation Hazards

Potential for exposure to ionizing radiation exists when working with RFP samples and from other analyses performed in the ATI laboratory The soil and vegetation samples must be verified to contain less than 2 nCi/g activity by RFP prior to shipment to the ATI facility Approximately 20 kg of each material (soil and vegetation) will be submitted to ATI for bench-scale testing. ATI will track and control this material. ATI will check out necessary amounts of sample to RCC on an as-needed basis. Because exposure to ionizing radiation may cause cancer, monitoring for ionizing radiation (gamma, beta, and alpha) will be performed to assess potential exposure. Personnel will wear thermoluminescent dosimeters (TLDs) when working in areas where radioactive materials may be present. Personnel will screen their hands and shoes to assess potential surface contamination before leaving the laboratory, as described in ATI Standard Operating Procedure (SOP) O12FCI. RCC personnel will read and follow the ATI radiation safety manual (Attachment 1) Screening instrumentation will be provided by ATI

3.1.2 Fire or Explosion Hazards

Fire or explosion hazards are possible when using triethylamine Triethylamine is the flammable solvent used in RCC's extraction process to extract contaminants Triethylamine is a colorless liquid

with an ammonia-like odor. Laboratory activities involving triethylamine will be performed in a ventilation hood to prevent the buildup of flammable vapors

3.1.3 Electrical Hazards

Electrical hazards may exist with centrifuges, ovens, and other appliances used in the laboratory Before initiating activities, electrical cords will be inspected for exposed wires, cuts, cracks, etc. Personnel will not modify or use modified electrical plugs that are missing the grounding prong Only trained individuals will repair electrical devices

3.1.4 Slip, Trip, or Fall Hazards

Good housekeeping practices will be observed to minimize slip, trip, or fall hazards. Floors will be kept dry and no loose mats or floor coverings will be present.

3.1.5 Hot Surfaces Hazards

Hot surfaces (greater than 110°F) may be encountered during the heating process of the extraction, while drying solids, and in solvent/water recovery Hot equipment shall be designated with a sign to warn employees the equipment is hot. Hot surfaces should be placed as far away as possible from the employees hands Caution should be used when working near heated surfaces to avoid direct burns and because gloves may melt to skin if they come into contact with hot equipment.

3.2 Chemical Hazards

Some chemicals that will be on-site for the bench-scale study include triethylamine, sodium hydroxide, carbonate, sodium hypochlorite, EDTA, acetone, and methylene chloride. Potential chemical hazards that may exist include exposure from contact, ingestion, and vapor exposure RCC will read and follow ATI's Chemical Hygiene Plan (Attachment 5) Exposures to laboratory chemicals will be kept as low as reasonably achievable The Material Safety Data Sheets (MSDSs) will be available for chemicals used in the bench-scale study MSDSs are included in this plan as Attachment 2 of Appendix A

3.2.1 Skin Exposure to Vapors and Splashes and/or Inhalation Hazards

Potential inhalation hazards may exist during feed material preparation. ATI and RCC will sieve soil to remove particles greater than 25-inch diameter and grind vegetation using a cuisinart food processor To reduce potential inhalation hazards, the feed material will be moistened and work will be performed inside a laboratory hood equipped with a HEPA filter approved for use with radionuclides.

Triethylamine is a flammable solvent with an ammonia-like odor. Triethylamine is corrosive and volatile, therefore, contact lenses must not be worn in the laboratory where triethylamine is used. The threshold limit value for triethylamine is 10 parts per million (ppm) in air (see Section 6 0) Personnel will perform tasks involving triethylamine inside a laboratory ventilation hood to reduce the potential exposure to airborne concentrations of triethylamine Chemical resistant gloves will be worn when working with triethylamine

Methylene chloride is a colorless, volatile liquid with an ether-like odor It is a B2 human carcinogen and has a threshold limit value of 50 ppm in air A B2 carcinogen is a probable carcinogen (i.e , there is sufficient evidence of carcinogenicity in animals, but inadequate evidence in humans). Tasks involving methylene chloride will be performed inside a laboratory ventilation hood. Chemical resistant gloves will be worn when working with methylene chloride

4.0 PERSONNEL

This section describes training and medical surveillance as well as responsibilities of personnel involved with the bench-scale treatability study.

4.1 Training and Medical Surveillance

Personnel on site for the bench-scale study will have 40 hours of initial safety and health training, a current 8-hour refresher course, and 3 days of on-the-job experience. In addition, personnel will be enrolled in a medical monitoring program that meets the requirements of the Occupational Safety and Health Act 29 Code of Federal Regulations Section 1910 120. The training certificates will be kept by the ATI Site Safety and Health Officer Safety meetings will be held before work startup and weekly thereafter to discuss problems, changes to the process, and other safety concerns.

4.2 Responsibilities of Personnel

4.2.1 Project Manager

The Project Manager (PM) for the bench-scale treatability study is William F Heins of RCC. The PM's responsibilities will include acquainting field personnel with potential hazards and procedures to minimize those hazards, making available proper personal protective equipment (PPE) and providing trained personnel to perform site work in a safe manner

4 2 2 Site Safety and Health Officer

The Site Safety and Health Officer (SSHO) for the bench-scale treatability study is Ed Wallace of ATI. The SSHO will be responsible for implementing the guidelines, rules, and procedures in this Health and Safety Plan. The SSHO will maintain and inspect PPE, monitor on-site hazards, maintain training and medical surveillance files, and shut down operations that pose a potential health threat to laboratory personnel The SSHO will conduct an initial safety meeting and weekly safety meetings The SSHO will maintain on file a log of meeting attendance.

4.2.3 Radiation Safety Officer

The Radiation Safety Officer (RSO) for the bench-scale treatability study is Ed Wallace of ATI The RSO will be responsible for the safe handling, use, and shipment of radioactive materials The RSO will track and keep records regarding the disposition of radioactive materials. The RSO is responsible for issuing employee TLD badges, monitoring their use, and arranging for badge processing

4.2.4 Employees

The RCC employees assigned to this task will obey safety and health work practices identified in this health and safety plan and by the SSHO, wear appropriate PPE, and use safety equipment as directed by this plan and by law Employees will report recognized hazards to the SSHO or PM.

4.2.5 Subcontractors

RCC subcontractors will follow the guidelines, rules, and procedures outlined in this Health and Safety Plan. Subcontractors must report recognized hazards to the SSHO or PM.

4.2.6 Visitors

Visitors to RCC work sites will read, understand, and sign this Health and Safety Plan. Visitors will not be allowed to enter work zones unless they provide the appropriate Occupational Safety and Health Administration (OSHA)-required training certificates and medical monitoring to the SSHO.

5.0 PERSONAL PROTECTIVE EQUIPMENT

This section describes the levels of PPE anticipated to be used during this task and when each should be used.

5.1 Levels of Personal Protective Equipment

Level D PPE (general lab wear)

- Leather shoes
- Safety glasses or chemical splash goggles
- Long sleeve shirt
- Long pants or skirt (no shorts)

Modified Level D PPE

Level D PPE, plus the following:

- Laboratory coat or coveralls (splash protection)
- Gloves (chemical resistant)
- Face shield (if necessary)

Level C PPE

- Chemical resistant clothing (polyethylene-coated Tyvek as appropriate)
- Gloves (chemical resistant)
- Boots or disposable covers (chemical resistant)
- Full-face respirator with cartridges approved for use with organic vapors, dusts, mists, chlorine, radionuclides, and asbestos

Level B PPE is not anticipated.

Level A PPE is not anticipated.

5.2 Levels of Protection by Activity

Level D	Bench-scale treatability study work not involving handling of soil/vegetative materials or hazardous chemicals
Modified Level D	Bench-scale work involving handling or transfer of contaminated material, hazardous chemicals or minor spills
Level C	Major spill cleanup, handling contaminated media or hazardous chemicals outside of laboratory hood

6.0 AIR MONITORING EQUIPMENT

RCC will have available Drager type colorimetric detector tubes for triethylamine detection. Monitoring will be performed if an ammonia-like odor is detected.

6.1 Radiological Monitoring Equipment

6.1.1 Personnel Monitoring

Personnel will wear TLDs to measure potential external radiation dose. TLDs will be processed once at the conclusion of Phase I, and once at the conclusion of Phase II, or quarterly, whichever comes first

6.1.2 Surface Contamination

Portable instrumentation provided by ATI will be used in the laboratory to screen for surface contamination of equipment, shoes, and clothing ATI SOPs 007FCZ, 013FCI, and 014FC describe instrument operational verification, calibration, and determination of counting efficiency Surface contamination surveys will be performed in accordance with ATI SOP 010 FC1 No laboratory equipment will leave the laboratory until it has been screened by ATI Treatability samples, materials, and waste must be screened by ATI to assess the level of contamination before they can be removed from the laboratory

6 1.3 Air Monitoring

ATI will provide continuous Alpha air monitoring and grab sampling.

7.0 DECONTAMINATION

Decontamination activities will be limited because of the small quantities of sample feed material and the low levels of radioactivity (less than 2 nCi/g) present. All laboratory equipment will be washed and rinsed with soap and water, then surveyed for contamination. Shoes, gloves, etc , will be screened, then washed and rinsed if contamination is present. RCC will decontaminate (wash and rinse) the exterior of sample bottles prior to relinquishing collected samples to ATI for radioactive screening and other analyses. Wastewater and discarded material will be handled according to ATI SOP 015FCO

8.0 SPILL CONTAINMENT PROCEDURES

Personnel working in the laboratory will work with radioactive materials inside a tray so that any spills are contained. Surfaces and areas where radioactive materials have been used will, at a minimum, be screened daily for contamination. Spilled materials must be cleaned up as soon as possible. If personnel are splashed the affected area should be rinsed with plenty of water (approximately 15 minutes).

9.0 WORK PROCEDURES

The procedures for this bench-scale study are listed in Section 4.0 of the Work Plan. Additional safe work practices are as follows:

- Do not use flame sources in the laboratory when using triethylamine.
- Do not eat, drink, or smoke in the laboratory
- Do not wear contact lenses in the laboratory
- Screen shoes, clothes, and hands before leaving the laboratory.
- Ensure that facial hair does not interfere with fit when wearing a respirator
- Perform work using the buddy system.
- Perform work involving hazardous or contaminated materials inside a laboratory ventilation hood.
- Verify laboratory ventilation hood operation by checking the flow daily before use.
- Do not use laboratory hoods for chemical storage Store chemicals in a properly labeled storage area.
- Be familiar with locations of safety equipment such as fire extinguishers, eyewashes/showers, and first-aid kits.
- Do not use damaged glassware
- Keep potential exposures to chemicals and contaminated materials as low as is reasonably achievable.

10.0 EMERGENCY RESPONSE PLAN

Emergency response procedures are outlined in ATT's Chemical Hygiene Plan (Attachment 5) and ATT's Radiation Safety Manual (Attachment 1).

11.0 EMERGENCY RESPONSE TELEPHONE NUMBERS

Police, fire, and ambulance call 911.

Medical assistance Monday through Friday 8.00 a m. to 5.00 p m. call

Poudre Valley Hospital Occupational Health Services

Medical assistance at all other times call

Poudre Valley Hospital at 911.

12.0 EMERGENCY CONTACTS

ATT's Emergency Coordinator	Edward S Wallace	490-1511	
	24 hours:	226-8778	
Alternate Emergency Coordinator	Steve Workman		490-1511
	24 hours:	484-8044	

RCC's Emergency Coordinator: _____

13.0 PLAN APPROVAL

This Health and Site Safety Plan has been written for use by RCC EG&G claims no responsibility for its use by others, unless specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, contractors, and personnel specified and must be amended if these conditions change.

PLAN WRITTEN BY: **DATE:**

PLAN APPROVED BY: **DATE:**

13.1 Plan Amendments

DATE: **CHANGES MADE BY:**

CHANGES TO PLAN:

APPROVED: **DATE:**

13.2 Plan Amendments

DATE: **CHANGES MADE BY:**

CHANGES TO PLAN:

APPROVED: **DATE:**

14.0 ATTACHMENTS TO PLAN

Attachment 1. Analytical Technologies, Inc., Radiation Safety Manual

Attachment 2: Material Safety Data Sheets for Chemicals Used by Resources Conservation Company

Attachment 3: Employee Signoff

Attachment 4: Form 533 (Record of Hazardous Waste Field Activity)

Attachment 5: Analytical Technologies, Inc., Chemical Hygiene Plan

ATTACHMENT 1

ANALYTICAL TECHNOLOGIES, INC. RADIATION SAFETY MANUAL

RADIATION SAFETY MANUAL

ANALYTICAL TECHNOLOGIES, INC.

Fort Collins Laboratory

JANUARY 1993

REVISION 1

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Radiation Safety Training Course Outline 22

PREFACE

Analytical Technology, Inc. is devoted to the health and safety of its employees. The training of every employee in the fundamentals of radiation safety is imperative. This document is being provided to every employee involved in the use of radioactive materials in order to establish general guidelines and minimum requirements for the safe handling of these materials. This manual will be reviewed with employees during annual radiation safety training and new employee orientation. Every employee should be familiar with the contents of this manual in order to use it as a reference in the laboratory environment. To be fully successful, ATI's health and safety program must be accepted and supported by all employees. Toward this end, every employee is encouraged to make any inquiry or suggestion to help us achieve our goal of a safe workplace.

Faye Bowers
Lab Director

I. PURPOSE AND SCOPE

ATI's Fort Collins Laboratory has established, as part of its overall safety program, this manual to provide guidelines for the safety and well-being of personnel involved in radiation work. Although this is a low-level to intermediate level facility, proper training of workers, laboratory techniques, and general housekeeping practices must be established and maintained in order to prevent unnecessary radiation exposure and/or contamination.

General guidelines are presented here. More detailed information can be found in the indicated references.

II. SITE PERSONNEL RESPONSIBILITIES

A. FORT COLLINS RADIATION SAFETY OFFICER

Radiation Safety Officer duties include the following:

1) Insure safe, legal, and environmentally acceptable use of radioactive materials.

2) Advise ATI management on matters of policy to emphasize application of ALARA principles.

3) Provide technical guidance for the development of policies and procedures for the proper handling of radioactive materials.

4) Recommend and implement changes to the Radiation Safety Manual.

5) Maintain all records regarding the disposition of radioactive materials.

6) Maintain and control inventory of radioactive materials to ensure compliance with the Radioactive Materials License.

7) Maintain the Radioactive Materials License up to date to reflect current operating procedures and equipment.

8) Ensure that all ATI activities related to the use of radioactive materials are in compliance with Colorado Department of Health and other applicable state and federal laws and the stipulations of the Radioactive Materials License.

B. LABORATORY PERSONNEL

All employees involved in the use of radioactive materials are required to familiarize themselves with Title 10 CFR Part 20; applicable National Bureau of Standards Handbooks; NCRP publications; state and local regulations on radiation control; Subpart G 1910.96 and 1910.97 of the Occupational Safety and Health Standards, Part 1910, Chapter XVII, Title 29 CFR. All employees should also familiarize themselves with NRC Reg. Guides 8.13 and 8.29 received during radiation safety training.

Each employee who is designated as a user of, or who has contact with, any radioactive material is responsible for the following:

(1) Keeping his/her external exposure to radiation as low as reasonably achievable ("ALARA").

(2) Wearing the prescribed monitoring equipment, such as a TLD, in radiation areas.

(3) Wearing protective clothing, including gloves, whenever contamination is possible and not wearing such clothing when outside the laboratory area. Gloves are required at all times when handling radioactive materials which are known or suspected to be in a loose form, such as unsealed containers of liquids or soils. Gloves will also be worn when handling materials whose radioactivity content or surface contamination levels are unknown.

(4) Wearing respiratory protection devices where needed.

(5) Using pipette filling devices. Never pipette radioactive liquids by mouth.

(6) Performing radioactive work within the confines of an exhaust hood unless previous examination has indicated the safety of working in the open.

(7) Radiologically surveying hands, shoes, and body for radioactivity and removing contamination before leaving radiation area.

(8) Avoiding prolonged use of any organic solvent

(9) Avoiding smoking or eating where radioactive materials are present. Refrigerators must not be used jointly for foods and radioactive materials.

(10) Maintaining good personal hygiene:

   (a) Keeping fingernails short and clean.

   (b) Not working with radioactive materials if there is a break in the skin below the wrist, unless the cut is well protected from the possible absorption of radioactive contamination.

   (c) Washing hands and arms thoroughly before handling any object that goes to the mouth, nose, or eyes.

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(11) Checking at lease once daily the immediate areas of hoods, benches, or any work area where radioactive materials are being used for possible contamination and removing contamination immediately. If removal is not possible, the area shall be clearly identified and the laboratory Radiation Safety Officer notified.

(12) Keeping the laboratory neat and clean. Work areas shall be free of equipment and materials not required for the immediate procedure. Transport and keep radioactive materials in double containers to prevent breakage or spillage and to ensure adequate shielding. Keep work surfaces covered with absorbent materials, preferably paper lined. Use stainless steel trays or pans in order to limit and collect spillage in case of an accident.

(13) Labeling and isolating radioactive waste and equipment, such as glassware, used in the laboratory for radioactive materials. Equipment used for radioactive substances shall not be used for other work or sent from the area to cleaning facilities, repair shops, or to surplus, until it has been demonstrated to be free of contamination. The survey for release of this equipment shall include direct frisk for measurement of fixed contamination and smear surveys for the determination of removable contamination. If either contamination survey results in a measurement of greater than 0.01 microcurie per 100 square centimeters, the item may not be released. If the item cannot be cleaned to below 0.01 microcurie per 100 square centimeters, it must be treated as radioactive material and may not be released except to a facility authorized to recieve radioactive materials.

(14) Reporting immediately accidental release, inhalation, ingestion, or injury involving radioactive materials to your supervisor and the facility Radiation Safety Officer and immediately carrying out recommended corrective measures. The individual shall cooperate in all attempts to evaluate his exposure.

(15) Carrying out decontamination procedures when necessary and taking adequate steps to prevent additional spread of contamination.

III. RADIONUCLIDES

A. PROCUREMENT

The procedure for procuring radionuclides is as follows:

1. Obtain a Radionuclide Purchase Request Form from the RSO.
2. Return the completed form to the RSO, who will order the radionuclides after consideration of safety issues and licensing provisions.
3. All radioisotopes will be delivered to the RSO, who, in turn, will notify the purchaser.

   Radionuclides must be stored in clearly marked storage areas that have been designated as such by the RSO. These procurement procedures shall cover all radionuclides brought into the laboratory. An inventory of all radionuclides will be maintained by the RSO. Updates will be made to include new or deleted isotopes. Employees must inform the RSO of expected changes in the source inventory.

B. RADIOACTIVE MATERIALS

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Radioactive materials must be stored so that the measured ionizing radiation level in areas occupied by personnel is less than 2.0 mR/hr (10 CFR 20.105). If additional storage space or shielding is needed, arrangements must be made with the RSO.

C. PACKAGING, TRANSFER, AND/OR SHIPMENT OF RADIOACTIVE MATERIALS

The RSO will package all radioactive material for shipment off-site in compliance with the applicable requirements stated in 10 CFR 71, "Packaging and Transportation of Radioactive Materials," and 49 CFR 173 Subpart I, "Radioactive material."

All transfers of source material or radioactive waste shipments will also be carried out by the RSO.

D. DISPOSAL

It is the responsibility of the employee who generates radioactive waste to notify the RSO when there is a need for disposal. The RSO must be provided with a listing of concentrations of the nuclides present. If the concentrations are not known, it is the responsibility of the employee to have the waste analyzed prior to disposal.

Radionuclides at the station are disposed of by the RSO or his designee in the following manner:

1. Decay

   If the radionuclide is short-lived it may be stored until the activity has decayed. This method becomes impractical if the half-life is greater than 30 days.

2. Sewer Disposal

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If the radionuclide is water soluble, it may be flushed down the drain, provided that the activity does not exceed maximum permissible levels as specified in CFR, part 20.303 and R.H. 4.18 are not exceeded. If a liquid waste cannot be disposed of by the sewer method, it may be precipitated or evaporated and treated as a solid waste.

3 Monitoring of all liquid waste must be done on a daily basis in order to document and record the level of activity present and to establish that no quantity of activity is released into the sanitary sewer exceeding the allowable quantity established by the State of Colorado. In addition, pH of the effluent must also be adjusted to pH 5.2 or higher before being released through the sanitary sewer.

4. Solid Wastes

Solid wastes are stored in steel drums to be shipped to a disposal agency. The laboratories that produce solid wastes should provide themselves with an appropriate can. This radioactive waste can must be clearly labeled and should be painted yellow. It must have a cover that is kept in place and must be lined with a disposable plastic bag obtainable from the RSO. When full, a request is made to the RSO for disposal. The bag should be labeled to show the nuclides present in the waste and the dates the wastes were accumulated (start and completion dates).

IV. PROTECTIVE MEASURES

A. EXTERNAL --time, distance, and shielding

The basic protective measures to reduce external radiation are time, distance, and shielding. In every situation, these three factors must be considered jointly. While shielding is desirable in reducing exposure, it must not be overlooked that doing the job in one-half the time is just as effective as halving the dose rate with shielding. Working twice as far from a point source is as effective as doing a job in one-fourth the time. Continuous use of monitoring equipment is the best method of evaluating the hazard and reducing the potential for exposure. Every user of radioisotopes should have at hand adequate survey instruments to monitor his operations.

B. INTERNAL

The general policy in the use of radionuclides is to use equipment and procedures that will most reduce the probability of getting radionuclides into the body. Outlined below are rules and procedures for this purpose. These rules are for amounts and potential hazards greater than those ordinarily encountered in environmental samples.

1. Protective Clothing

Wear a laboratory coat when working with radioactive materials, and, when necessary, wear rubber gloves, safety glasses, and shoe covers. These items should not be worn outside the laboratory, that is, in offices, counting rooms, restrooms, and so forth. After working with radioactive materials, monitor clothing before it is returned to the laundry. The RSO will provide protective clothing when possible; otherwise, the items must be purchased by the program using them.

2. Laboratory Equipment and Design

The experiment should be designed with recognition of the radiation hazards involved. The equipment should be such that harm to the operator is minimal if the worst should happen. When designing radioactive work, consider how hoods, drains, ventilation, and traffic patterns can be used to minimize exposure.

3. Handling Procedures

To reduce the risk of spills and the contamination of the work place, adhere to the following procedures:

a. Use double containers when transferring radionuclides in solution from one area to another.

b. Use protective coverings and lids.

c. Use unbreakable containers to store radioisotopes.

d. Use extreme caution in transfers--try a dummy run to test the procedure.

e. Use hoods for transfers and dilutions.

f. Use a dry box or hood for dusty materials and operations. Dust masks should also be worn.

g. Do not pipette by mouth. Use rubber bulbs, syringes, or pipettors.

h. Always plan the procedure to be used. Know what you are going to do before you do it and have a safety plan worked out beforehand.

i. Use absorbent paper to cover the working area to absorb the radioactive materials in the event of a spill, and replace it if it gets wet or torn. Always notify the RSO in the event of a spill.

j. Check for contamination with lab survey instruments and/or smear after completing procedures where contamination may occur.

4. Good Housekeeping Habits

Much of the job of preventing the spread of contamination is a matter of good housekeeping.

a. Keep the laboratory neat and clean. Keep the work area free of equipment and materials not required for the immediate procedure.

b. Wash hands and arms thoroughly before handling any object that goes to the mouth, nose, or eyes. Wash your hands whenever leaving the laboratory after handling radioactive materials, e.g., before taking sample to counting room. Monitor your hands whenever contamination is suspected and decontaminate immediately.

c. Keep fingernails short and clean. Do not work with radioactive materials if there is a break in the skin below the wrist unless the wound is so protected that radioactive materials cannot gain access to the body. Cover the break with tape (plastic or adhesive) and wear a rubber glove.

d. No smoking, eating or drinking is allowed in any laboratory area. Signs are posted notifying employees and visitors of such laboratory areas. Food containers are not permitted in the laboratory work areas. Refrigerators shall NOT be used jointly for foods and radioactive materials.

5. Personnel Monitoring

Each person is responsible for monitoring his person, clothing, shoes, and laboratory equipment that may be contaminated. The RSO should be called if contamination is detected.

V. INSTRUMENTATION

A. PERSONNEL MONITORING

The basic personnel monitoring system at the station is as follows:

1. Thermoluminescent Dosimeters

Any person who has a probability of being exposed to detectable amounts of external radiation is issued a TLD by the RSO. The TLD is read quarterly and the results are kept on file with the RSO. The recorded doses will be furnished to individuals upon request.

2. Survey Meters

Each area where radionuclides are stored or used will have a working survey meter available. This instrument is for the use of personnel in the laboratories to check for alpha, beta, and gamma contamination, as appropriate to the laboratory in which it is used, and is suitable for such routine uses as the following:

a. Checking laboratory surfaces, glassware, and tools.

b. Checking hands, shoes, and clothing.

c. Measuring the radiation level from low level sources (less than 5 mR/hr).

B LABORATORY MONITORING

The radioisotope laboratories will be monitored periodically by the RSO. This should in no way be considered a substitute for routine day-to-day monitoring by the personnel working in the laboratories. The RSO

shall have a floor plan of each laboratory that uses radioisotopes. During the periodic checkup, the RSO will record on this floor plan all smear counts, instrument readings, and any other pertinent information. The RSO will direct any changes or decontamination necessary, and the personnel involved will be responsible for the required action. If not complied with, action will be taken by the Director. The RSO will do special monitoring jobs such as taking necessary air samples and checking hoods and drains prior to repair.

C. PERMISSIBLE EXPOSURES

The NRC's present limit of radiation dose that can be received on the job is 5 rem/year (1,250 mrem per quarter). The National Council on Radiation Protection and Measurements (NCRP) has recommended that the dose equivalent to the unborn child be limited to 500 mrem for the entire pregnancy. Female employees should notify the RSO as soon as pregnancy is known in order to assess the employee's potential exposures.

Every effort should be made to assure that the dose to any employee is as low as reasonably achievable. EPA has set an administrative dose limit with the maximum permissible external exposure to be 100 millirem per week as suggested by 10 CFR 20.105, "Permissible Levels of Radiation in Unrestricted Areas". The maximum permissible concentrations of radionuclides in air and water are chosen in accordance with 10 CFR 20.103.

VI. DECONTAMINATION

A. PREVENT SPREAD OF CONTAMINATION

The RSO should be called for assistance as soon as possible whenever a spill occurs. The first consideration after personnel safety is

decontamination. Many factors must be considered, including tracking by persons, movement by air currents (hoods, fans, etc.), dusting, mopping, and other physical actions.

B. MAKE A PLAN

Successful decontamination calls for planned action. A spur-of-the-moment action or attempt at decontamination can cause more harm than good.

C. MONITORING

Make full use of instruments and available assistance. Each step of the decontamination should be monitored. One person should remain uncontaminated to operate instruments and do other monitoring. When the instruments become contaminated, any progress is hopeless. Protective clothing, footwear, gloves, and respirators should be used as needed.

D. RECORDS

Complete records should be made of each action. Copies should be sent to the RSO. In most cases, the RSO will be involved, so a joint report can be filed.

E. WASTE DISPOSAL

Provisions must be made for proper disposition of cleaning solutions and their contaminated articles. In some instances, it may be judged better to dispose of a contaminated article than to attempt to decontaminate. All materials used in the cleanup of radiologically contaminated areas, or potentially radiologically contaminated areas, will be segregated and monitored for radioactivity prior to disposal. Items surveyed as having loose or fixed contamination levels greater that 0.01

microcuries per 100 square centimeters shall be disposed of as radioactive waste.

VII. ACCIDENT AND EMERGENCY PROCEDURES

The emergencies most likely to be encountered at ATI are spills, fires, or explosions that can cause radioactivity to be spread around the laboratory. Emergency procedures adopted from National Bureau of Standards Handbook are given here as a guide. These procedures are general; any specific emergency will call for adaptations and changes.

A. MINOR SPILLS INVOLVING NO RADIATION HAZARD TO PERSONNEL

1. Immediately notify all other persons in the room.
2. Permit only the minimum number of persons necessary to deal with the spill into the area.
3. Confine the spill immediately.

   Liquid Spills: Don protective gloves.
   Drop absorbent paper on spill.

   Dry Spills: Don protective gloves.
   Dampen thoroughly, taking care not to spread the contamination. Water may generally be used except where chemical reaction with the water would generate an air contaminant; oil should then be used.
4. Decontaminate, but decide upon a logical plan with the RSO first.
5. Monitor all persons involved with the spill and clean-up operations.

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6. A complete history of the accident and subsequent remedial or protective measures must be submitted to the RSO.

B. MAJOR SPILLS INVOLVING RADIATION HAZARD TO PERSONNEL

1. Notify all persons not involved in the spill to vacate the room at once. Limit the movement of displaced persons to confine the spread of contamination.
2. If the spill is on the skin, flush thoroughly.
3. If the spill is on clothing, discard outer or protective clothing at once.
4. Switch off all fans.
5. Vacate the room.
6. Notify the RSO as soon as possible.
7. Take immediate steps to decontaminate personnel involved, as necessary.
8. Decontaminate the area.

   Personnel involved in decontamination must use adequate protective equipment to avoid the risk of external and/or internal contamination.

C. INJURIES TO PERSONNEL INVOLVING RADIATION HAZARD

1. Wash minor wounds immediately under running water.
2. Report all radiation accidents to personnel (wounds, over-exposure, ingestion, inhalation) to the RSO as soon as possible.
3. If deemed necessary, the RSO will call a physician qualified to treat radiation injuries.

4. Permit no person involved in a radiation injury to return to work without the approval of the attendant physician and the RSO.
5. Prepare a complete history of the accident and subsequent activity related thereto for the RSO.

D. FIRES OR OTHER MAJOR EMERGENCIES

1. Immediately notify all other persons in the room and building and evacuate.
2. Notify the fire department, site safety personnel, and the RSO.
3. Monitor all persons involved in combating the emergency.
4. Following the emergency, monitor the area and determine the protective devices necessary for safe decontamination.
5. Decontaminate.
6. Permit no person to return to work without the approval of the RSO.
7. Prepare a complete history of the emergency and subsequent activity related thereto for the RSO.

VIII. RADIATION SAFETY TRAINING

All employees involved with the use of radioactive materials at ATI are required to complete a Radiation Safety Training Course. The course is also required for new employees before beginning work. Copies of the ATI Radiation Safety Manual and NRC Reg. Guides 8.13 and 8.29, will be included in the course material (see Appendix A for course outline).

IX. RECORDS

The RSO is responsible for keeping all records required now or in the future under the State of Colorado Licensing Agreements and essential to the operation of the Radiation Safety Program.

REFERENCES

Advisory Committee on the Effects of Ionizing Radiation, "The Effect on Populations of Exposures. of Low Doses of Ionizing Radiation." National Academy of Sciences - National Research Council, Washington, D.C. (1979).

Colorado Department of Health, "Rules and Regulations Pertaining to Radiation Control", Colorado Department of Health, 1992.

H. Cember, "Introduction to Health Physics," Second Edition, Pergamon Press Inc. (1983).

10 CFR 20, "Standards for Protection Against Radiation," Office of the Federal Register National Archives and Records Administration, (January 1988).

49 CFR 173, "Shippers - General Requirements for Shipments and Packages."

J. Shapiro, "Radiation Protection," Second Edition, Harvard University Press, (1981).

D. C. Stewart, "Handling Radioactivity, A Practical Approach for Scientists and Engineers," Krieger Publishing Co., Inc., (1981).

U.S. Environmental Protection Agency, "EPA Radiological Health and Safety Program "

U.S. Nuclear Regulatory Commission (NRC), "Regulatory Guide 8.13 (Task OP 031-4) Instruction Concerning Prenatal Radiation Exposure," NRC, Washington, D.C. 20555, (December 1987).

U.S. Nuclear Regulatory Commission (NRC), "Regulatory Guide 8.29 (Task OH 902-4) Instruction Concerning Risks From Occupational Radiation Exposure," NRC, Washington, D.C. 20555, (July 1981).

APPENDIX A

Fundamentals of Radiation Protection
Training Course Outline

1) Atomic Structure
   - Protons, Neutrons, Electrons
   - Mass and Charge
   - Elements
   - Isotopes

2) Radioactivity and Decay
   - Radioactivity
   - Decay
   - Half-life
   - Methods of radioactive decay
     - Alpha Emissions
     - Beta Emissions
     - Positron Emissions
     - Gamma and X-ray Emission
     - Fission
   - Conservation of mass, charge, and energy

3) Types of radiation
   - History and discovery of radiation
   - Radiation units
   - Alpha Particles
   - Beta Particles
   - Gamma and X-rays
   - Neutrons

4) Ionization
   - Gamma and X-ray interaction
     - Photoelectric effect
     - Compton Scattering
     - Pair Production/Annihilation
   - Charged particle interaction
     - Excitation

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Ionization

Neutron interactions

Scattering

Activation

Fission

5) Units of Radiation and Radioactivity

Curie

Roentgen

RAD

REM

Dose and Dose Rate

SI Units

Radiation vs. Contamination

6) Detection and Measurement

Personnel monitoring

Film Badge

TLD

Pocket Ion Chambers

Gas filled detectors

The six region curve

Ion chambers

Proportional counters

Geiger-Mueller counters

Scintillation detectors

Sodium Iodide

Zinc Sulfide

Solid state detectors

Germanium

Silicon

Detector applications

Portable survey instruments

Fixed monitoring instruments

Spectrometry instruments

7) Background radiation

Cosmic radiation

Radioactivity in:

Earth

Air

Water

Human Body

Man-made radioactivity

8) Biological effects of radiation
Causes of radiation effects
Radiosensitivity
Linear or Threshold theories
Acute effects
Delayed effects
Somatic and Genetic Effects
Stochastic and non-stochastic principles

9) Radiation Protection
Federal and State regulations
ALARA
Time, Distance, Shielding
Personnel protection
Warning signs
Good housekeeping
Engineered controls
Administrative controls
The unborn child
Radioactive waste

ATTACHMENT 2

MATERIAL SAFETY DATA SHEETS
FOR CHEMICALS USED

J T Baker Inc
222 Red School Lane
Phillipsburg NJ 08865
24-Hour Emergency Telephone 908 859 2151
National Response Center 800 424-8802
Chemtrec 800 424-9300

National Response in Canada
CANUTEC 613 996 6666
Outside U S and Canada
Chemtrec 202 483 7616

MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

E0170 -03 EDTA, Disodium Salt, Dihydrate, Crystal Page: 1
Effective: 03/09/92 Issued: 11/02/93

T.BAKER INC., 222 Red School Lane, Phillipsburg, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

Product Name: EDTA, Disodium Salt, Dihydrate, Crystal
Common Synonyms: Disodium(ethylene dinitrilo)tetraacetic acid; Disodium Edetate
Chemical Family: Complexing Agents
Formula: $C_{10}H_{14}N_2Na_2O_8\ 2H_2O$
Formula Wt.: 372.24
CAS No.: 6381-92-6
NIOSH/RTECS No.: AH4375000
Product Use: Laboratory Reagent
Product Codes: 8993EP,8993,8994,4040,5835

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* System

HEALTH	FLAMMABILITY	REACTIVITY	CONTACT
1	1	0	1
SLIGHT	SLIGHT	NONE	SLIGHT

Laboratory Protective Equipment

U.S. Precautionary Labeling

CAUTION!

MAY CAUSE IRRITATION.
During use avoid contact with eyes, skin, clothing. Wash thoroughly after handling. When not in use keep in tightly closed container.

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J T Baker Inc
222 Red School Lane
Phillipsburg NJ 08865
24-Hour Emergency Telephone 908 859 2151
National Response Center 800 424 8802
Chemtrec 800 424 9300

National Response in Canada
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PRECAUTIONARY LABELING (CONTINUED)

International Labeling

Do not breathe dust. Avoid contact with skin and eyes.

SAF-T-DATA* Storage Color Code: Orange (general storage)

SECTION II - COMPONENTS

Component	CAS No.	Weight %	OSHA/PEL	ACGIH/TLV
EDTA, Disodium Salt, Dihydrate	6381-92-6	90-100	N/E	N/E

SECTION III - PHYSICAL DATA

Boiling Point: N/A

Vapor Pressure (mmHg): N/A

Melting Point: N/A

Vapor Density (air=1): N/A

Specific Gravity: N/A (H_2O=1)

Evaporation Rate: N/A

Solubility(H_2O): Appreciable (>10%)

% Volatiles by Volume: 0 (21°C)

pH : N/A

Odor Threshold (ppm): N/A

Physical State: Solid

Coefficient Water/Oil Distribution: N/A

Appearance & Odor: White crystalline powder. Odorless.

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Chemtrec 800-424-9300

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SECTION IV - FIRE AND EXPLOSION HAZARD DATA

I ash Point (Closed Cup): N/A

Autoignition Temperature: N/A

I ammable Limits: Upper - N/A Lower - N/A

F re Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode.

U usual Fire & Explosion Hazards
None identified.

T xic Gases Produced
oxides of nitrogen, carbon monoxide, carbon dioxide

E plosion Data-Sensitivity to Mechanical Impact
None identified.

E plosion Data-Sensitivity to Static Discharge
None identified.

SECTION V - HEALTH HAZARD DATA

T reshold Limit Value (TLV/TWA): Not Established

Short-Term Exposure Limit (STEL): Not Established

P rmissible Exposure Limit (PEL): Not Established

T xicity of components

Oral Rat LD_{50} for EDTA, Disodium Salt, Dihydrate 2000 mg kg
I travenous Mouse LD_{50} for EDTA, Disodium Salt, Dihydrate 56 mg/kg
Carcinogenicity: NTP: No IARC: No Z List: No OSHA Reg: No

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SECTION V - HEALTH HAZARD DATA (CONTINUED)

Carcinogenicity
None identified.

Reproductive Effects
None identified.

Effects of Overexposure

INHALATION: irritation of upper respiratory tract

SKIN CONTACT: irritation

EYE CONTACT: irritation

SKIN ABSORPTION: none identified

INGESTION: ingestion of large quantities may be harmful

CHRONIC EFFECTS: none identified

Target Organs
none identified

Medical Conditions Generally Aggravated by Exposure
none identified

Primary Routes of Entry
inhalation, ingestion, skin contact, eye contact

Emergency and First Aid Procedures

INGESTION: If swallowed and the person is conscious, immediately give large amounts of water. Get medical attention.

INHALATION: If a person breathes in large amounts, move the exposed person to fresh air.

SKIN CONTACT: In case of contact, immediately wash skin with plenty of soap and water for at least 15 minutes.

EYE CONTACT: In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

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SECTION V - HEALTH HAZARD DATA (CONTINUED)

SARA/TITLE III HAZARD CATEGORIES and LISTS

Acute: No Chronic: No Flammability: No Pressure: No Reactivity: No

Extremely Hazardous Substance: No
CERCLA Hazardous Substance: No
SARA 313 Toxic Chemicals: No
TSCA Inventory: Yes

SECTION VI - REACTIVITY DATA

Stability: Stable Hazardous Polymerization: Will not occur

Conditions to Avoid: none documented

Incompatibles: strong oxidizing agents, chemically active metals

Decomposition Products: oxides of nitrogen, carbon monoxide, carbon dioxide

SECTION VII - SPILL & DISPOSAL PROCEDURES

Steps to be Taken in the Event of a Spill or Discharge
Wear suitable protective clothing. Carefully sweep up and remove.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Ventilation: Use adequate general or local exhaust ventilation to keep fume or dust levels as low as possible.

Respiratory Protection: None required where adequate ventilation conditions exist. If airborne concentration is high, use an appropriate respirator or dust mask.

Eye/Skin Protection: Safety goggles, proper gloves are recommended.

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Chemtrec 800-424-9300

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Outside U S and Canada
Chemtrec 202 483 7616

MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800-JTBAKER) for assistance

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

AF-T-DATA* Storage Color Code: Orange (general storage)

Storage Requirements
Keep container tightly closed. Suitable for any general chemical storage area.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)

International (I.M.O.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)
Marine Pollutants: No

AIR (I.C.A.O.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)

U S. Customs Harmonization Number: 29224960001

NOTE: When handling liquid products, secondary protective containers must be used for carrying.
N/A = Not Applicable, or not Available;
N E = Not Established.-
The information in this Material Safety Data Sheet meets the requirements of the United States OCCUPATIONAL SAFETY AND HEALTH ACT and regulations promulgated thereunder (29 CFR 1910.1200 et. seq.) and the Canadian WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. This document is intended only as a guide to the appropriate precautionary handling of the material by a person trained in, or supervised by a person trained in, chemical handling. The user is responsible for determining the precautions and dangers of this chemical for his or her particular application. Depending on usage, protective clothing including eye and face guards and respirators must be used to avoid contact with material or breathing chemical vapors/fumes.
Exposure to this product may have serious adverse health effects. This chemical may interact with other substances. Since the potential uses are so varied, Baker cannot warn of all of the potential dangers of use or interaction with other chemicals or materials. Baker warrants that

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the chemical meets the specifications set forth on the label.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.
The user should recognize that this product can cause severe injury and even death, especially if improperly handled or the known dangers of use are not heeded. READ ALL PRECAUTIONARY INFORMATION. As new documented general safety information becomes available, Baker will periodically revise this Material Safety Data Sheet.
Note: CHEMTREC, CANUTEC, and NATIONAL RESPONSE CENTER emergency telephone numbers are to be used ONLY in the event of CHEMICAL EMERGENCIES involving a spill, leak, fire, exposure, or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1-800-JTBAKER) for assistance.

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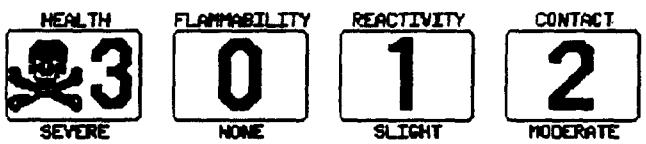
J.T.BAKER INC., 222 Red School Lane, Phillipsburg, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

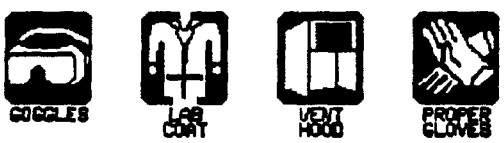
Product Name: Sodium Fluoride
Common Synonyms: Disodium Difluoride; Natrium Fluoride; Floridine; Florocid
Chemical Family: Inorganic Sodium Compounds
Formula: NaF
Formula Wt.: 41.99
CAS No.: 7681-49-4
NIOSH/RTECS No.: WB0350000
Product Use: Laboratory Reagent
Product Codes: 3688,5245,3687,3689

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* System



Laboratory Protective Equipment



U.S. Precautionary Labeling

POISON! DANGER!
CAUSES SEVERE IRRITATION. KEEP AWAY FROM STRONG ACIDS. MAY BE FATAL IF SWALLOWED OR INHALED.
Do not get in eyes, on skin, on clothing. Do not breathe dust. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.

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FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

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PRECAUTIONARY LABELING (CONTINUED)

International Labeling

Toxic by inhalation, in contact with skin and if swallowed.
Keep locked up and out of reach of children. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. If you feel ill well, seek medical advice (show the label where possible).

SAF-T-DATA* Storage Color Code: Blue (health)

SECTION II - COMPONENTS

Component	CAS No.	Weight %	OSHA/PEL	ACGIH/TLV
Sodium Fluoride	7681-49-4	99-100	2.5 mg/m³	2.5 mg/m³

TLV and PEL are for Fluorides, as F.

SECTION III - PHYSICAL DATA

Boiling Point: 1704°C (3099°F) (at 760 mm Hg)

Vapor Pressure (mmHg): N/A

Melting Point: 993°C (1819°F) (at 760 mm Hg)

Vapor Density (air=1): 1.4

Specific Gravity: 2.78 (H_2O=1)

Evaporation Rate: N/A

Solubility(H_2O): Appreciable (>10%)

% Volatiles by Volume: 0 (21°C)

pH: N/A

Odor Threshold (ppm): N/A

Physical State: Solid

Coefficient Water/Oil Distribution: N/A

Appearance & Odor: White crystals or powder. Odorless.

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MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Closed Cup): N/A NFPA 704M Rating: 2-0-0

Autoignition Temperature: N/A

Flammable Limits: Upper - N/A Lower - N/A

Fire Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode.

Unusual Fire & Explosion Hazards
None identified. Closed containers exposed to heat may explode.

Toxic Gases Produced
hydrogen fluoride

Explosion Data-Sensitivity to Mechanical Impact
None identified.

Explosion Data-Sensitivity to Static Discharge
None identified.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): 2.5 mg/m^3

TLV is for Fluorides, as F.

Short-Term Exposure Limit (STEL): Not Established

Permissible Exposure Limit (PEL): 2.5 mg/m^3

PEL is for Fluorides, as F.

Toxicity of components

Oral Rat LD_{50} for Sodium Fluoride 64 mg/kg

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All non-emergency questions should be directed to Customer Service (1 800-JTBAKER) for assistance

MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

SECTION V - HEALTH HAZARD DATA (CONTINUED)

C al Mouse LD_{50} for Sodium Fluoride	57	mg/kg
Intraperitoneal Rat LD_{50} for Sodium Fluoride	22	mg/kg
I travenous Rat LD_{50} for Sodium Fluoride	12	mg/kg

Carcinogenicity: NTP: No IARC: No Z List: No OSHA Reg: No

C rcinogenicity
None identified.

E productive Effects
None identified.

E^fects of Overexposure

INHALATION: is harmful and may be fatal, nausea, vomiting, difficult breathing, severe irritation of respiratory system

SKIN CONTACT: severe irritation or burns

EYE CONTACT: severe irritation or burns

SKIN ABSORPTION: none identified

INGESTION: is harmful and may be fatal, headache, nausea, vomiting, gastrointestinal irritation, convulsions, burns to mouth, throat, and stomach

CHRONIC EFFECTS: increased bone density, calcium deposits in ligaments, mottled tooth enamel

T rget Organs
eyes, skin, respiratory system, lungs, central nervous system, kidneys, GI tract

M dical Conditions Generally Aggravated by Exposure
none identified

P imary Routes of Entry
inhalation, ingestion, eye contact, skin contact

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SECTION V - HEALTH HAZARD DATA (CONTINUED)

Emergency and First Aid Procedures

INGESTION: CALL A PHYSICIAN. If swallowed, if conscious, immediately induce vomiting.

INHALATION: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

SKIN CONTACT: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use.

EYE CONTACT: In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

Notes to Physician

Urinary fluoride excretion levels have been useful in evaluating industrial exposures to fluoride dusts.

SARA/TITLE III HAZARD CATEGORIES and LISTS

Acute: Yes Chronic: Yes Flammability: No Pressure: No Reactivity: No

Extremely Hazardous Substance: No
CERCLA Hazardous Substance: Yes Contains Sodium Fluoride (RQ = 1000 LBS)
SARA 313 Toxic Chemicals: No
TSCA Inventory: Yes

SECTION VI - REACTIVITY DATA

Stability: Stable Hazardous Polymerization: Will not occur

Conditions to Avoid: heat

Incompatibles: strong acids, glass

Decomposition Products: hydrogen fluoride

Continued on Page: 6

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SECTION VII - SPILL & DISPOSAL PROCEDURES

eps to be Taken in the Event of a Spill or Discharge

Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

Disposal Procedure

Dispose in accordance with all applicable federal, state, and local environmental regulations.

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

ntilation:	Use general or local exhaust ventilation to meet TLV requirements.
spiratory Protection:	None required where adequate ventilation conditions exist. If airborne concentration exceeds TLV, a dust/mist respirator is recommended. If concentration exceeds capacity of respirator, a self-contained breathing apparatus is advised.
Eye/Skin Protection:	Safety goggles, uniform, apron, proper gloves are recommended.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* Storage Color Code: Blue (health)

orage Requirements

Keep container tightly closed. Store in secure poison area. Do not store in glass. Keep away from strong acids.

Special Precautions

Sodium Fluoride reacts with acids to form hydrogen fluoride, which is highly corrosive and poisonous - KEEP AWAY FROM STRONG ACIDS.

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SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

I mestic (D.O.T.)

Proper Shipping Name: Sodium fluoride, solid
H zard Class: 6.1
UN/NA: UN1690 Reportable Quantity: 1000 LBS. Packaging Group: III
Labels: KEEP AWAY FROM FOOD
R gulatory References: 49CFR 172.101

International (I.M.O.)

P oper Shipping Name: Sodium fluoride, solid
Hazard Class: 6.1 I.M.O. Page: 6258
UN: UN1690 Marine Pollutants: No Packaging Group: III
L bels: HARMFUL - STOW AWAY FROM FOOD STUFFS
R gulatory References: 49CFR PART 176; IMDG Code

A R (I.C.A.O.)

Proper Shipping Name: Sodium fluoride, solid
Hazard Class: 6.1
U : UN1690 Packaging Group: III
L bels: KEEP AWAY FROM FOOD
Regulatory References: 49CFR PART 175; ICAO=== We believe the transportation data and references contained herein to be factual and the opinion of qualified experts. The data is meant as a guide to the overall classification of the product and is not package size specific, nor should it be taken as a warranty or representation for which the company assumes legal responsibility.=== The information is offered solely for your consideration, investigation, and verification. Any use of the information must be determined by the user to be in accordance with applicable Federal, State, and Local laws and regulations. See shipper requirements 49CFR 171.2, Certification 172.204, and employee training 49 CFR 173.1(b).

U S. Customs Harmonization Number: 28261100005

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NOTE: When handling liquid products, secondary protective containers must be used for carrying.
-N/A = Not Applicable, or not Available;
N/E = Not Established.-
The information in this Material Safety Data Sheet meets the requirements of the United States OCCUPATIONAL SAFETY AND HEALTH ACT and regulations promulgated thereunder (29 CFR 1910.1200 et. seq.) and the Canadian WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. This document is intended only as a guide to the appropriate precautionary handling of the material by a person trained in, or supervised by a person trained in, chemical handling. The user is responsible for determining the precautions and dangers of this chemical for his or her particular application. Depending on usage, protective clothing including eye and face guards and respirators must be used to avoid contact with material or breathing chemical vapors/fumes.
Exposure to this product may have serious adverse health effects. This chemical may interact with other substances. Since the potential uses are so varied, Baker cannot warn of all of the potential dangers of use or interaction with other chemicals or materials. Baker warrants that the chemical meets the specifications set forth on the label.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.
The user should recognize that this product can cause severe injury and even death, especially if improperly handled or the known dangers of use are not heeded. READ ALL PRECAUTIONARY INFORMATION. As new documented general safety information becomes available, Baker will periodically revise this Material Safety Data Sheet.
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J T.BAKER INC., 222 Red School Lane, Phillipsburg, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

Product Name: Sodium Phosphate, Monobasic, Dihydrate
Common Synonyms: Sodium Dihydrogen Phosphate, Dihydrate; Sodium Biphosphate, Dihydrate
Chemical Family: Inorganic Sodium Compounds
Formula: NaH_2PO_4 $2H_2O$
Formula Wt.: 155.99
CAS No.: 13472-35-0
NIOSH/RTECS No.: WA1900000
Product Use: Laboratory Reagent
Product Codes: 3819,5591

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* System

HEALTH	FLAMMABILITY	REACTIVITY	CONTACT
1	0	1	2
SLIGHT	NONE	SLIGHT	MODERATE

Laboratory Protective Equipment

U.S. Precautionary Labeling

WARNING!
CAUSES IRRITATION. HARMFUL IF SWALLOWED OR INHALED.
Avoid contact with eyes, skin, clothing. Avoid breathing dust. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.

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PRECAUTIONARY LABELING (CONTINUED)

International Labeling

Avoid contact with eyes. After contact with skin, wash immediately with plenty of water. Keep container tightly closed.

SAF-T-DATA* Storage Color Code: Orange (general storage)

SECTION II - COMPONENTS

Component	CAS No.	Weight %	OSHA/PEL	ACGIH/TLV
Sodium Phosphate, Monobasic	13472-35-0	98-100	N/E	N/E

SECTION III - PHYSICAL DATA

Boiling Point: N/A

Vapor Pressure (mmHg): N/A

Melting Point: N/A

Vapor Density (air=1): N/A

Specific Gravity: N/A (H_2O=1)

Evaporation Rate: N/A

Solubility(H_2O): Appreciable (>10%)

% Volatiles by Volume: 0 (21°C)

pH: N/A

VOC or Threshold (ppm): N/A

Physical State: Solid

Coefficient Water/Oil Distribution: N/A

Appearance & Odor: White crystals. Odorless.

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SECTION IV - FIRE AND EXPLOSION HAZARD DATA

ash Point (Closed Cup): N/A

Autoignition Temperature: N/A

Flammable Limits: Upper - N/A Lower - N/A

Fire Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards
Closed containers exposed to heat may explode.

Toxic Gases Produced
oxides of phosphorus

Explosion Data-Sensitivity to Mechanical Impact
None identified.

Explosion Data-Sensitivity to Static Discharge
None identified.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): Not Established

Short-Term Exposure Limit (STEL): Not Established

Permissible Exposure Limit (PEL): Not Established

Toxicity of components

Oral Rat LD_{50} for Sodium Phosphate, Monobasic 8290 mg/kg

Carcinogenicity: NTP: No IARC: No Z List: No OSHA Reg: No

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SECTION V - HEALTH HAZARD DATA (CONTINUED)

Carcinogenicity
None identified.

Reproductive Effects
None identified.

Effects of Overexposure

INHALATION: irritation of upper respiratory tract

SKIN CONTACT: irritation, prolonged contact may cause dermatitis

EYE CONTACT: irritation

SKIN ABSORPTION: none identified

INGESTION: nausea, vomiting, diarrhea, irritation and burns to mouth and stomach

CHRONIC EFFECTS: none identified

Target Organs
eyes, skin

Medical Conditions Generally Aggravated by Exposure
none identified

Primary Routes of Entry
inhalation, ingestion, skin contact, eye contact

Emergency and First Aid Procedures

INGESTION: CALL A PHYSICIAN. If swallowed, if conscious, immediately induce vomiting.

INHALATION: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

SKIN CONTACT: In case of contact, flush skin with water.

EYE CONTACT: In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

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MATERIAL SAFETY DATA SHEET
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NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1-800-JTBAKER) for assistance.

SECTION V - HEALTH HAZARD DATA (CONTINUED)

SARA/TITLE III HAZARD CATEGORIES and LISTS

Acute: Yes Chronic: Yes Flammability: No Pressure: No Reactivity: No

Extremely Hazardous Substance: No
CERCLA Hazardous Substance: No
SARA 313 Toxic Chemicals: No
TSCA Inventory: Yes

SECTION VI - REACTIVITY DATA

Stability: Stable Hazardous Polymerization: Will not occur

Conditions to Avoid: heat

Incompatibles: iron and other heavy metals, strong acids

Decomposition Products: oxides of phosphorus

SECTION VII - SPILL & DISPOSAL PROCEDURES

Steps to be Taken in the Event of a Spill or Discharge
Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Ventilation: Use adequate general or local exhaust ventilation to keep fume or dust levels as low as possible.

Respiratory Protection: None required where adequate ventilation conditions exist. If airborne concentration is high, use an appropriate respirator or dust mask.

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HD

J.T.Baker
J T Baker Inc
222 Red School Lane
Phillipsburg NJ 08865
24-Hour Emergency Telephone 908-859 2151
National Response Center 800-424-8802
Chemtrec 800-424-9300

National Response in Canada
CANUTEC 613 996 6666
Outside U S and Canada
Chemtrec 202 483 7616

MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT (CONTINUED)

Eye/Skin Protection: Safety goggles, uniform, proper gloves are recommended.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* Storage Color Code: Orange (general storage)

Storage Requirements
Keep container tightly closed. Suitable for any general chemical storage area.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)

International (I.M.O.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)
Marine Pollutants: No

IATA (I.C.A.O.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)

U S. Customs Harmonization Number: 28352200001

NOTE: When handling liquid products, secondary protective containers must be used for carrying.
- /A = Not Applicable, or not Available;
N/E = Not Established.-
The information in this Material Safety Data Sheet meets the requirements of the United States OCCUPATIONAL SAFETY AND HEALTH ACT and regulations promulgated thereunder (29 CFR 1910.1200 et. seq.) and the Canadian WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. This document is intended only as a guide to the appropriate precautionary handling of the material by a person trained in, or supervised by a person trained in, chemical handling. The user is responsible for determining the

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MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE
HOJAS DE DATOS DE SEGURIDAD

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precautions and dangers of this chemical for his or her particular application. Depending on usage, protective clothing including eye and face guards and respirators must be used to avoid contact with material or breathing chemical vapors/fumes.
Exposure to this product may have serious adverse health effects. This chemical may interact with other substances. Since the potential uses are so varied, Baker cannot warn of all of the potential dangers of use or interaction with other chemicals or materials. Baker warrants that the chemical meets the specifications set forth on the label.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.
The user should recognize that this product can cause severe injury and even death, especially if improperly handled or the known dangers of use are not heeded. READ ALL PRECAUTIONARY INFORMATION. As new documented general safety information becomes available, Baker will periodically revise this Material Safety Data Sheet.
Note: CHEMTREC, CANUTEC, and NATIONAL RESPONSE CENTER emergency telephone numbers are to be used ONLY in the event of CHEMICAL EMERGENCIES involving a spill, leak, fire, exposure, or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1-800-JTBAKER) for assistance.

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MATERIAL SAFETY DATA SHEET

FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.
All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

T.BAKER INC., 222 Red School Lane, Phillipsburg, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

Product Name: Sodium Phosphate, Monobasic, Monohydrate
Common Synonyms: Sodium Dihydrogen Phosphate, Monohydrate; Sodium Biphosphate, Monohydrate
Chemical Family: Inorganic Sodium Compounds
Formula: NaH_2PO_4 H_2O
Formula Wt.: 137.99
CAS No.: 10049-21-5
OSHA/RTECS No.: WA1900000
Product Use: Laboratory Reagent
Product Codes: 3820,3818,3821,3815,4011

PRECAUTIONARY LABELING

KER SAF-T-DATA* System

HEALTH	FLAMMABILITY	REACTIVITY	CONTACT
1	0	1	2
SLIGHT	NONE	SLIGHT	MODERATE

Laboratory Protective Equipment

U.S. Precautionary Labeling

WARNING!
CAUSES IRRITATION. HARMFUL IF SWALLOWED OR INHALED.
Avoid contact with eyes, skin, clothing. Avoid breathing dust. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.

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J.T.Baker

J T Baker Inc
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MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

PRECAUTIONARY LABELING (CONTINUED)

International Labeling

Avoid contact with eyes. After contact with skin, wash immediately with plenty of water. Keep container tightly closed.

NFPA-T-DATA* Storage Color Code: Orange (general storage)

SECTION II - COMPONENTS

Component	CAS No.	Weight %	OSHA/PEL	ACGIH/TLV
Sodium Phosphate, Monobasic	10049-21-5	98-100	N/E	N/E

SECTION III - PHYSICAL DATA

Boiling Point: N/A

Vapor Pressure (mmHg): N/A

Melting Point: N/A

Vapor Density (air=1): N/A

Specific Gravity: 2.04 (H_2O=1)

Evaporation Rate: N/A

Solubility(H_2O): Appreciable (>10%)

% Volatiles by Volume: 0 (21°C)

pH: N/A

OC or Threshold (ppm): N/A

Physical State: Solid

Coefficient Water/Oil Distribution: N/A

Appearance & Odor: White crystals. Odorless.

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J.T Baker Inc
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MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

I ash Point (Closed Cup): N/A

A toignition Temperature: N/A

Flammable Limits: Upper - N/A Lower - N/A

I re Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

S ecial Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards
Closed containers exposed to heat may explode.

Toxic Gases Produced
oxides of phosphorus

Explosion Data-Sensitivity to Mechanical Impact
None identified.

E plosion Data-Sensitivity to Static Discharge
None identified.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): Not Established

S ort-Term Exposure Limit (STEL): Not Established

Permissible Exposure Limit (PEL): Not Established

Toxicity of components

C al Rat LD_{50} for Sodium Phosphate, Monobasic 8290 mg/kg

Carcinogenicity: NTP: No IARC: No Z List: No OSHA Reg: No

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MATERIAL SAFETY DATA SHEET
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NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

SECTION V - HEALTH HAZARD DATA (CONTINUED)

Carcinogenicity
None identified.

Reproductive Effects
None identified.

Effects of Overexposure

INHALATION: irritation of upper respiratory tract

SKIN CONTACT: irritation, prolonged contact may cause dermatitis

EYE CONTACT: irritation

SKIN ABSORPTION: none identified

INGESTION: nausea, vomiting, diarrhea, irritation and burns to mouth and stomach

CHRONIC EFFECTS: none identified

Target Organs
eyes, skin

Medical Conditions Generally Aggravated by Exposure
none identified

Primary Routes of Entry
inhalation, ingestion, skin contact, eye contact

Emergency and First Aid Procedures

INGESTION: CALL A PHYSICIAN. If swallowed, if conscious, immediately induce vomiting.

INHALATION: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

SKIN CONTACT: In case of contact, flush skin with water.

EYE CONTACT: In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

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MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

SECTION V - HEALTH HAZARD DATA (CONTINUED)

SARA/TITLE III HAZARD CATEGORIES and LISTS

ute: Yes Chronic: Yes Flammability: No Pressure: No Reactivity: No

Extremely Hazardous Substance: No
RCLA Hazardous Substance: No
RA 313 Toxic Chemicals: No
TSCA Inventory: Yes

SECTION VI - REACTIVITY DATA

ability: Stable Hazardous Polymerization: Will not occur

nditions to Avoid: moisture, heat

Incompatibles: iron and other heavy metals, strong acids

composition Products: oxides of phosphorus

SECTION VII - SPILL & DISPOSAL PROCEDURES

Steps to be Taken in the Event of a Spill or Discharge
Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

sposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Ventilation: Use adequate general or local exhaust ventilation to keep fume or dust levels as low as possible.

Respiratory Protection: None required where adequate ventilation conditions exist. If airborne concentration is high, use an appropriate respirator or dust mask.

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SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT (CONTINUED)

Eye/Skin Protection: Safety goggles, uniform, proper gloves are recommended.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* Storage Color Code: Orange (general storage)

Storage Requirements
Keep container tightly closed. Suitable for any general chemical storage area.

Special Precautions
Material is hygroscopic.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)

International (I.M.O.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)
Marine Pollutants: No

AIR (I.C.A.O.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)

U S. Customs Harmonization Number: 28352200001

NOTE: When handling liquid products, secondary protective containers must be used for carrying.
- /A = Not Applicable, or not Available;
N/E = Not Established.-
The information in this Material Safety Data Sheet meets the requirements of the United States OCCUPATIONAL SAFETY AND HEALTH ACT and regulations promulgated thereunder (29 CFR 1910.1200 et. seq.) and the Canadian WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. This document

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MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE
HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

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is intended only as a guide to the appropriate precautionary handling of the material by a person trained in, or supervised by a person trained in, chemical handling. The user is responsible for determining the precautions and dangers of this chemical for his or her particular application. Depending on usage, protective clothing including eye and face guards and respirators must be used to avoid contact with material or breathing chemical vapors/fumes.

Exposure to this product may have serious adverse health effects. This chemical may interact with other substances. Since the potential uses are so varied, Baker cannot warn of all of the potential dangers of use or interaction with other chemicals or materials. Baker warrants that the chemical meets the specifications set forth on the label.

BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.

The user should recognize that this product can cause severe injury and even death, especially if improperly handled or the known dangers of use are not heeded. READ ALL PRECAUTIONARY INFORMATION. As new documented general safety information becomes available, Baker will periodically revise this Material Safety Data Sheet.

Note: CHEMTREC, CANUTEC, and NATIONAL RESPONSE CENTER emergency telephone numbers are to be used ONLY in the event of CHEMICAL EMERGENCIES involving a spill, leak, fire, exposure, or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1-800-JTBAKER) for assistance.

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MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

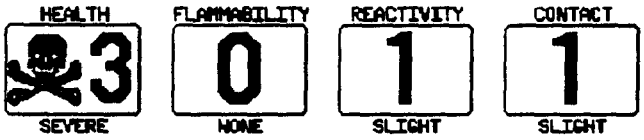
J.T.BAKER INC., 222 Red School Lane, Phillipsburg, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

Product Name: Potassium Fluoride, Anhydrous
Common Synonyms: N/A
Chemical Family: Potassium Compounds
Formula: KF
Formula Wt.: 58.10
CAS No.: 7789-23-3
NIOSH/RTECS No.: TT0700000
Product Use: Laboratory Reagent
Product Codes: 5243,3123

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* System



Laboratory Protective Equipment

U.S. Precautionary Labeling

POISON! DANGER!
MAY BE FATAL IF SWALLOWED OR INHALED.
Do not get in eyes, on skin, on clothing. Do not breathe dust. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.

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MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

PRECAUTIONARY LABELING (CONTINUED)

International Labeling

Avoid contact with eyes. After contact with skin, wash immediately with plenty of water. Keep container tightly closed.

F-T-DATA* Storage Color Code: Blue (health)

SECTION II - COMPONENTS

Component	CAS No.	Weight %	OSHA/PEL	ACGIH/TLV
Potassium Fluoride, Anhydrous	7789-23-3	90-100	N/E	N/E

SECTION III - PHYSICAL DATA

Boiling Point: 1505°C (2741°F) (at 760 mm Hg)

Vapor Pressure (mmHg): N/A

Melting Point: 860°C (1580°F) (at 760 mm Hg)

Vapor Density (air=1): 2.0

Specific Gravity: 2.48 (H_2O=1)

Evaporation Rate: N/A

Solubility(H_2O): Appreciable (>10%)

% Volatiles by Volume: 0 (21°C)

pH: N/A

VOC or Threshold (ppm): N/A

Physical State: Solid

Coefficient Water/Oil Distribution: N/A

Appearance & Odor: White powder or solid.

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NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800) JTBAKER) for assistance

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Closed Cup): N/A

Autoignition Temperature: N/A

Flammable Limits: Upper - N/A Lower - N/A

Fire Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode.

Unusual Fire & Explosion Hazards
None identified.

Toxic Gases Produced
hydrogen fluoride

Explosion Data-Sensitivity to Mechanical Impact
None identified.

Explosion Data-Sensitivity to Static Discharge
None identified.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): 2.5 mg/m^3

Short-Term Exposure Limit (STEL): Not Established

Permissible Exposure Limit (PEL): 2.5 mg/m^3

Toxicity of components

Oral Rat LD_{50} for Potassium Fluoride, Anhydrous	245	mg/kg
Intraperitoneal Rat LD_{50} for Potassium Fluoride, Anhydrous	64	mg/kg

Carcinogenicity: NTP: No IARC: No Z List: No OSHA Reg: No

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MATERIAL SAFETY DATA SHEET
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NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

SECTION V - HEALTH HAZARD DATA (CONTINUED)

Carcinogenicity
None identified.

Reproductive Effects
None identified.

Effects of Overexposure

INHALATION: ulceration of mucous membranes, excessive inhalation is irritating, may cause respiratory system damage, and may be fatal

SKIN CONTACT: irritation

EYE CONTACT: irritation

SKIN ABSORPTION: none identified

INGESTION: headache, nausea, vomiting, dizziness, gastrointestinal irritation

CHRONIC EFFECTS: none identified

Target Organs
eyes, skin, respiratory system, central nervous system, kidneys

Medical Conditions Generally Aggravated by Exposure
none identified

Primary Routes of Entry
inhalation, ingestion, eye contact, skin contact

Emergency and First Aid Procedures

INGESTION: CALL A PHYSICIAN. If swallowed, if conscious, immediately induce vomiting.

INHALATION: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

SKIN CONTACT: In case of contact, flush skin with water.

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MATERIAL SAFETY DATA SHEET
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NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals All non-emergency questions should be directed to Customer Service (1 800-JTBAKER) for assistance

SECTION V - HEALTH HAZARD DATA (CONTINUED)

EYE CONTACT: In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

SARA/TITLE III HAZARD CATEGORIES and LISTS

Acute: Yes Chronic: Yes Flammability: No Pressure: No Reactivity: No

Extremely Hazardous Substance: No
CERCLA Hazardous Substance: No
SARA 313 Toxic Chemicals: No
TSCA Inventory: Yes

SECTION VI - REACTIVITY DATA

Stability: Stable Hazardous Polymerization: Will not occur

Conditions to Avoid: moisture

Incompatibles: strong acids, strong bases, water

Decomposition Products: hydrogen fluoride

SECTION VII - SPILL & DISPOSAL PROCEDURES

Steps to be Taken in the Event of a Spill or Discharge
Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

Disposal Procedure
Dispose in accordance with all applicable federal, state, and local environmental regulations.

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Ventilation: Use adequate general or local exhaust ventilation to keep fume or dust levels as low as possible.

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SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT (CONTINUED)

Respiratory Protection: A respirator with dust/mist filter is recommended. If airborne concentration exceeds TLV, a self-contained breathing apparatus is advised.

Eye/Skin Protection: Safety goggles, uniform, apron, rubber gloves are recommended.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* Storage Color Code: Blue (health)

Storage Requirements
Keep container tightly closed. Store in secure poison area.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)

Proper Shipping Name: Potassium fluoride
Hazard Class: 6.1
UN/NA: UN1812 Packaging Group: III
Labels: KEEP AWAY FROM FOOD
Regulatory References: 49CFR 172.101

International (I.M.O.)

Proper Shipping Name: Potassium fluoride
Hazard Class: 6.1 I.M.O. Page: 6211
UN: UN1812 Marine Pollutants: No Packaging Group: III
Labels: KEEP AWAY FROM FOOD
Regulatory References: 49CFR PART 176; IMDG Code

Air (I.C.A.O.)

Proper Shipping Name: Potassium fluoride
Hazard Class: 6.1
UN: UN1812 Packaging Group: III
Labels: KEEP AWAY FROM FOOD
Regulatory References: 49CFR PART 175; ICAO=== We believe the transportation data and references contained herein to be factual and the opinion of qualified experts. The data is meant as a guide to the overall classification of the product

Continued on Page: 7

J T Baker Inc
222 Red School Lane
Phillipsburg NJ 08865
24-Hour Emergency Telephone 908 859 2151
National Response Center 800-424-8802
Chemtrec 800-424-9300

National Response in Canada
CANUTEC 613 996-6666
Outside U S and Canada
Chemtrec 202 483 7616

MATERIAL SAFETY DATA SHEET
FICHE SIGNALÉTIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.
All non-emergency questions should be directed to Customer Service (1 800 JTBAKER) for assistance

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION (CONTINUED)

and is not package size specific, nor should it be taken as a warranty or representation for which the company assumes legal responsibility.=== The information is offered solely for your consideration, investigation, and verification. Any use of the information must be determined by the user to be in accordance with applicable Federal, State, and Local laws and regulations. See shipper requirements 49CFR 171.2, Certification 172.204, and employee training 49 CFR 173.1(b).

U.S. Customs Harmonization Number: 28261900007

N^TE: When handling liquid products, secondary protective containers must be ı ed for carrying.
-N/A = Not Applicable, or not Available;
N/E = Not Established.-
T e information in this Material Safety Data Sheet meets the ı_quirements of the United States OCCUPATIONAL SAFETY AND HEALTH ACT and regulations promulgated thereunder (29 CFR 1910.1200 et. seq.) and the C nadian WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. This document ı intended only as a guide to the appropriate precautionary handling of the material by a person trained in, or supervised by a person trained in, chemical handling. The user is responsible for determining the p ecautions and dangers of this chemical for his or her particular application. Depending on usage, protective clothing including eye and face guards and respirators must be used to avoid contact with material c breathing chemical vapors/fumes.
E posure to this product may have serious adverse health effects. This chemical may interact with other substances. Since the potential uses a e so varied, Baker cannot warn of all of the potential dangers of use c interaction with other chemicals or materials. Baker warrants that the chemical meets the specifications set forth on the label.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD T THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS F R A PARTICULAR PURPOSE.
The user should recognize that this product can cause severe injury and e-en death, especially if improperly handled or the known dangers of use a e not heeded. READ ALL PRECAUTIONARY INFORMATION. As new documented general safety information becomes available, Baker will periodically revise this Material Safety Data Sheet.
N te: CHEMTREC, CANUTEC, and NATIONAL RESPONSE CENTER emergency telephone n mbers are to be used ONLY in the event of CHEMICAL EMERGENCIES involving a spill, leak, fire, exposure, or accident involving chemicals. All

Continued on Page: 8

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J T Baker Inc
222 Red School Lane
Phillipsburg, NJ 08865
24-Hour Emergency Telephone 908 859 2151
National Response Center 800-424-8802
Chemtrec 800-424-9300

National Response in Canada
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MATERIAL SAFETY DATA SHEET
FICHE SIGNALETIQUE HOJAS DE DATOS DE SEGURIDAD

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals. All non-emergency questions should be directed to Customer Service (1-800-JTBAKER) for assistance

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non-emergency questions should be directed to Customer Service
(-800-JTBAKER) for assistance.

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I proved by Quality Assurance Department.

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MALLINCKRODT

Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

Mallinckrodt provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT MAKES NO REPRESENTATIONS, OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR TO THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION

Emergency Telephone Number: 314-982-5000

HYDROGEN PEROXIDE SOLUTION, 30%

PRODUCT IDENTIFICATION:

Synonyms. Peroxide, 100 volume peroxide

Formula CAS No 7722-84-1

Molecular Weight 34.01

Chemical Formula H_2O_2

Hazardous Ingredients Hydrogen peroxide

PRECAUTIONARY MEASURES

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
CAUSES SEVERE BURNS. HARMFUL IF SWALLOWED OR INHALED.

Do not get in eyes, on skin, or on clothing.
Avoid breathing mist
Keep from contact with clothing and other combustible materials.
Do not store near combustible materials.
Use with adequate ventilation.
Wash thoroughly after handling.

EMERGENCY/FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. For eyes, get medical attention. If swallowed, give water or milk to drink. Get medical attention immediately Never give anything by mouth to an unconscious person If inhaled, remove to fresh air Get medical attention for any breathing difficulty In all cases call a physician
SEE SECTION 5

DOT Hazard Class. Oxidizer

SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Acrid odor.

Solubility: Infinitely soluble in water.

Boiling Point: 108°C (226°F)

Melting Point: -25°C (-13°F)

Specific Gravity: 1.11

Vapor Density (Air=1): (Air=1) 1.17

Vapor Pressure (mm Hg): 25 at 30°C (86°F)

Evaporation Rate: (BuAc=1): <1

SECTION 2 Fire and Explosion Information

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Increases the flammability of combustible, organic and readily oxidizable materials.

Explosion:
Contact with oxidizable substances may cause extremely violent combustion. Drying of concentrated hydrogen peroxide on clothing or other combustible materials may cause fire or explosion.

Fire Extinguishing Media:
Water spray may be used to extinguish surrounding fire and cool exposed containers. Water spray will also reduce fume and irritant gases.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Unstable. Unstable with heat, may result in dangerous pressures. A strong oxidizer, reacts violently upon contact with many organic substances, particularly textile and paper

Hazardous Decomposition Products:
Decomposes to water and oxygen with rapid heat release. Use vented containers. The solution can decompose violently upon heating.

Hazardous Polymerization:
This substance does not polymerize.

Incompatibilities:
Heat, reducing agents, organic materials, dirt, alkalies, rust, and many metals. Spontaneous combustion may occur on standing in contact with readily flammable materials.

SECTION 4 Leak/Spill Disposal Information

CAUTION! Caustic material. Causes fires with organic material. Ventilate area of leak or spill. Clean-up personnel require protective clothing. Contain and recover liquid when possible Do not return spilled material to original container Larger Spills: Dilute with a large amount of water and hold in a pond or dyked area until the H_2O_2 decomposes followed by discharge into a suitable treatment system. May be neutralized with sodium metabisulfite or sodium sulfite after diluting to 5-10% peroxide. Do not flush undiluted material to sewer This oxidizing material can increase the flammability of adjacent combustible materials. Empty containers should be rinsed with water before discarding

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health: 2 Flammability: 0 Reactivity: 1 Other: Oxidizer

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Vapors are corrosive and irritating to the respiratory tract. Inhalation of mist may burn the mucous membrane of the nose and throat

Ingestion:
Corrosive and irritating to the mouth, throat, and abdomen. Large doses may cause symptoms of abdominal pain, vomiting, and diarrhea as well as blistering or tissue destruction

Skin Contact:
Irritating in contact with the skin. Symptoms include discoloration of skin and pain

Eye Contact:
Vapors are very corrosive and irritating to the eyes. Symptoms include pain, redness and blurred vision Splashes may cause tissue destruction.

Chronic Exposure:
No information found

Aggrevation of Pre-existing Conditions.
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation:
Remove to fresh air Get medical attention for any breathing difficulty

Ingestion:
If swallowed, give water or milk to drink. Get medical attention immediately Never give anything by mouth to an unconscious person.

Skin Exposure:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally Get medical attention immediately

C. TOXICITY DATA (RTECS, 1986)

No LD50/LC50 information found relating to normal routes of occupational exposure. Tumorigenic data cited.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL).
1 ppm (TWA)
-ACGIH Threshold Limit Value (TLV)
1 ppm (TWA)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommende Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Store in a cool, well-ventilated dark area separated from combustible substances, reducing agents, strong bases, organics. Suggest rotation of stock. Containers must be vented, but check periodically for bulging containers which can burst from pressure. Protect containers from physical damage and contamination. Contamination from any source (dust, metals) may cause rapid decomposition with generation of large quantities of oxygen gas and high pressures. Rinse empty containers thoroughly with clean water.

.....

HYPER

J.T.BAKER INC. 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865
M A T E R I A L S A F E T Y D A T A S H E E T
24-HOUR EMERGENCY TELEPHONE -- (908) 859-2151
CHEMTREC # (800) 424-9300 -- NATIONAL RESPONSE CENTER # (800) 424-8802

J.T.BAKER INC., 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: HYDROGEN PEROXIDE, 30%
COMMON SYNONYMS: HYDROGEN PEROXIDE SOLUTION
CHEMICAL FAMILY: AQUEOUS SOLUTIONS
FORMULA: H2O2
FORMULA WT.: 34.01
CAS NO.: 7722-84-1
NIOSH/RTECS NO.: MX0899000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 2189,5170,2190,2191,2200,2201,2186,2192,5369

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* SYSTEM

HEALTH	-	2	MODERATE
FLAMMABILITY	-	0	NONE
REACTIVITY	-	3	SEVERE (OXIDIZER)
CONTACT	-	4	EXTREME (CORROSIVE)

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

U.S. PRECAUTIONARY LABELING

DANGER

CAUSES BURNS. HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE EYE INJURY. EFFECTS MAY BE DELAYED. STRONG OXIDIZER. CONTACT WITH COMBUSTIBLE MATERIALS, FLAMMABLE MATERIALS, OR POWDERED METALS CAN CAUSE FIRE OR EXPLOSION.
KEEP FROM CONTACT WITH CLOTHING AND OTHER COMBUSTIBLE MATERIALS. DO NOT STORE NEAR COMBUSTIBLE MATERIALS. DO NOT GET IN EYES, ON SKIN, ON CLOTHING. AVOID CONTAMINATION FROM ANY SOURCE, METALS, DUST, AND ORGANIC MATERIALS THAT MAY CAUSE RAPID DECOMPOSITION, GENERATION OF LARGE QUANTITIES OF OXYGEN GAS AND HIGH PRESSURE. DRYING OF PRODUCT ON CLOTHING OR COMBUSTIBLE MATERIALS MAY CAUSE FIRE. IN CASE OF FIRE, USE WATER ONLY. FLUSH SPILLS OR LEAKS AWAY BY FLOODING WITH WATER APPLIED QUICKLY TO ENTIRE SPILL OR LEAK.

CONTINUED ON PAGE: 2

PRECAUTIONARY LABELING (CONTINUED)

INTERNATIONAL LABELING

AVOID CONTACT WITH EYES. AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH PLENTY OF WATER. KEEP CONTAINER TIGHTLY CLOSED.

SAF-T-DATA* STORAGE COLOR CODE: YELLOW (REACTIVE)

SECTION II - COMPONENTS

COMPONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
HYDROGEN PEROXIDE	7722-84-1	30	1 PPM	1 PPM
WATER	7732-18-5	70	N/E	N/E

SECTION III - PHYSICAL DATA

BOILING POINT: 106 C (222 F)
(AT 760 MM HG)

VAPOR PRESSURE (MMHG): 23.3
(20 C)

MELTING POINT: -28 C (-18 F)
(AT 760 MM HG)

VAPOR DENSITY (AIR=1): N/A

SPECIFIC GRAVITY: 1.11
(H2O=1)

EVAPORATION RATE: >1
(BUTYL ACETATE = 1)

SOLUBILITY(H2O): COMPLETE (100%)

% VOLATILES BY VOLUME: 100
(21 C)

PH: 3.3 (30% SOLUTION)

ODOR THRESHOLD (P.P.M.): N/A

PHYSICAL STATE: LIQUID

COEFFICIENT WATER/OIL DISTRIBUTION: N/A

APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID. PUNGENT ODOR.

CONTINUED ON PAGE: 3

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): N/A NFPA 704M RATING: 2-0-1 OXY

AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: UPPER - N/A LOWER - N/A

FIRE EXTINGUISHING MEDIA
USE WATER SPRAY.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
STRONG OXIDIZER. CONTACT WITH COMBUSTIBLE MATERIALS, FLAMMABLE MATERIALS, OR POWDERED METALS CAN CAUSE FIRE OR EXPLOSION.

TOXIC GASES PRODUCED
NONE IDENTIFIED

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT
NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE
NONE IDENTIFIED.

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 1.4 MG/M3 (1 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

PERMISSIBLE EXPOSURE LIMIT (PEL): 1.4 MG/M3 (1 PPM)

TOXICITY OF COMPONENTS

ORAL RAT LD50 FOR HYDROGEN PEROXIDE	1518 MG/KG
INTRAPERITONEAL MOUSE LD50 FOR WATER	190 G/KG

CONTINUED ON PAGE. 4

SECTION V - HEALTH HAZARD DATA (CONTINUED)

INTRAVENOUS MOUSE LD50 FOR WATER 25 G/KG
CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

CARCINOGENICITY
NONE IDENTIFIED.

REPRODUCTIVE EFFECTS
NONE IDENTIFIED.

EFFECTS OF OVEREXPOSURE

INHALATION: SEVERE IRRITATION OF RESPIRATORY SYSTEM

SKIN CONTACT: SEVERE IRRITATION OR BURNS

EYE CONTACT: SEVERE IRRITATION OR BURNS, PROLONGED CONTACT MAY CAUSE SEVERE EYE DAMAGE, BLINDNESS

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: IRRITATION OF ESOPHAGUS & BLEEDING STOMACH ULCERS

CHRONIC EFFECTS: NONE IDENTIFIED

TARGET ORGANS
EYES, SKIN, MUCOUS MEMBRANES, RESPIRATORY SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

PRIMARY ROUTES OF ENTRY
EYE CONTACT, SKIN CONTACT, INHALATION, INGESTION

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, DO NOT INDUCE VOMITING. IF CONSCIOUS, GIVE LARGE AMOUNTS OF WATER.

INHALATION: IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

CONTINUED ON PAGE: 5

SECTION V - HEALTH HAZARD DATA (CONTINUED)

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE RE-USE.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: YES PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE: NO
CERCLA HAZARDOUS SUBSTANCE: NO
SARA 313 TOXIC CHEMICALS: NO
TSCA INVENTORY: YES

SECTION VI - REACTIVITY DATA

STABILITY: UNSTABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT

INCOMPATIBLES: COMBUSTIBLE MATERIALS, STRONG REDUCING AGENTS, MOST COMMON METALS, ORGANIC MATERIALS, METALLIC SALTS, ALKALIES, POROUS MATERIALS; ESP. WOOD, ASBESTOS, SOIL, RUST, STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: NONE IDENTIFIED

SECTION VII - SPILL & DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL. FLUSH AREA WITH FLOODING AMOUNTS OF WATER. (USE CAUTION.)

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SECTION VII - SPILL & DISPOSAL PROCEDURES (CONTINUED)

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D001, D002 (IGNITABLE, CORROSIVE WASTE)

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 1 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, NEOPRENE GLOVES ARE RECOMMENDED.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* STORAGE COLOR CODE: YELLOW (REACTIVE)

STORAGE REQUIREMENTS
KEEP CONTAINER TIGHTLY CLOSED. STORE SEPARATELY AND AWAY FROM FLAMMABLE AND COMBUSTIBLE MATERIALS. KEEP CONTAINERS OUT OF SUN AND AWAY FROM HEAT. CONTAINERS SHOULD BE COVERED AND VENTED.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: HYDROGEN PEROXIDE, AQUEOUS SOLUTION (WITH NOT LESS THAN 20% TO 40% HYDROGEN PEROXIDE)
HAZARD CLASS: 5.1, 8
UN/NA: UN2014 PACKAGING GROUP: II
LABELS: OXIDIZER, CORROSIVE

CONTINUED ON PAGE: 7

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION (CONTINUED)

REGULATORY REFERENCES: 49CFR 172.101

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: HYDROGEN PEROXIDE, AQUEOUS SOLUTIONS, 20% TO 60% HYDROGEN PEROXIDE (STABILIZED AS NECESSARY)
HAZARD CLASS: 5.1, 8 I.M.O. PAGE: 5151
UN: UN2014 MARINE POLLUTANTS: NO PACKAGING GROUP: II
LABELS: OXIDIZING AGENT, CORROSIVE
REGULATORY REFERENCES: 49CFR 172.102; PART 176; IMO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: HYDROGEN PEROXIDE, AQUEOUS SOLUTION (WITH NOT LESS THAN 20% TO 40% HYDROGEN PEROXIDE)
HAZARD CLASS: 5.1, 8
UN: UN2014 PACKAGING GROUP: II
LABELS: OXIDIZER, CORROSIVE
REGULATORY REFERENCES: 49CFR 172.101; 173.6; PART 175; ICAO/IATA=== WE BELIEVE THE TRANSPORTATION DATA AND REFERENCES CONTAINED HEREIN TO BE FACTUAL AND THE OPINION OF QUALIFIED EXPERTS. THE DATA IS MEANT AS A GUIDE TO THE OVERALL CLASSIFICATION OF THE PRODUCT AND IS NOT PACKAGE SIZE SPECIFIC, NOR SHOULD IT BE TAKEN AS A WARRANTY OR REPRESENTATION FOR WHICH THE COMPANY ASSUMES LEGAL RESPONSIBILITY.=== THE INFORMATION IS OFFERED SOLELY FOR YOUR CONSIDERATION, INVESTIGATION, AND VERIFICATION. ANY USE OF THE INFORMATION MUST BE DETERMINED BY THE USER TO BE IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND REGULATIONS. SEE SHIPPER REQUIREMENTS 49CFR 172.3 AND EMPLOYEE TRAINING 49CFR 173.1.

U.S. CUSTOMS HARMONIZATION NUMBER: 28470000003

N/A = NOT APPLICABLE OR NOT AVAILABLE
N/E = NOT ESTABLISHED

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE REQUIREMENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND REGULATIONS PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF

CONTINUED ON PAGE: 8

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THE MATERIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED IN, CHEMICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE PRECAUTIONS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR APPLICATION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND FACE GUARDS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL OR BREATHING CHEMICAL VAPORS/FUMES.
EXPOSURE TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS CHEMICAL MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES ARE SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE OR INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT THE CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL.
BAKER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD TO THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS FOR A PARTICULAR PURPOSE.
THE USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND EVEN DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE ARE NOT HEEDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED GENERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY REVISE THIS MATERIAL SAFETY DATA SHEET.
NOTE: CHEMTREC, CANUTEC, AND NATIONAL RESPONSE CENTER EMERGENCY TELEPHONE NUMBERS ARE TO BE USED ONLY IN THE EVENT OF CHEMICAL EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE, OR ACCIDENT INVOLVING CHEMICALS. ALL NON-EMERGENCY QUESTIONS SHOULD BE DIRECTED TO CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

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===
APPROVED BY QUALITY ASSURANCE DEPARTMENT.

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. CHEMICAL PRODUCT A.)COMPANY IDENTIFICATION

ANUFACTURER.....:

EM SCIENCE
A DIVISION OF EM INDUSTRIES
P.O. BOX 70
480 DEMOCRAT RD.
GIBBSTOWN, N.J. 08027

PREPARATION DATE.: 03/01/91
DATE MSDS PRINTED.: JUN 11, 1992

INFORMATION PHONE NUMBER.: 609-354-9200
HOURS: MON. TO FRI. 8:30-5
CHEMTREC EMERGENCY NUMBER: 800-424-9300
HOURS: 24 HRS A DAY

ATALOG NUMBER(S):
HX0630

HEMICAL NAME....: HYDROGEN PEROXIDE SOLUTION, 50%
RADE NAME.....: HYDROGEN DIOXIDE
HEMICAL FAMILY..: PEROXIDE
ORMULA.....: H2O2

MOLECULAR WEIGHT.: 34.02

2. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS #	APPR %
YDROGEN PEROXIDE	7722-84-1	50%
ATER	7732-18-5	50%

3. HAZARDS IDENTIFICATION

MERGENCY OVERVIEW
STRONG OXIDIZER.
LABORATORY TESTS INDICATE MATERIAL MAY BE CARCINOGENIC.
CAUSES BURNS.
CAN BE TOXIC BY INGESTION.
HARMFUL IF INHALED.
MAY CONTAIN GAS UNDER PRESSURE.
CONTAMINATION MAY RESULT IN DANGEROUS PRESSURE.
APPEARANCE.....:
CLEAR, COLORLESS LIQUID WITH SHARP ODOR

OTENTIAL HEALTH EFFECTS (ACUTE AND CHRONIC)

SYMPTOMS OF EXPOSURE:
EYES: SEVERE DAMAGE, POSSIBLY DELAYED; POSSIBLE BLINDNESS.
INHALATION: IRRITATION OF NASAL & RESPIRATORY PASSAGES.
BLEACHING, BLISTERING OF SKIN ON CONTACT.
TOXIC AND CORROSIVE BY INGESTION.
MEDICAL COND. AGGRAVATED BY EXPOSURE:
DATA NOT AVAILABLE.
ROUTES OF ENTRY.....:
INHALATION, INGESTION
CARCINOGENICITY.....:
THERE IS "LIMITED EVIDENCE" THAT H2O2 IS CARCINOGENIC TO EXPERIMENTAL ANIMALS (IARC: 36, 1985) HOWEVER, IT IS IMPROBABLE THAT HUMANS WILL BE EXPOSED TO HIGH ORAL DOSES DUE TO ACUTE TOXICITY OF CONCENTRATED SOLUTIONS AND CORROSIVITY OF H2O2 TO MUCOUS MEMBRANES.

4. FIRST AID MEASURES

EMERGENCY FIRST AID:
GET MEDICAL ASSISTANCE FOR ALL CASES OF OVEREXPOSURE.
SKIN: IMMEDIATELY FLUSH THOROUGHLY WITH LARGE AMOUNTS OF WATER.
EYES: IMMEDIATELY FLUSH THOROUGHLY WITH WATER FOR AT LEAST 15 MINUTES.
INHALATION: REMOVE TO FRESH AIR; GIVE ARTIFICIAL RESPIRATION IF BREATHING HAS STOPPED.
INGESTION: DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER FREELY AND GET MEDICAL ATTENTION.
REMOVE CONTAMINATED CLOTHING AND WASH BEFORE REUSE.

. FIRE FIGHTING MEASURES

FLASH POINT (F).....: NONCOMBUSTIBLE
FLAMMABLE LIMITS LEL (%).: N/A
FLAMMABLE LIMITS UEL (%).: N/A
EXTINGUISHING MEDIA.....:
WATER; FLOOD FIRE-EXPOSED CONTAINERS WITH WATER TO COOL.
FIRE FIGHTING PROCEDURES.:
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING.
FIRE & EXPLOSION HAZARDS.:
DECOMPOSITION RELEASES OXYGEN WHICH MAY INTENSIFY FIRE.

6. ACCIDENTAL RELEASE MEASURES

PILL RESPONSE:
EVACUATE THE AREA OF ALL UNNECESSARY PERSONNEL.
WEAR SUITABLE PROTECTIVE EQUIPMENT LISTED UNDER EXPOSURE / PERSONAL PROTECTION.
ELIMINATE ANY IGNITION SOURCES UNTIL THE AREA IS DETERMINED TO BE FREE FROM EXPLOSION OR FIRE HAZARDS.
CONTAIN THE RELEASE AND ELIMINATE ITS SOURCE, IF THIS CAN BE DONE WITHOUT RISK.
TAKE UP AND CONTAINERIZE FOR PROPER DISPOSAL AS DESCRIBED UNDER DISPOSAL.
COMPLY WITH FEDERAL, STATE, AND LOCAL REGULATIONS ON REPORTING RELEASES. REFER TO REGULATORY INFORMATION FOR REPORTABLE QUANTITY AND OTHER REGULATORY DATA.
EM SCIENCE RECOMMENDS SPILL-X NEUTRALIZERS AND ABSORBENT AGENTS FOR VARIOUS TYPES OF SPILLS.
ADDITIONAL INFORMATION ON THE SPILL-X PRODUCTS CAN BE PROVIDED THROUGH THE EM SCIENCE TECHNICAL SERVICE DEPARTMENT (609) 354-9200.
THE FOLLOWING EM SCIENCE SPILL-X NEUTRALIZER AND ABSORBENT IS RECOMMENDED FOR THIS PRODUCT:

SX0861 ACID SPILL TREATMENT KIT

- HANDLING AND STORAGE

HANDLING & STORAGE:
VENT ALL CONTAINERS TO PREVENT PRESSURE BUILD-UP; KEEP UPRIGHT.
DO NOT BREATHE VAPOR.
STORE IN A COOL AREA AWAY FROM COMBUSTIBLE MATERIAL AND CATALYTIC METALS.
DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING.
AVOID EXCESSIVE HEAT AND CONTAMINATION OF ANY KIND.
RETAINED RESIDUE MAY MAKE EMPTY CONTAINERS HAZARDOUS; USE CAUTION.
NEVER RETURN UNUSED HYDROGEN PEROXIDE TO ORIGINAL CONTAINER.

- EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT:

VENTILATION, RESPIRATORY PROTECTION, PROTECTIVE CLOTHING, EYE PROTECTION
RESPIRATORY PROTECTION: IF WORKPLACE EXPOSURE LIMIT(S) OF PRODUCT OR ANY COMPONENT IS EXCEEDED (SEE TLV/PEL), A NIOSH/MSHA APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS (NEGATIVE PRESSURE TYPE) UNDER SPECIFIED CONDITIONS (SEE YOUR SAFETY EQUIPMENT SUPPLIER). ENGINEERING

AND/OR ADMINISTRATI.. CONTROLS SHOULD BE IMPLEM..TED TO REDUCE EXPOSURE.
MATERIAL SHOULD BE HANDLED OR TRANSFERRED IN AN APPROVED FUME HOOD OR WITH ADEQUATE VENTILATION.
PROTECTIVE GLOVES (RUBBER, NEOPRENE OR EQUIVALENT) MUST BE WORN TO PREVENT SKIN CONTACT.
PROTECTIVE CLOTHING (IMPERVIOUS) SHOULD BE WORN WHEN HANDLING THIS MATERIAL.
SAFETY GLASSES WITH SIDE SHIELDS MUST BE WORN AT ALL TIMES.

WORK / HYGENIC PRACTICES:
WASH THOROUGHLY AFTER HANDLING.
DO NOT TAKE INTERNALLY.
EYE WASH AND SAFETY EQUIPMENT SHOULD BE READILY AVAILABLE.

EXPOSURE GUIDELINES

OSHA - PEL:

COMPONENT	TWA PPM	TWA MG/M3	STEL PPM	STEL MG/M3	CL PPM	CL MG/M3	SKIN
HYDROGEN PEROXIDE	1	1.4					
WATER							

ACGIH - TLV:

COMPONENT	TWA PPM	TWA MG/M3	STEL PPM	STEL MG/M3	CL PPM	CL MG/M3	SKIN
HYDROGEN PEROXIDE	1	1.4					
WATER							

9. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT (C 760 MMHG).: 114C
MELTING POINT (C).....: -52C
SPECIFIC GRAVITY (H2O = 1).: 1.196
VAPOR PRESSURE (MM HG).....: 18 30C
PERCENT VOLATILE BY VOL (%): 50

APOR DENSITY (AIR = 1)....: 0.9
EVAPORATION RATE (BUAC = 1): >1
OLUBILITY IN WATER (%)....: MISCIBLE
PPEARANCE.....:
CLEAR, COLORLESS LIQUID WITH SHARP ODOR

0. STABILITY AND REACTIVITY

STABILITY.....: NO
AZARDOUS POLYMERIZATION:
DOES NOT OCCUR

HAZARDOUS DECOMPOSITION.:
OXYGEN WHICH SUPPORTS COMBUSTION

CONDITIONS TO AVOID.....:

CONTAMINATION OF ANY KIND.
EXCESSIVE HEAT WHICH ACCELERATES DECOMPOSITION.

ATERIALS TO AVOID.....:
( )WATER
( )ACIDS
( )BASES
( )CORROSIVES
( )OXIDIZERS
(X)OTHER :

COMBUSTIBLE MATERIALS, POWDERED METALS, RUST, DIRT, ORGANICS

11. TOXICOLOGICAL INFORMATION

OXICITY DATA:
NONE ESTABLISHED
TOXICOLOGICAL FINDINGS:
TESTS ON LABORATORY ANIMALS INDICATE MATERIAL MAY CAUSE TUMORS
CITED IN REGISTRY OF TOXIC EFFECTS OF SUBSTANCES (RTECS)

12. DISPOSAL CONSIDERATIONS

PA WASTE NUMBERS: D002
TREATMENT:
INCINERATION, FUELS BLENDING OR RECYCLE. CONTACT YOUR LOCAL
PERMITTED WASTE DISPOSAL SITE (TSD) FOR PERMISSIBLE TREATMENT
SITES.
ALWAYS CONTACT A PERMITTED WASTE DISPOSER (TSD) TO ASSURE

COMPLIANCE WITH ALL CURRENT LOCAL, STATE AND FEDERAL REGULATIONS.

3. TRANSPORT INFORMATION

DOT PROPER SHIPPING NAME...:
HYDROGEN PEROXIDE SOLUTION, 50%
DOT ID NUMBER.....: UN2014

14. REGULATORY INFORMATION

SCA INVENTORY.....:
THIS PRODUCT IS A "MIXTURE". THE CAS NUMBERS OF ALL COMPONENTS ARE LISTED ON THE TSCA INVENTORY.

COMPONENT	SARA EHS (302)	SARA EHS TPQ (LBS)	CERCLA RQ (LBS)
YDROGEN PEROXIDE	Y	1000	1
ATER			

COMPONENT	OSHA FLOOR LIST	SARA 313	DEMINIMIS FOR SARA 313 (%)
HYDROGEN PEROXIDE	Y		
ATER			

15. OTHER INFORMATION

OMMENTS:
NONE
NFPA HAZARD RATINGS:

HEALTH : 2
FLAMMABILITY : 0
REACTIVITY : 1
SPECIAL HAZARDS: OXY

REVISION HISTORY:
08/01/84 04/01/85 06/29/87 10/27/87 03/27/90

= REVISED SECTION
N/A = NOT AVAILABLE
N/E = NONE ESTABLISHED

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Emergency Phone Number: 314-539-1600

Performance and Laboratory Chemical Div P O Box 800 Paris KY 40362

POTASSIUM PERMANGANATE

PRODUCT IDENTIFICATION

Synonyms. Permanganic acid, potassium salt Condy's crystals

Formula CAS No 7722-64-7

Molecular Weight 158 03

Chemical Formula $KMnO_4$

Hazardous Ingredients. Potassium permanganate

PRECAUTIONARY MEASURES

DANGER!
STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
HARMFUL IF SWALLOWED OR INHALED.
CAUSES IRRITATION

Keep from contact with clothing and other combustible materials
Store in a tightly closed container
Remove and wash contaminated clothing promptly
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Contact with other materials may cause fire or explosion
container tightly closed and away from heat
Wash clothing thoroughly at once

EMERGENCY/FIRST AID

If swallowed, induce vomiting immediately by giving two glasses of water or milk if available and sticking finger down throat Never give anything by mouth to an unconscious person If inhaled, remove to fresh air If not breathing, give artificial respiration If breathing is difficult, give oxygen In case of contact immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician
SEE SECTION 5

DOT Hazard Class. Oxidizer

SECTION 1 Physical Data

Appearance Purple-bronze crystals

Odor Odorless.

Solubility 7 g in 100 g of water

Boiling Point Not applicable

Melting Point Decomposes ca 240°C (464°F)

Density 2.7

Vapor Density (Air = 1). No information found

Vapor Pressure (mm Hg) No information found

Evaporation Rate No information found

SECTION 2 Fire and Explosion Information

Fire.
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition Contact with oxidizable substances may cause extremely violent combustion

Explosion:
Strong oxidants may explode when shocked, or if exposed to heat flame or friction Also may act as initiation source for dust or vapor explosions. Contact with oxidizable substances may cause extremely violent combustion

Fire Extinguishing Media:
Use water spray to blanket fire, cool fire exposed containers and to flush non-ignited spills or vapors away from fire

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage

Hazardous Decomposition Products.
Possibly toxic or irritating oxides of manganese or potassium at high temperature

Hazardous Polymerization.
This substance does not polymerize

Incompatibilities:
Powdered metals alcohol, arsenites, bromides, iodides phosphorous sulfuric acid, organic compounds, sulfur activated carbon, hydrides, strong hydrogen peroxide, ferrous or mercurous salts, hypophosphites, hyposulfites, sulfites, peroxides, and oxalates

SECTION 4 Leak/Spill Disposal Information

Clean-up personnel should wear protective clothing and respiratory equipment suitable for flammable and fire-promoting materials Dike and cover spill with ferrous sulfate, sodium sulfite or sodium thiosulfate, then moisten and acidify, if necessary, to promote the reduction reaction Neutralize slurry with soda ash Transfer to a suitable closed container preferably metal, for intermediate storage before reclamation or disposal Neutralized waste may be transferred to a closed, preferably metal container and sent to a RCRA-approved waste disposal facility

Reportable Quantity (RQ)(CWA/CERCLA) 100 lbs

Ensure compliance with local, state and federal regulations

NFPA Ratings. Health 1 Flammability 0 Reactivity 0 Other Oxidizer

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Emergency Phone Number: 314-539-1600

Performance and Laboratory Chemical Div P O Box 800 Paris KY 40362

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation.
May cause irritation to nasal and respiratory passages

Ingestion:
* rritating to the gastro-intestinal system Nausea, vomiting and arrhea may result Prolonged ingestion can lead to serious chronic effects, see below

Skin Contact:
May cause severe irritation with redness and pain Concentrated solutions are caustic; contact may cause skin burns.

Eye Contact:
Irritation, redness and tearing from contact with dust

Chronic Exposure:
Prolonged skin contact may cause irritation, defatting, and dermatitis Chronic manganese poisoning can result from excessive inhalation exposure to manganese dust and involves impairment of the central nervous system Early symptoms include sluggishness sleepiness, and weakness in the legs Advanced cases have shown symptoms of fixed facial expression emotional disturbances spastic gait, and falling.

Aggravation of Pre-existing Conditions:
* information found

B FIRST AID

Inhalation:
Remove to fresh air Get medical attention for any breathing difficulty

Ingestion:
If swallowed, induce vomiting immediately by giving two glasses of water, or milk if available and sticking finger down throat Call a physician immediately Never give anything by mouth to an unconscious person

Skin Exposure:
In case of contact immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes Wash clothing before reuse Call a physician immediately

Eye Exposure.
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally Get medical attention immediately

C TOXICITY DATA (RTECS 1991)

Oral rat LD50: 1090 mg/kg; investigated as a mutagen, reproductive effector

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL)
5 mg/m^3 Ceiling for manganese compounds as Mn

-ACGIH Threshold Limit Value (TLV)
5 mg/m^3 (TWA) for manganese dust and compounds as Mn

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommend Practices", most recent edition, for details

Personal Respirators. (NIOSH Approved)
If the TLV is exceeded a dust/mist respirator may be worn up to ten times the TLV Consult respirator supplier for details

Skin Protection:
Wear impervious protective clothing including boots gloves lab coat, apron or coveralls to prevent skin contact

Eye Protection.
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible Contact lenses should not be worn when working with this material Maintain eye wash fountain and quick-drench facilities in work area

SECTION 7 Storage and Special Information

Keep in a tightly closed container Store in a cool dry, ventilated area away from sources of heat or ignition Isolate from flammable materials Do not store on wooden floors

.....

POPLR

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Performance and Laboratory Chemical Div PO Box 800 Paris KY 40362

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS must include a copy of this addendum

(Chem Key POPER)

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X			X

Product or Components of Product	SARA EHS Sect 302 RQ (lbs)	SARA EHS Sect 302 TPQ (lbs)	SARA Section 313 Chemicals Name List	SARA Section 313 Chemicals Chemical Category	CERCLA Sec 103 RQ (lbs)	RCRA Sec 261 33
POTASSIUM PERMANGANATE (7722-64-7)	No	No	No	Manganese compound	100	No

SARA Section 302 EHS RQ Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355
SARA Section 302 EHS TPQ Threshold Planning Quantity of Extremely Hazardous Substance An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS
SARA Section 313 Chemicals Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372 65
CERCLA Sec 103 Comprehensive Enviromental Response, Compensation and Liability Act (Superfund) Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802), Listed at 40 CFR 302 4
RCRA Resource Conservation and Recovery Act Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261 33

J. T. BAKER CHEMIC CO. 222 RED SCHOOL LANE, HILLIPSBURG, NJ 08865

M A T E R I A L S A F E T Y D A T A S H E E T

24-HOUR EMERGENCY TELEPHONE -- (201) 859-2151

CHEMTREC # (800) 424-9300 -- NATIONAL RESPONSE CENTER # (800) 424-8802

5409 -01 POTASSIUM CARBONATE, ANHYDROUS PAGE: 1

F ECTIVE: 09/26/85 ISSUED: 01/24/86

SECTION I - PRODUCT IDENTIFICATION

R_DUCT NAME: POTASSIUM CARBONATE, ANHYDROUS

ORMULA: K2CO3

O MULA WT: 138.21

A NO.: 00584-08-7

IOSH/RTECS NO.: TS7750000

OMMON SYNONYMS: CARBONIC ACID, DIPOTASSIUM SALT; PEARL ASH; SALT OF TARTAR; POTASH

RUDUCT CODES: 3012,3010,3014,3015,5157

PRECAUTIONARY LABELLING

AKER SAF-T-DATA(TM) SYSTEM

HEALTH - 2
FLAMMABILITY - 0
REACTIVITY - 1
CONTACT - 2

ABORATORY PROTECTIVE EQUIPMENT

A. ETY GLASSES; LAB COAT; VENT HOOD; PROPER GLOVES

R CAUTIONARY LABEL STATEMENTS

WARNING
HARMFUL IF SWALLOWED
CAUSES IRRITATION

VOID CONTACT WITH EYES, SKIN, CLOTHING.
EEP IN TIGHTLY CLOSED CONTAINER. WASH THOROUGHLY AFTER HANDLING.

SECTION II - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
OTASSIUM CARBONATE	90-100	584-08-7

SECTION III - PHYSICAL DATA

OILING POINT: N/A

VAPOR PRESSURE(MM HG): N/A

IE_TING POINT: 891 C (1636 F)

VAPOR DENSITY(AIR=1): N/A

P CIFIC GRAVITY: 2.42 (H2O=1)

EVAPORATION RATE: N/A (BUTYL ACETATE=1)

O' UBILITY(H2O): APPRECIABLE (MORE THAN 10 %)

% VOLATILES BY VOLUME: 0

PrEARANCE & ODOR: WHITE, ODORLESS GRANULES.

CONTINUED ON PAGE: 2

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

L.SH POINT: N/A

I E EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SECTION V - HEALTH HAZARD DATA

OXICITY: LD50 (ORAL-RAT)(MG/KG) - 1870

F. ECTS OF OVEREXPOSURE
CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS.
EXCESSIVE INHALATION OF DUST IS IRRITATING AND MAY BE SEVERELY DAMAGING TO RESPIRATORY PASSAGES AND/OR LUNGS.

M"RGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

SECTION VI - REACTIVITY DATA

T BILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

O"DITIONS TO AVOID: MOISTURE

NCOMPATIBLES: WATER, STRONG ACIDS, MAGNESIUM, BROMINE TRIFLUORIDE AND TRICHLORIDE

SECTION VII - SPILL AND DISPOSAL PROCEDURES

T PS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

J. T. BAKER NEUTRACIT-2(R) CAUSTIC NEUTRALIZER IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

I.POSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION VIII - PROTECTIVE EQUIPMENT

E TILATION: USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.

CONTINUED ON PAGE: 3

SECTION VIII - PROTECTIVE EQUIPMENT (CONTINUED)

ESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION IS HIGH, USE AN APPROPRIATE RESPIRATOR OR DUST MASK.

YE/SKIN PROTECTION: SAFETY GLASSES WITH SIDESHIELDS, UNIFORM, RUBBER GLOVES ARE RECOMMENDED.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

AI -T-DATA(TM) STORAGE COLOR CODE: ORANGE

PECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

OMESTIC (D.O.T.)

R ER SHIPPING NAME CHEMICALS, N.O.S.

NTERNATIONAL (I.M.O.)

RO ER SHIPPING NAME CHEMICALS, N.O.S.

T) AND (R) DESIGNATE TRADEMARKS.
/A = NOT APPLICABLE OR NOT AVAILABLE

H INFORMATION PUBLISHED IN THIS MATERIAL SAFETY DATA SHEET HAS BEEN COMPILED ROM OUR EXPERIENCE AND DATA PRESENTED IN VARIOUS TECHNICAL PUBLICATIONS. IT IS HE USER'S RESPONSIBILITY TO DETERMINE THE SUITABILITY OF THIS INFORMATION FOR H ADOPTION OF NECESSARY SAFETY PRECAUTIONS. WE RESERVE THE RIGHT TO REVISE A.ERIAL SAFETY DATA SHEETS PERIODICALLY AS NEW INFORMATION BECOMES AVAILABLE.

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Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P O. Box M Paris, KY 40361

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Emergency Telephone Number: 314-982-5000

SODIUM CARBONATE ANHYDROUS

PRODUCT IDENTIFICATION:

Synonyms: Carbonic acid, disodium salt; disodium carbonate

Formula CAS No.: 497-19-8

Molecular Weight: 105.99

Che. . Formula: Na_2CO_3

Hazardous Ingredients: Sodium carbonate anhydrous

PRECAUTIONARY MEASURES

DANGER! MAY CAUSE EYE BURNS. HARMFUL IF SWALLOWED.

Do not get in eyes, on skin, or on clothing.
Avoid breathing dust.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

EMERGENCY/FIRST AID

If swallowed, DO NOT INDUCE VOMITING!
Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. In case of contact, imme ly flush skin or eyes with plenty of water for at least 15 mina s all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Not Regulated

SECTION 1 Physical Data

Appearance: White powder or granules.

Odor: Odorless.

Solubility: 45.5 g/100 ml water @ 100°C (212°F)

Boiling Point: Decomposes

Melting Point: 851°C (1564°F)

Specific Gravity: 2.53

Vapor Density (Air=1): No information found.

Vapor Pressure (mm Hg): No information found.

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not considered to be a fire hazard.

Explosion:
Not considered an explosion hazard, but explosion may occur when applied to red-hot aluminum.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.

Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization:
Will not occur

Incompatibilities:
Phosphorous pentoxide, sulfuric acid, zinc, lithium, moisture, calcium hydroxide and 2,4,6-trinitrotoluene.
Reacts violently with acids to form carbon dioxide.

SECTION 4 Leak/Spill Disposal Information

Those involved in clean-up should use protection against skin contact or inhalation of dust or mist. Scoop up solid and place in sealable containers for recovery or disposal. Flush residues and liquid spills to holding area for neutralization (e.g., with dilute HCl) before discharge. Reclaim and reuse as much as possible. Send remainder to an approved waste disposal facility. Alternatively, if local ordinances allow, neutralized wastes can usually be flushed to drain with much excess water.

Ensure compliance with local, state and federal regulations.

ECTION 5 Health Hazard Information

. EXPOSURE / HEALTH EFFECTS

ihalation:
ihalation of dust may cayse irritation to the respiratory tract. mptoms may include coughing and labored breathing. Excessive ntact is known to cause damage to the nasal septum.

igestion:
aly slightly toxic, but large doses may be corrosive to the str[illegible]stinal tract where symptoms may include severe ido[illegible]l pain, vomiting, diarrhea, and collapse.

kin Contact:
xcessive contact may cause irritation with blistering and dness. Solutions may cause severe irritation or burns.

ye Contact:
ontact may be corrosive to eyes and cause conjuctival edema and rneal destruction.

hronic Exposure:
rolonged or repeated skin exposure may cause sensitization.

ggrevation of Pre-existing Conditions:
o information found.

B. FIRST AID

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1986)

No LD50/LC50 information found relating to normal routes of occupational exposure. Irritation eye rabbit: 100mg/24 H.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
None established.

Ventilation System:
A local exhaust system which captures the contaminant at its source is recommended to prevent dispersion of the contaminant into the workroom air.

Personal Respirators: (NIOSH Approved)
For conditions of use where exposure to the dust is apparent, a dust/mist respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.

Skin Protection:
Wear protective gloves and clean body-covering clothing.

Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances.

••

SODCA

ATTACHMENT 3

EMPLOYEE SIGNOFF

EMPLOYEE SIGNOFF

The employees listed below have been provided a copy of this Health and Safety Plan, have read and understood it, and agree to abide by its provisions.

EMPLOYEE	EMPLOYEE SIGNATURE / DATE

Attachment 4

FORM 533 (RECORD OF HAZARDOUS WASTE FIELD ACTIVITY)

FORM 533
RECORD OF HAZARDOUS WASTE FIELD ACTIVITY

SITE NAME:
SITE SAFETY COORDINATOR
PROJECT NUMBER
RECORD OF ACTIVITIES FOR (DATES)

Employee Name/Number	Total Days Onsite	Days in Level B	Days in Level C	Days in Level D	Days as SSC Level B	Days as SSC Level C	Days as SSC at Level D	Activities Performed

Attachment 5

CHEMICAL HYGIENE PLAN

CHEMICAL HYGIENE PLAN

Analytical Technologies, Inc.
Fort Collins, CO

Revision 1
January 1993

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ANALYTICAL TECHNOLOGIES, INC.
CHEMICAL HYGIENE PLAN

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SECTION ONE

Introduction

OCCUPATIONAL EXPOSURES TO HAZARDOUS CHEMICALS IN LABORATORIES (29CFR 1910.1450)

CHEMICAL HYGIENE PLAN

1.0 INTRODUCTION

New knowledge, new technology, and ongoing concerns for individual health and safety and the protection of the environment are spurring major changes in the way laboratories and analytical facilities manage, store and use chemicals. As a result we have created what is called a Chemical Hygiene Plan. This plan is designed to show people, with an easily understood method, the way we as an analytical facility feel chemicals should be procured, distributed, stored and used.

Ideally, we would like this plan to become part of basic job training. It is our goal to have all lab employees who use chemicals use them in a safe manner and to ensure that they are stored correctly. This plan will illustrate the best ways to do these things. As new and better information becomes available we will implement it into this plan so that you as an employee can be made aware of it. By doing this we hope to create a safer working environment for employees and demonstrate a sense of caring about the people who work at Analytical Technologies, Inc.

1.1 History of the OSHA Laboratory Standard

On November 25, 1983, the Occupational Safety and Health Administration (OSHA) published the Hazard Communication Standard which applied to certain manufacturers and in part to certain laboratories. OSHA received many comments regarding whether the procedures of the Hazard Communication Standard should apply to laboratories where the staff is usually highly educated. OSHA decided although "...31.9% of all laboratory workers have bachelors degrees, 20.6% have masters degrees, and 20.9% have doctorates.. ," that, ".. there is some question as to whether laboratory workers actually make themselves as knowledgeable as they should be and some laboratory employees are not professionally trained."

Other unique differences for laboratories were noted including: the small amounts of chemicals used, the vast numbers of different chemicals involved, and that nearly half of the laboratories in one survey could not accurately predict their chemical needs even one month in advance.

OSHA decided that ". Despite the existence of the unique characteristics of laboratory work places, in actual practice incidents of acute adverse health effects resulting from exposures to toxic substances in laboratories do occur. Furthermore, some studies. .have shown increased risks of certain types of diseases for laboratory workers. In addition, although laboratory workers are, in general, a well educated work force, there is evidence that many laboratories do not have health and safety programs.. "Therefore, OSHA proposed the Occupational Exposures to Hazardous Chemicals in Laboratories" rule from which this Chemical Hygiene Plan originates.

On January 31, 1990, The Department of Labor published in the Federal Register an amendment to 29 CFR 1910, Subpart Z, "Occupational exposure to hazardous chemicals in the laboratory", but is better known as the "Laboratory Standard" (Attachment A)

The effective date of the standard is May 1, 1990. A part of that standard is the requirement for the development of a chemical hygiene plan. That plan must be developed and implemented by January 31, 1991.

1.2 Summary of the Laboratory Standard

SUMMARY OF OSHA's HEALTH AND SAFETY STANDARDS; OCCUPATIONAL EXPOSURE TO HAZARDOUS CHEMICALS IN LABORATORIES 29 CFR 1910.1450 LAB STANDARD

A. Scope and Application

1. Applies to all employees whose laboratories use hazardous chemicals.

2. This amends (for laboratories) all other provisions of 29 CFR 1910 Subpart Z except for PEL.

3. This does not apply to activities that do not fit term "laboratory use".

B. Definitions (See Appendix A)

1. Laboratory - Means any facility where the "laboratory use of hazardous chemicals" occur. It is a work place where relatively small quantities of hazardous chemicals are used on a non-production basis.

2 Laboratory Scale - Means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those work places whose function is to produce commercial quantities of materials.

3 Laboratory use of hazardous chemicals - Means handling or use of such chemicals in which all of the following conditions are met·

a) Chemical manipulations are carried out on a laboratory scale,

b) Multiple chemical procedures or chemicals are used,

c) The procedures involved are not part of a production process, nor in any way simulate a production process, and

d) Protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

C. Laboratory Standard Application

Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR Part 1910, Subpart Z, except as follows:

1. For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories;

2. Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed,

3. Where the action level or the PEL is routinely exceeded for an OSHA regulated substance the monitoring and medical surveillance parts of the standard will be applied.

D. Employee Exposure Determination

1. Initial monitoring - The employer shall measure an employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels exceed the PEL or action level.

2 Periodic monitoring - If initial monitoring indicates employee exposure above the PEL or action level the employer shall immediately comply with the monitoring provisions of the relevant standard.

3. Termination of monitoring - the employer may terminate monitoring in accordance with the relevant standard.

4. The employee must be notified of the result of the monitoring within 15 days of the employer's receipt of the results.

E. Chemical Hygiene Plan

1. Where hazardous chemicals are used in the work place, the employer shall develop and carry out the provisions of a chemical hygiene plan which are:

   a) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

   b) Capable of keeping the exposures below the action level or PEL

2. The Chemical Hygiene Plan must be readily accessible to employees.

3. The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures the employer will take to ensure laboratory employee protection:

   a) Standard operating procedures relevant to safety and health:

   b) Criteria employer will use to implement control measures to reduce employee exposure to hazardous chemicals,

   c) A requirement that fume hoods and other protective equipment are functioning properly and methods to be taken to ensure proper and adequate performance;

   d) Provisions for employee training and information;

   e) Circumstances requiring prior approval from the employer or his designee before implementation,

f) Provisions for medical consultation and examination;

g) Designation of personnel responsible for implementation of the Chemical Hygiene Plan.

i) Provisions for additional protection for employees working with particularly hazardous substances including:

- select carcinogens
- reproductive toxins
- substances with a high degree of acute toxicity

Specific consideration shall be given to the following provisions which shall be included where appropriate:

1) Establishment of a designated area;

2) Use of containment devices such as fume hoods or glove boxes;

3) Procedures for safe removal of contaminated waste; and

4) Decontamination procedures

4. The employer shall review and update the plan on a yearly basis.

F. Employee Information and Training

1. The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals in their work area.

2 Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations.

3. Information - employees shall be informed of:

a) The contents of this standard

b) The location and availability of the Chemical Hygiene Plan;

c) The PEL's for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where PELs do not exist.

d) Signs and symptoms associated with exposures to the hazardous chemicals used in the laboratory, and

e) The location and availability of known reference materials including MSDSs, but not limited to them.

4. Training - employee training shall include:

a) Methods and observations that may be used to detect the presence or release of a hazardous chemical;

b) The physical and health hazards of chemicals in the work area;

c) Measures employees can use to protect themselves from these hazards, including specific procedures such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

The employee shall be trained of the applicable details of the employers written Chemical Hygiene Plan.

G. Medical Consultation and Medical Examinations.

1. The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention under the following circumstances:

a) When the employee develops signs and/or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory;

b) When routine monitoring reveals an exposure above the PEL or action level,

c) When an event takes place in the work area such as a spill or leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.

2. All medical examinations and consultations shall be performed by a licensed physician or under his/her direct supervision.

3 Information provided to the physician - The employer shall provide the following information to the physician:

a) The identity of the hazardous chemicals to which the employee may have been exposed;

b) A description of the conditions under which the exposure occurred; and

c) A description of the signs and symptoms of exposure the employee is experiencing, if any.

4. Physicians written opinion including:

a) Any recommendation for further medical follow up;

b) The results of the examination and any associated tests;

c) Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk; and

d) A statement that the employee has been informed by the physician of the results of the examination and any medical condition that may require further examination or treatment.

The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

H. Hazard Identification

1. With respect to labels and Material Safety Data Sheets:

a) Employers shall ensure that labels on incoming hazardous chemicals are not removed or defaced.

b) Employers shall maintain any MSDSs received and make them readily available to employees.

2. The following provisions shall apply to chemical substances developed in the laboratory:

a) If the composition of a chemical substance produced of laboratory use is known and determined to be hazardous, the employer shall supply appropriate training.

b) If the chemical produced is a by-product whose composition is not known, the employer shall assume that it is hazardous and implement the Chemical Hygiene Plan.

c) If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.100) including the requirements for the preparation of a Material Safety Data Sheet and labeling

I. Use of Respirators

Where the use of respirators is required to maintain exposure below the PEL, the employer shall provide the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.135.

J. Record keeping

1. The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

2. The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.20

1.3 Role of the Chemical Hygiene Plan

This Chemical Hygiene Plan describes Analytical Technologies, Inc. safety program, including but not limited to personal protective equipment used, control equipment inventory and operations (such as vented hoods), employee training programs, medical programs, and safety inspections. The Chemical Hygiene Plan is supplemented by safety procedural notes included in test methods used (examples: ASTM, EPA Test Methods, or Standard Methods...). The Chemical Hygiene Plan is designed as a tool to coordinate safety procedures. Every employee in the laboratory must be trained in the applicable details of this Plan.

1.4 Chemical Hygiene Plan Coverage

All employees will cooperate in complying with the provisions of the Chemical Hygiene Plan. This Plan applies to all employers involved in laboratory use of hazardous chemicals. With this OSHA standard laboratories which have and implement a Chemical Hygiene Plan are otherwise exempt from other regulations under 29 CFR 1910 Subpart Z, except for any activities which do not match OSHA's definition of "laboratory use of hazardous chemicals" even though the activity is done inside a laboratory.

SECTION TWO

Description of ATI

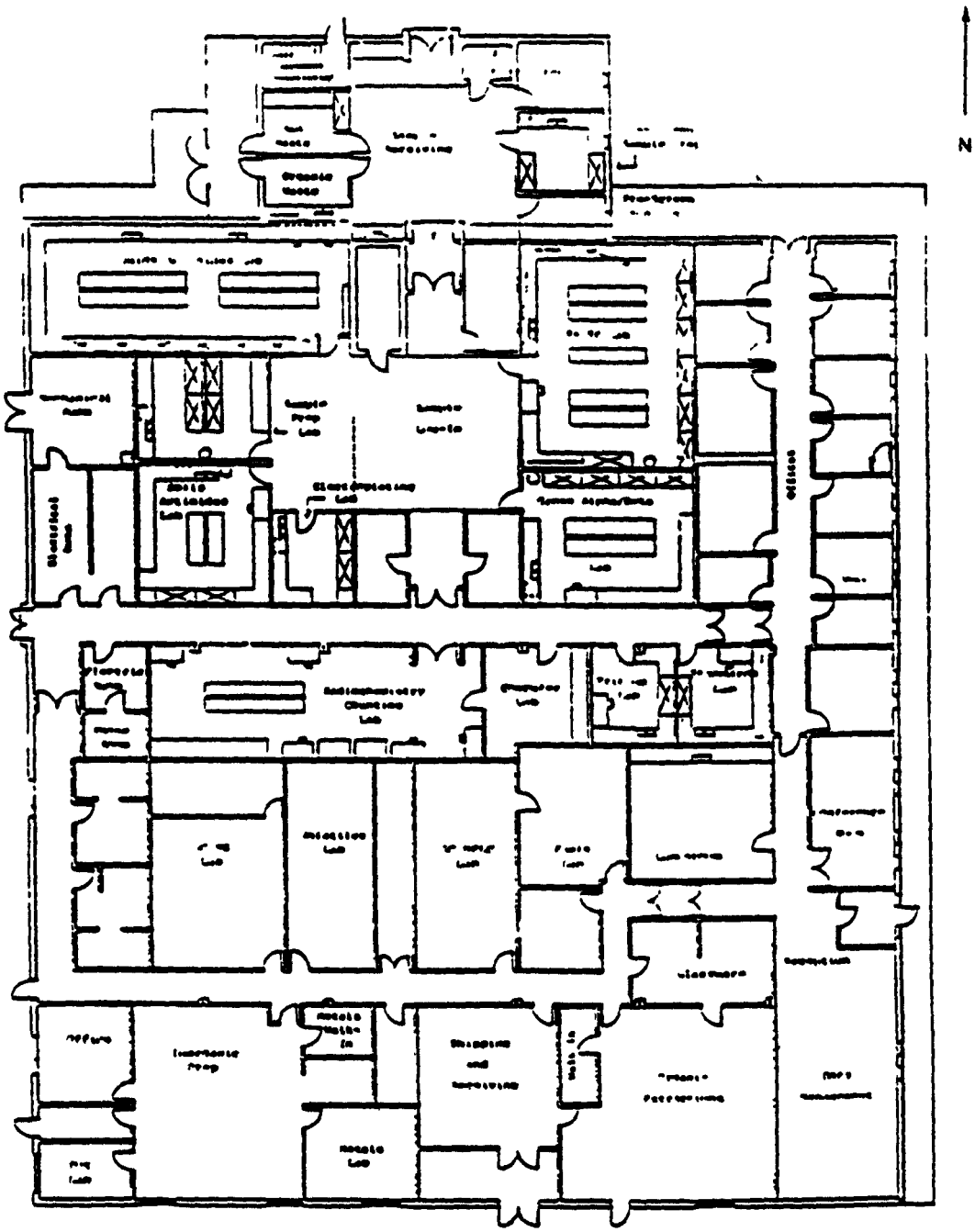
2.0 DESCRIPTION OF ANALYTICAL TECHNOLOGIES INC.

Analytical Technologies, Inc. is a full service, client oriented, group of analytical chemistry laboratories. We have a well managed quality assurance program and a commitment to producing quality data in a timely manner. We have a staff of over 200 chemists which enables us to respond quickly to our clients needs.

2.1 Description of ATI's Activities

Each of our laboratories contain standard equipment and chemicals for analyzing hazardous waste, soil and ground water surrounding underground storage tanks, air samples, ground water parameters, and special pesticides and herbicides. Our hazardous waste disposal program is conducted in accordance with E.P.A. and D.O.T. regulations.

2.2 Map of Analytical Technologies, Inc , Fort Collins, CO



ANALYTICAL TECHNOLOGIES, INC.
Fort Collins, Colorado

SECTION THREE

Responsibilities for the Chemical Hygiene Plan

3.0 RESPONSIBILITIES FOR THE CHEMICAL HYGIENE PLAN

This section defines who is responsible to implement and enforce the provisions of this Plan. This section also co-assigns responsibility for individual safety to each individual involved.

3.1 Personnel Responsible for Implementing the Chemical Hygiene Plan.

The Chemical Hygiene Officer will be personally responsible for the assigning responsibility for, and following up on the duties mentioned below (See Attachment A for a list of individuals responsible for each duty):

3.1.1 Develops and updates the Chemical Hygiene Plan and appropriate policies and practices.

3.1.2 Provides technical assistance in complying with the Chemical Hygiene Plan and answers safety questions for employees.

3.1.3 Assists department supervisors in developing appropriate safety precautions for new projects and procedures.

3.1.4 Monitors procurement of new chemicals.

3.1.5 Monitors collection and disposal of chemical wastes.

3.1.6 Remains current on developing legal rules and regulations concerning chemicals used at ATI.

3.1.7 Ensures that employees comply with the Chemical Hygiene Plan.

3.1.8 Ensures that appropriate personal protective equipment is available as needed.

3.1.9 Monitors proper functioning of protective equipment, such as fume hoods, and arranges for prompt repairs as needed.

3.1.10 Performs regular chemical hygiene and housekeeping inspections.

3.1 11 Performs routine inspections of emergency equipment.

3.1.12 Gathers and maintains manufacturers' Material Safety Data Sheets.

3 1.13 Develops and implements a chemical labeling program.

3.1.14 Determines when a complaint of possible over - exposure is "reasonable" and should be referred for medical consultation.

3.1.15 Determines when an "Exposure Assessment" is appropriate.

3.1.16 Conducts "Exposure Assessments".

3.1.17 Reviews chemical inventory to determine which chemicals are carcinogens.

3.2 Responsibilities of Each Employee

Each person working with or around chemicals, having been trained, is responsible for remaining aware of the hazards of those materials and handling those chemicals in a safe manner. Each person is responsible for knowing how to handle a hazardous chemical safely according to its types of hazards, and if that person is unsure of a hazard or safety procedure, to ASK!

Everyone shares the responsibility to ensure that all containers of chemicals are properly labeled with the identity of the chemical and its hazards.

REMEMBER: NO AMOUNT OF INSURANCE CAN CURE BLINDNESS OR RESURRECT THE DEAD! SO BE RESPONSIBLE FOR YOUR WELL BEING.

ATTACHMENT A

Personnel Responsible for Section 3.1 Chemical Hygiene Duties

3.1.1	Paul J. Valentinelli
3.1.2	Paul J. Valentinelli/Gus Harris III
3.1.3	Paul J. Valentinelli
3.1.4	Bobbi Hansen (Corporate)
3.1.5	Paul J. Valentinelli
3.1.6	Paul J. Valentinelli
3.1.7	Alex Blanche/Tom Austin/K.R. Vault/ Bob Jump/Lance Steere/Doug VanCleef
3.1.8	Paul J. Valentinelli
3.1.9	Paul J. Valentinelli
3.1.10	Paul J. Valentinelli/Gus Harris III
3.1.11	Paul J. Valentinelli/Gus Harris III
3.1.12	Paul J. Valentinelli/Gus Harris III
3.1.13	Paul J. Valentinelli
3.1.14	Paul J. Valentinelli
3.1.15	Paul J. Valentinelli
3.1.16	Paul J. Valentinelli
3.1.17	Paul J. Valentinelli

SECTION FOUR

Chemical Hygiene and Safety Plan

4.0 CHEMICAL HYGIENE AND SAFETY PLAN

This section describes appropriate procedures and practices for chemical hygiene and safety

4 1 General Standard Operating Procedures

The General Standard Operating Procedures are fundamental safety precautions which should be familiar to all employees.

The following practices should be adhered to at all times

4 1 1 General rules

Awareness is the most fundamental rule of chemical safety Everyone should remain constantly aware of

a) The chemical's hazards, as determined from the MSDS and other appropriate references,

b) Appropriate safeguards for using that chemical, including personal protective equipment,

c) Location and proper use of emergency equipment

d) How and where to properly store the chemical when not in use. (Remember the chemical is actually used for only minutes in the average work day, the rest of the time it is being "stored" on the laboratory bench or in the fume hood.)

e) Proper personal hygiene practices

f) The proper methods of transporting chemicals within the laboratory

g) Appropriate procedures for emergencies, including evacuation routes, spill cleanup procedures and proper waste disposal

NEVER work alone in the laboratory Someone should be working with you If that is not possible, then someone should know of the solitary worker and check on him or her at regular intervals

4 1 2 Personal Hygiene

Personal hygiene is an important factor in chemical hygiene To react with a person, a toxic chemical must contact that person The four routes of entry are inhalation, ingestion, injection, and eye or skin absorption, if we properly protect ourselves, we can eliminate the ability of the chemical to do harm Personal hygiene practices include

a) Wash promptly if skin contact is made with any chemical, regardless of corrosiveness

b) Wear appropriate eye protection at all times

c) Avoid inhalation of chemicals, do not "sniff" test chemicals

d) Do not mouth pipette anything, use suction bulbs

e) Wash well before leaving the laboratory, do not wash with solvents, use soap

f) Change clothing as soon as possible after leaving the laboratory Launder work clothes often

g) Do not eat, drink or smoke in chemical areas

h) Do not bring food, beverage or tobacco products into chemical storage or use areas Food, drink, and especially tobacco absorb chemical vapors and gases from the air.

4 1 3 Food and Smoking

There will be no eating, drinking or smoking allowed in areas where chemicals are either stored or used. Because chemical vapors can be absorbed by foodstuffs (especially bread) and tobacco, no food or tobacco products should be allowed into chemical areas

Instead of designating laboratory and storage areas as "Non Smoking" areas, **ALL** areas are considered "No Smoking" areas The only area that smoking is allowed is outside the building

4 1 4 Protective Clothing and Equipment

Most personal protective equipment is provided by Analytical Technologies, Inc to employees when and where necessary It is the responsibility of each employee to be certain that the appropriate equipment is worn as necessary

The most fundamental piece of personal protective clothing is provided by each employee for his or her own use It is the normal clothing worn in the laboratory Clothing should be worn to mininize exposed skin surfaces available for direct contact through splashing Therefore, all employees should wear long sleeved and long legged clothing and avoid short sleeved shirts, short trousers or skirts

Additional equipment available from Analytical Technologies Inc include

Eye wear
Lab Coats
Gloves
Aprons
Face Shields
Respirators and assoc equipment

The proper uses and maintenance of the equipment is discussed in Section 4 3 5 in Control Measures

4 1 5 Housekeeping

Common housekeeping practices contribute greatly towards chemical hygiene and safety A clean work area is much safer than a cluttered or dirty one Some appropriate housekeeping measures include

- Keep all aisles, hallways, and stairs clear of all chemicals

- Keep all work areas and especially workbenches clear of clutter and obstructions.

- All working surfaces and floors should be cleaned regularly

- Access to emergency equipment, showers, eyewashes and exits should never be blocked by anything

- Wastes should be kept in the proper containers and labeled properly

- Any unlabeled containers are considered wastes by the end of each workday

- All chemicals are placed in proper storage areas by the the end of each workday

- All chemical containers are labeled with both the identity of the chemical and its hazards.

- All spills are promptly cleaned up and the spilled chemical is properly disposed of.

- No chemicals are stored in aisles, stairwells, on desks or workbenches, on floors or in hallways, or left on shelves over the workbenches.

4 1 6 Prior Approval

Approval to proceed with a laboratory task should be obtained when

- There is a new procedure, process or test, even if it is very similar to older practices,

- There is a cnange or substitution of any of the ingredient chemicals in a procedure,

- There is a substantial change in the amount of chemicals used, usually one should review safety practices if the volume of chemicals used increases by 20 or 25%,

- There is a failure of any of any of the equipment used in the process, especially safeguards such as fume hoods

- There are unexpected test results. When a test result is different than the predicted, a review of how the new result impacts safety practices must be made, and

- Where members of the laboratory staff become ill, suspect exposure, smell chemicals, or otherwise suspect a failure of engineered safeguards

Any new procedure should be subjected to peer review Not only from a scientific standpoint, but also to assure that all safety considerations are in place prior to implementation

4 1 7 Spills and Accidents

Spills of toxic substances or accidents involving any hazardous chemical should be resolved immediately, according to Analytical Technologies, Inc 's Emergency Contingency plan The overall steps of handling an accident are briefly

a) Notify your supervisor and appropriate emergency responders immediately

b) If the spilled chemical is flammable, extinguish all nearby sources of ignition.

c) If a person has been splashed with a chemical, wash them with plenty of water for at least 15 minutes, remove all contaminated clothing, and **GET MEDICAL ATTENTION.**

d) If a person has been overexposed by inhalation, get victim to fresh air, apply artificial respiration if necessary, and **GET MEDICAL ATTENTION**

e) In other cases of everexposure, **GET MEDICAL ATTENTION** and follow the instructions of the medical professional

f) After obtaining proper medical attention for a chemical exposure victim, neutralize or absorb the spilled chemical with the proper spill clean up material and dispose of it in accordance with hazardous wastes procedures

For more detailed discussions of handling emergencies in the laboratory and evacuation procedures, read Appendix C

There are some fundamental actions which must **NOT** be used in handling emergencies Some of them include·

- **DO NOT** force any liquids into the mouth of an unconscious person.

- **DO NOT** handle emergencies alone, especially without notifying someone that the accident has occurred

- **DO NOT** apply medical aid procedures without some training in that area (except to wash with WATER for 15 - 30 minutes and get the victim to fresh air) If you are not trained in fundamental first aid, get MEDICAL direction before inducing vomiting, giving antidotes or applying a "neutralizer" to the skin or eyes of the victim Everyone should be trained in CPR.

- **DO NOT** linger at the accident scene if you are not one of the emergency responders

4 1 8 Waste Chemicals

Chemical wastes are regulated by the Environmental Protection Agency under the Resource Conservation and Recovery Act and its amendments Under new changes to the regulations, a Generator of hazardous wastes is now defined and regulated if the entire facility produces more than 100 KG of hazardous wastes per month

All employees should be advised by their supervisor on how to handle wastes from their work

4.2 Specific Safety Procedures

For specific safety procedures see ATI Safety Standard Operating Procedure, January 1992 Revision

4 3 Control Measures and Equipment

Chemical safety is accomplished by awareness of the chemical hazards and by keeping the chemical under control through a variety of engineered safeguards Laboratory personnel should be familiar with the proper use of those safeguards. Laboratory supervisors should be able to detect the malfunction of those safeguards All engineered controls must be properly maintained, inspected on a regular basis, and never overloaded beyond their design limits

4 3 1 Ventilation

Laboratory ventilation should be normally not less than 20 linear feet per minute air flow through each room This gives the workers comfortable breathing air But 20 feet per minute translates to less than one quarter mile per hour, the flow should not be considered sufficient to prevent accumulation of chemical vapors Work done with chemicals with low TLVs or high vapor pressures should be performed in a fume hood.

Fume hoods should provide 80-120 linear feet per minute of air flow When using a fume hood the worker should be aware that.

- The fume hood is a safety backup device to the condensers, traps, or other devices designed to trap and collect the flammable or toxic vapors

- Fume hood shields should be lowered to the proper operating level at all times except when adjusting the apparatus inside

- The apparatus inside the hood should be kept towards the rear of the hood to prevent vapors from escaping

- The design of the hood is usually for substances of specific characteristics (e g venting at the top or bottom sides is for chemicals of low and high vapor density, respectively)

- Fume hoods are containment devices, they contain the vapors from apparatus and experiments within them, they do not suck vapors in from outside of the hood.

- Hoods are **NOT** storage areas

- The vent ducts and fans must be kept clean and clear of obstructions

- The hood must remain "on" at all times when a chemical is inside the hood, <u>regardless</u> of whether any work is being done in the hood.

- Personnel should be aware of steps to take in case of power failure or other causes of hood failure

4 3 2 Safety Cans

Flammable liquids should be kept in cans specifically designed for them The cans should be used according to manufacturer instructions and common safety practices, including

- The can must be kept closed except when adding or removing liquid.
- The flame arrestor screen must be kept in place at all times and replaced if punctured or damaged
- As with all chemicals, chemicals in safety cans must be stored in storage areas and not in laboratory work areas or hallways.
- All flammables must be protected against sources of ignition

4 3 3 Flammable Storage Cabinets

Cabinets designed for the safe storage of flammable chemicals can only do so if used and maintained properly Cabinets are generally made of double walled construction and are made of 18 gage steel

The doors are two inches above the base and the cabinet is liquid proof to that point Two vents are provided on opposite sides of the cabinet and are equipped with flame arrestor screens Always read the manufacturer's information and follow some prudent safety practices such as

- Store only compatible materials inside the cabinet
- Do not store paper or cardboard inside cabinets with the chemicals
- Do not overload the cabinet

4 3 4 Corrosive Storage Cabinets

All corrosive chemicals should be kept in cabinets especially designed to hold them Care must be taken to separate acids from bases by distance or barrier

4 3 5 Eyewashes and Safety Showers

Wherever chemicals have the possibility of damaging the skin or eyes, and emergency supply of water must be available All laboratories must be equipped with eyewashes and safety showers. As with any safety equipment, these can only be useful if they can be used, therefore

- Keep all passageways to the eyewash and shower clear of any obstacles (even a temporarily parked sample cart)

- Eyewashes should be checked routinely to be certain that water flows through them properly

- Showers should be checked routinely to be assured that access is not restricted and the start chain is within reach

- The flow through the safety showers should be tested periodically to ensure a flow of 30 gallons per minute.

4 3 6 Protective Apparel

Protective clothing was briefly discussed in Section 4 1 4 Some additional information about the use of protective clothing includes.

Gloves - Must be of a material compatible with the chemicals used Gloves should be inflated (by whipping it in the air, not by mouth inflation) to check its integrity before each use

Safety Glasses - Should be worn at all times in the labs Especially while working with chemicals

Goggles - Form a liquid proof seal around the eyes which is necessary when working with acidic chemicals.

Goggles with Face Shield - For more hazardous chemicals, corrosives, and hot chemicals, both face shield with goggles must be used. The goggles protect the eyes in case a splash comes from the side or beneath the shield.
Laboratory Coat - Long sleeved coats offer the wearer minimal skin protection against minor splashes, allowing the chemical something to react with before the skin, and offering the victim time to remove the coat and shower

Laboratory Coat and Apron - Rubberized aprons offer additional time to react to the splash than the coat alone. Arm guards should be worn when using an apron

4 3 7 Respirators

OSHA requires all employers to primarily prevent atmospheric contamination If that cannot keep the vapor concentrations below regulated levels, then the employer will implement a written respiratory program (see 29 CFR 1910 134) The written respiratory program will discuss such issues as respirator selection criteria, inspection, and maintenance All personnel using respirators must be trained in their proper use and care. For more detailed discussion of respirator uses and selection, see Analytical Technologies, Inc. Written Respiratory Program attached as Appendix D

4 3 8 Vapor Detection

Because odor thresholds can be greater than TLVs, odors are not to be used as the primary methods of vapor detection If suspicious odors are noticed, the investigators should obtain mechanical vapor detectors, such as draeger tubes or ionization meters, and respiratory protection.

4 4 Special Procedures for Carcinogens

OSHA has noted that many laboratory workers use known or suspected carcinogens While industrial workers might use only one or a limited few chemical carcinogens, laboratory workers are likely to use many such chemicals.

Exposures to those carcinogens would at least have an additive impact on risk, if not synergistic To limit the possible exposures, Analytical Technologies, Inc. has special procedures and precautions for work with carcinogens See Appendix B for a list of carcinogens used at Analytical Technologies, Inc

4 4 1 Regulated and Controlled Work Areas

Special work areas are designated for work with carcinogens The rooms, including storage areas for the chemical carcinogens, will have restricted access Signs warning "Authorized Personnel Only" will be posted at entrances to these work areas, and if necessary, the areas will be locked Only personnel with special instruction on the hazards and safe handling of carcinogens will be permitted access to the areas.

4 4 2 Closed System Protection

All work involving carcinogens must be done in specially equipped closed systems to reduce the risks of employee exposure to the vapors The closed systems include fume hoods, glove boxes or similar devices.

4 4 3 Handling of Contaminated Waste Waters

Rinse water and other waste waters contaminated with carcinogens are to be collected for disposal Specific disposal procedures will be outlined in Analytical Technologies Hazardous Waste SOP, and will be consistent with RCRA regulations

4 4 4 Personal Hygiene

Laboratory workers using carcinogens shall take extra precautions in maintaining good personal hygiene In addition to hygiene practices in Section 4 1 2, workers will wash before leaving the facility

No food, beverage or tobacco products will be permitted in the restricted areas (haz-mat storage area)

4 4 5 Protective Apparel

Persons working in restricted areas should not wear any personal items such as jewelry which might be lost if decontamination is not possible Gloves and long sleeves should be used at all times to prevent skin contact with the carcinogen.

4 4 6 Additional Precautions

Work with carcinogens should be done with the smallest amounts possible` Purchases of the chemicals should be restricted to minimal amounts necessary to prevent uninterrupted work

SECTION FIVE

Criteria for Control Measures

5.0 CRITERIA FOR CONTROL MEASURES

This section examines criteria and guidelines which can or will be used to determine the use of engineered controls and personal protective equipment.

5.1 Exposure Guidelines

Most materials have some guidelines for exposure, such as Threshold Limit Values (TLV) or Permissible Exposure Limits (PEL). When such values exist, they will be used to assist the Safety Officer or the Chemical Hygiene Officer in determining proper safety precautions, including control measures and safety apparel.

When TLV or PEL values exist and are low, the user of the chemical must use it in an operating fume hood or if a fume hood is not available, a respirator will be used in accordance with the Analytical Technologies, Inc. Respiratory Program (see Appendix D).

When TLV or PEL values are not available for that substance, the Lethal Dosage information LD_{50} will be assessed. If that is low, then the chemical must also be used in a fume hood if possible, or a respirator must be used.

Whenever the chemical has a high vapor pressure, meaning that it evaporates quickly at room temperature, it will be used in a fume hood or else respiratory protection is needed. Those controls are necessary even if the chemical with the high vapor pressure also has a very high TLV or LD_{50}, because such chemicals are likely to reach their exposure limits in air at least as quickly as a chemical with low exposure guidelines and a low vapor pressure.

Fume hoods or respirators will be used when:

- The TLV or PEL is below 100 ppm
- The LD_{50} is below 100 mg/kg
- The vapor pressure is above 28 mm at 20 degrees C.

5.2 Fire Guidelines

In general, a flammable chemical is determined by its flash point, the lowest temperature at which an ignition source can cause the chemical to ignite momentarily Although the lowest temperature at which the chemical will catch fire with an ignition source is greater than the "flash point." Therefore, the flash point will be used as the reference of "fire hazard" here at Analytical Technologies, Inc.

OSHA and NFPA have guidelines on when a chemical is considered flammable. Those guidelines are herein adopted for use in the laboratory.

"Flammable" is generally used to refer to chemicals with a flash point below 100 degrees Fahrenheit (F). Chemicals with flash points between 100 and 200 degrees F are termed "Combustible". Combustible chemicals have caused buildings to burn down; therefore, any chemical with a flash point below 200 degrees F will be considered a "fire hazard" and will be stored in a flammable solvent storage area or flammable storage cabinet. They will be used in a vented fume hood, away from source of ignition.

More detailed discussions on fire hazards can be found in OSHA,s regulations (29 Code of Federal Regulations 1910).

5.3 Reactivity Guidelines

While NFPA has developed some guidelines on what constitutes a reactive chemical, their emphasis is centered on a fire emergency.

Other guidelines on which chemicals are reactive can be found in regulations from the Department of Transportation (49 CFR) and the Environmental Protection Agency (40 CFR).

At Analytical Technologies, a reactive chemical is one which is:

- Ranked by NFPA as 3 or 4 for reactivity.
- Determined by the U.S. D.O.T. as either:
  - An oxidizer
  - An organic peroxide
  - An explosive (Classes A, B, or C)
- Fits the U.S. EPA definition of reactive in 40 CFR 261.
- Fits the OSHA definitions of unstable or polymerizing.
- Is found to be reactive with ordinary substances

Once a chemical has been determined to be reactive, all proper safety precautions will be used including extra segregation in storage and prohibition on mixing with other chemicals without appropriate personal protection and precautions.

5.4 Corrosiveness and Contact Hazards

A corrosive chemical is defined by OSHA, DOT, and EPA. So Analytical Technologies, Inc. will consider a chemical corrosive if it fits the definition of corrosive found in regulations by:

- OSHA (29 CFR)
- DOT (49 CFR)
- EPA (40 CFR)
- or it has a very low or a very high pH.

A skin or eye contact hazard chemical is one where the chemical's route of entry for its toxic effects is through the skin or eyes. Chemicals which are contact hazards will be determined by examining medical and industrial hygiene literature.

SECTION SIX

Exposure Evaluations and Medical Consultations

6.0 EXPOSURE EVALUATION AND MEDICAL CONSULTATIONS

This section discusses the reasons for performing a formal evaluation of suspected exposures, the documentation of such, and arrangements which should be made with medical professionals

6 1 There may be times when employees suspect that they have been exposed to some toxic substance in the laboratory If the circumstances surrounding the complaint are determined to cause a reasonable suspicion of exposure to a chemical, then a designated responsible and unbiased individual in Analytical Technologies, Inc. will initiate actions to formally evaluate the complaint

6 1 1 Example of "Reasonable" Suspicion of Exposure

The following are examples of some events or circumstances which Analytical Technologies, Inc might reasonably consider as evidence that an exposure to toxic substances is likely.

- The victim had direct skin or eye contact with a chemical substance.
- Odor was noticed, especially if person was working with any chemical which has a lower TLV than odor threshold
- Manifestation of health hazard symptoms such as headache, rash, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, dizziness, loss of motor dexterity or judgement which resemble drunkenness, etc
- Some or all symptoms disappear when person is taken away from chemical area and into fresh air
- Symptoms previously complained about reappear soon after person starts working with chemicals again.
- Complaints are received from more than one person in the same work area
- It is Analytical Technologies, Inc.'s policy to promptly investigate **ALL** complaints to determine risk of employee overexposure to the toxic substances in their work place

6.2 Exposure Evaluations

Once a complaint of possible hazardous chemical exposure has been received, the complaint should be documented in a short memo along with the decision of appropriate action If it was decided that no further evaluation of the event is necessary, the reason for that decision should be included in the document If a decision is made that the complaint should be investigated, then a formal Exposure Evaluation will commence

6 2 1 Steps of Exposure Evaluation

The actual steps of the Exposure Evaluation will have to be determined by a responsible person, preferably the safety officer If the safety officer is unavailable, then a group supervisor is authorized to do an exposure evaluation Some steps that might be considered (but not limited to) include

1 Interviewing the person initiating the complaint, and the victim if it is not the same person.

2 Listing essential information about the circumstances of the complaint including

- Chemical of suspicion
- Other chemicals in use by the victim at the time of incident
- Other chemicals being used by others in the immediate area
- Other chemicals stored in that area.
- Symptoms
- How symptoms compare to information in the Material Safety Data Sheets for those chemicals in the area
- Were control measures, such as fume hoods and personal protective equipment, used and used properly
- Are any air sampling or monitoring devices in place or available

NOTE The use of or failure to use personal protective equipment and control measures and to follow Standard Operating or Safety Procedures might contribute to the cause of overexposure It is not the Exposure Evaluator who places blame for the event. Blame, if appropriate, should come much later and from a different source than the exposure investigator THE PURPOSE OF THE EXPOSURE EVALUATION IS TO DETERMINE IF ANY EXPOSURE HAS TAKEN PLACE, NOT TO ASSIGN BLAME.

3 Air sampling of the area for suspect chemicals

4 Determining how the symptoms compare to the information on the MSDS

5 Deciding whether to send victim for medical evaluation

6 Review of the adequacy of present control measures and safety procedures.

6 2 2 The employees must be notified of the results of any monitoring within 15 days of receipt of those results

6 3 Medical Consultation

When employees are suspected or known to be overexposed to toxic chemicals, they should receive prompt medical attention To ensure that they do receive proper and informed medical attention, Analytical Technologies, Inc has contracted medical professionals who are experienced in treating victims of chemical overexposure These people are also knowledgeable about which tests or procedures to use to determine if there has been an over exposure (the techniques are called "Differential Diagnosis")

6 3 1 Medical Consultation

The Safety and Health Officer has the authority to authorize medical consultation in Non-Emergency cases

The person who will be examined will visit Doctor's Neighborhood Care Center

It is the responsibility of the Safety and Health Officer to arrange for the transportation of the person to be examined to and from the medical center

NOTE If chemical exposure is confirmed or suspected, Analytical Technologies, Inc cannot assure that the victim can properly operate a motor vehicle. The medical report will be sent directly to Analytical Technologies, Inc Safety and Health Officer and he or she will pass the appropriate information along to those involved

6 3 2 Medical Consultation Contract and Capabilities

Appendix E has a copy of the Contractual Agreement and the Statement of Qualifications of our medical consultant

6.4 Documentation

All memos, notes and reports related to a complaint of possible exposure to toxic substances must be maintained in a file for easy retrieval with a cross-reference in the victim's personnel file For more on reports and record keeping, see Section 8.0

6.5 Notification

The employee shall be notified of the results of any medical examination with regard to any medical condition which might exist from overexposure to a chemical

SECTION SEVEN

Employee Information and Training

7.0 EMPLOYEE INFORMATION AND TRAINING

This section incorporates the minimal informational requirements of the OSHA Standard with suggestions for making an employee informational and training program effective. To see the minimum regulatory requirements, see Appendix A.

7.1 Informational Requirements

OSHA has required that employees be informed of:

- The existence, location and availability of this document (the Chemical Hygiene Plan).
- 29 CFR 1910.1450 and its appendices.
- The criteria to select, and use personal protective equipment properly.
- Exposure limits including TLV and PEL.
- The emergency procedures and the location of the emergency equipment.
- The location of available reference materials including the Material Safety Data Sheets.

Information does not need to be a formal training session in a classroom setting. Information can be from informal group or individual discussions with one's supervisor, posted notices, or handout booklets. OSHA has not shown interest in how the employees learn this information, but if asked by an OSHA inspector, the employees must be able to answer those issues accurately.

7.2 Preparing the Tools of Training Programs

Although OSHA allows the information to be passed to employees in a non-classroom setting, formal training remains one of the best methods to ensure that all employees understand that safety is an issue to take seriously. There are many commercially available training aids, some of which we use at Analytical Technologies, Inc. including:

- Professional personnel contracted to perform various types of training.
- Various videos to be viewed by employees.
- Different types of books and booklets available to employees.

7.3 Development of a Training Program

A training program should be fully developed before it is presented. The following is a suggested training program from OSHA (Federal Register Vol. 49 No. 146, Friday, July 27, 1984, Pages 30290-30294) OSHA Training Guidelines. At Analytical Technologies, Inc. we are trying to adhere to this particular format, it goes as follows:

OSHA's training guidelines are divided into seven steps:

1. Determine if the training is needed.
2. Identify the training needs (who, what, when).
3. Identify the goals and objectives.
4. Develop learning activities.
5. Conduct the training.
6. Evaluate the program's effectiveness.
7. Improve and or supplement the program as necessary.

7.3.1 Determine if the Training Program is Needed

As with any major project, it is necessary to determine whether the program is necessary. In this case, the necessity is a regulatory one and not something which could be considered optional. To conserve the costs of training, it would be valuable to determine if there are any other training needs which are compatible with the OSHA training. For example, EPA's hazardous wastes regulations mandate that any employee involved with hazardous waste management must be trained on the hazards, which are very similar to OSHA's training requirements.

7.3.2 Identify the Training Needs

The regulatory contents of the training program have already been outlined, other needs should be identified, including:

- Who has to be trained and on which topics.
- When to do the training.
- How shall the training be done (the best format for the audience)
- Which topics should receive the most emphasis.

7.3.3 Identify Goals and Objectives

Training has many possible options and details to review. There are many safety topics which could be discussed. There are so many details, in fact, that it is possible to forget why the program is taking place. Remember that the Laboratory Standard training program is primarily for discussions on chemical safety and how the labels and Material Safety Data Sheets can improve safety, if properly used.

One special objective of any chemical safety course is that hazardous chemicals can be handled safely. Special safeguards may have to be used when handling a chemical, however, the chemical can ultimately be handled safely. This theme of safety should be repeated several times in the program.

7.3.4 Develop Training Programs

Developing the training program can be simplified be using existing systems, movies and programs for common safety issues such as flammable or corrosive chemical safety.

7 3 5 Conducting the Training

There will be some special problems to anticipate when conducting the training such as:

Scheduling - How to make sure everyone is trained, even those who are on vacations or have conflicting schedules or even sick.

Questions - How to address the audience's questions both during and especially after the training sessions.

7.3.6 Evaluating the Program's Effectiveness

Because OSHA's enforcement of training is by a Performance Standard (meaning how well the people remember what was discussed as opposed to whether they attended the class), testing of some sort should be given after each program to ensure that everyone understands what was discussed.

Documentation of everyone's attendance in the program can help somewhat in proving to OSHA that the training did take place, but the OSHA inspector may request some other proof of the program's effectiveness.

7.3.7 Improvement of or Augmenting the Program

If necessary, the training program could be improved, updated, or added to. The way of determining that requirement is to have an active way of testing or evaluating the program's effectiveness.

7.3.8 Training Under 29 CFR 1910.1450

Training under 29 CFR 1910.1450 must include the following:

A. Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.):

B. The physical and health hazards of chemicals in the work area; and

C. The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

(ii) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

(See p. 3329, January 31, 1990, Section f, 4, i of Federal Register Volume 55, No. 21.)

SECTION EIGHT

Records and Record Keeping

8.0 RECORDS AND RECORD KEEPING

This section reviews the value of documenting compliance with this safety standard, not just for OSHA's information, but for general liability and the ability to periodically assess the safe conduct of employees.

8.1 Records

Specific records may be required in the event of lost work time resulting from an exposure or accident on the job. The standard form OSHA 200 is used to document lost workdays from incidents that occur at work.

In addition to records required by OSHA, it is desirable to keep special records developed internally which document suspected exposures and employee exposure complaints regardless of the outcome of the Exposure Evaluation. Other incidents and activities could be documented for future reference. Some examples of desirable records include:

- Complaints from Employees - Even if the complaint is found to be unjustified, it is desirable to keep a record of the complaint, the investigation, and the outcome. The complaints might be about chemical exposure, but could include complaints about inoperative engineered controls or defective personal protective equipment.

- Repair and Maintenance Records for Control Systems - Demonstrate that equipment such as fume hoods are well maintained and kept in proper operating condition.

- Major Safety Suggestions from Employees - Can be valuable to improve laboratory safety. Even if the issue is decided to be non-workable, the fact that the suggestion was taken seriously and examined is valuable.

8.2 Record keeping

All records should be kept for at least as long as the employees affected are employed at the facility. OSHA requires some records to be kept for 30 years beyond the employee's time of employment. It is prudent to develop an archival system to keep all important documents related to safety, employee training and distribution of Material Safety Data Sheets for the lifetime of the company.

The Laboratory Standard requires that records be maintained of all Exposure Evaluations, Medical Consultations and reports, and that those records be maintained in accordance to 29 CFR 1910.20. That section requires those records to be maintained for at least 30 years and describes the accessibility of the records.

We must remember that depending upon the task and activity, there can be special record keeping requirements form OSHA, EPA, or other Federal and State Agencies.

APPENDIX A

OSHA Laboratory Standard

PART 1910-OCCUPATIONAL SAFETY AND HEALTH STANDARDS

1. The authority citation for part 1910, subpart Z is amended by adding the following citation at the end. (Citation which precedes asterisk indicates general rule making authority.)

   Authority: secs. 6 and 8. Occupational Safety and Health Act, 29 U.S.C. 655, 657; Secretary of Labor's Orders nos. 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736), as applicable; and 29 CFR part 1911. ***Section 1910.1450 is also issued under sec. 6(b), 8(c) and 8(g)(2), Pub. L. 91-596, 84 Stat. 1593, 1599, 1600; 29 U.S.C. 655, 657.

2. Section 1910.1450 is added to subpart Z, part 1910 to read as follows:

   Section #1910.1450: Occupational exposure to hazardous chemicals in laboratories.

   (a) Scope and application.

   (1) This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

   (2) Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

   (i) For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

   (ii) Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

   (iii) Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements, paragraphs (d) and (g)(1)(ii) of this section shall apply.

(3) This section shall not apply to:

(i) Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases the employer shall comply with the relevant standard in 29 CFR part 1910, subpart 2, even if such use occurs in a laboratory.

(ii) Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(A) Procedures using chemically impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

(B) Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

(b) Definitions:

"Action level" means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8) hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Carcinogen" (see "select carcinogen").

"Chemical Hygiene Officer" means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

"Chemical Hygiene Plan" means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular work place and (ii) meets the requirements of paragraph (e) of this section.

"Combustible liquid" means any liquid having a flash point at or above 100 degrees F (37 8°C), but below 200 degrees F (93.3 degrees C) except any mixture having components with flash points of 200 degrees F (93.3°C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Compressed gas" means: (i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 degrees F (21.1 degrees C); or (ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 degrees F (54.4 degrees F) regardless of the pressure at 70 degrees F (21.1 degrees C); or (iii) A liquid having a vapor pressure exceeding 40 psi at 100 degrees F (37.8 degrees C) as determined by ASTM D-323-72.

"Designated area" means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the work place.

"Employee" means an individual employed in a laboratory work place who may be exposed to hazardous chemicals in the course of his or her assignments.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) "Gas, flammable" means: (A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or (B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(iii) "Liquid, flammable" means any liquid having a flashpoint below 100°F (37.8 degrees C), except any mixture having components with flashpoints of 100 degrees F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in Section No. 1910.109 (a), that is liable to cause fire through friction, absorption of moisture, a spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

(v) "Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows: (i) Tagliabue Closed Tester [See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24-1979 (ASTM D 56-79)] for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 degrees F (37.8 degrees C), that do not have a tendency to form a surface film under test; or (ii) Pensky-Martens Closed Tester [see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79)] for liquids with a viscosity equal to or greater than 45 SUS at 100 degrees F (37 8 degrees C), or that contain suspended solids, or that have a tendency to form a surface film under test; or (iii) Set a flash Closed Tester [see American National Standard Method of Test for Flash Point by Set a flash Closed Tester (ASTM D 3278-78)].

Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Hazardous chemical" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health Hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determine whether or not a chemical is to be considered hazardous for purposes of this standard.

"Laboratory" means a facility where the "laboratory use of hazardous chemicals" occurs. It is a work place where relatively small quantities of hazardous chemicals are used on a non-production basis.

"Laboratory scale"means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those work places whose function is to produce commercial quantities of materials.

"Laboratory-type hood" means a device located in a laboratory, enclosure on five sides with a moveable sash for fixed partial enclosed on the remaining side, constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants, into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the air flow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

"Laboratory use of hazardous chemicals" means handling of use of such chemicals in which all of the following conditions are met: (i) chemical manipulations are carried out on a "laboratory scale;" (ii) Multiple chemical procedures or chemicals are used; (iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and (iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

"Medical consultation" means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

"Organic peroxide" means an organic compound that contains the bivalent -O-O- structure derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than a blasting agent or explosive as defined in Section No. 1910.109 (a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

"Protective laboratory practices and equipment" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

"Reproductive toxins" means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

"Select carcinogen" means any substance which meets one of the following criteria: (i) It is regulated by OSHA as a carcinogen; or (ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or (iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC)(latest editions); or (iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria: (A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3; (B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or (C) After oral dosages of less than 50 mg/kg of body weight per day.

"Unstable (reactive)" means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

(c) Permissible exposure limits. For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

(d) Employee exposure determination - (1) Initial monotoring. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL). (2) Periodic monitoring: If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employed shall immediately comply with the exposure monitoring provisions of the relevant standard. (3) Termination of monitoring: Monitoring may be terminated in accordance with the relevant standard. (4) Employee notification of monitoring results: The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

(e) Chemical hygiene plan - General: (Appendix A of this section is non mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan) (1) Where hazardous chemicals as defined by this standard are used in the work place, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is: (i) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and (ii) Capable of keeping exposures below the limits specified in paragraph (c) of this section. (2) The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary. (3) The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:

(i) Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals, (ii) Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous, (iii) A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment; (iv) Provisions for employee information and training as prescribed in paragraph (f) of this section; (v) The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation; (vi) Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section; (vii) Designation of personnel responsible for implementation of Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer and, if appropriate, establishment of a Chemical Hygiene Committee; and (viii) Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens", reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate: (A) Establishment of a designated area; (B) Use of containment devices such as fume hoods of glove boxes; (C) Procedures for safe removal of contaminated waste; and (D) Decontamination procedures. (4) The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and up date it as necessary.

(f) Employee information and training. (1) The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area. (2) Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer. (3) Information. Employees shall be informed of: (i) The contents of this standard and its appendices which shall be made available to employees; (ii) The location and availability of the employer's Chemical Hygiene Plan; (iii) The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard; (iv) Signs and symptoms associated with exposure to hazardous chemicals used in the laboratory; and (v) The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets received from the chemical supplier. (4) Training. (i) Employee training shall include: (A) Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.); (B) The physical and health hazards of chemicals in the work area; and (C) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals such as appropriate work practices, emergency procedures, and personal protective equipment to be used. (ii) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

(g) Medical consultation and medical examinations. (1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary under the following circumstances.

(i) Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination. (ii) Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard. (iii) Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination. (2) All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place. (2) Information provided to the physician. The employer shall provide the following information to the physician: (i) The identity of the hazardous chemical(s) to which the employee may have been exposed; (ii) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and (iii) A description of the signs and symptoms of exposure that the employee in experiencing, if any (4) Physician's written opinion. (i) For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following: (A) Any recommendation for further medical follow-up; (B) The results of the medical examination and any associated tests; (C) Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the work place; and (D) A statement that the employee has been informed by the physician of the results of the consultation of medical examination and any medical condition that may require further examination or treatment. (ii) The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

(h) Hazard identification; (1) With respect to labels and material safety data sheets: (i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced. (ii) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees. (2) The following provisions shall apply to chemical substances developed in the laboratory; (i) If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section. (ii) If the chemical produced is a by product whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section. (iii) If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of material safety data sheets and labeling.

(i) USE OF RESPIRATORS. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

(j) RECORD KEEPING.

(1) The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

(2) The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.20.

(k) DATES

(1) Effective date. This section shall become effective May 1, 1990.

(2) START-UP DATES.

(i) Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

(ii) Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

(1) APPENDICES. The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

APPENDIX A to 29 CFR 1910.1450--National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory)

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FORWARD

As guidance for each employer's development of an appropriate laboratory Chemical Hygiene Plan, the following non-mandatory recommendations are provided. They were extracted from "Prudent Practices for Handling Hazardous Chemicals in laboratories" (referred to below as "prudent Practices"). which was published in 1981 by the National Research Council and is available from the

National Research Council and is available from the National Academy Press 2101 Constitution Ane., MW., Washington DC. 20418.

"Prudent Practices" is cited because of its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council. However, none of the recommendations given here will modify and requirements of the laboratory standard. This

Appendix merely presents pertinent recommendations from "Prudent Practices", organized into a form convenient for quick reference during operation of a laboratory facility and during development and application of a Chemical Hygiene Plan. Users of this appendix should consult "Prudent Practices" for a more extended presentation and justification for each recommendation.

"Prudent Practices" deals with both safety and chemical hazards while the laboratory standard is concerned primarily with chemical hazards. Therefore, only those recommendations directed primarily toward control of toxic exposures are cited in this appendix, with the term "chemical Hygiene" being substituted for the word

"safety". However, since conditions producing or threatening physical injury often pose toxic risks as well, page references concerning major categories of safety hazards in the laboratory are given in section F.

The recommendations from "Prudent Practices" have been paraphrased, combined, or otherwise reorganized, and readings have been added. However, their sense has not been changed.

Corresponding Sections of the Standard and this Appendix

The following table is given for the convenience of those who are developing a Chemical Hygiene Plan which will satisfy the requirements of paragraph (e) of the standard. It indicates those sections of this appendix which are most pertinent to each of the sections of paragraph (e) and related paragraphs.

Paragraph and topic in laboratory standard Relevant	Appendix Section
(e)(3)(i) Standard operating procedures for handling toxic chemicals.	C,D,E.
(e)(3)(ii) Criteria to be used for implementation of measures to reduce exposures	D
(e)(3)(iii) Fume hood performance	C4b
(e)(3)(iv) Employee information and training (including emergency procedures).	D10, D9
(e)(3)(v) Requirements for prior approval of laboratory activities.	E2b, E4b
(e)(3)(vi) Medical consultation and medical examinations.	D5, E4i
(e)(3)(vii) Chemical hygiene responsibilities.	B
(e)(3)(viii) Special precautions for work with particularly hazardous substances.	E2,E3,E4

In this appendix, those recommendations directed primarily at administrators and supervisors are given in sections A-D. Those recommendations of primary concern to employees who are actually handling laboratory chemicals are given in section E. (Reference to page numbers in "Prudent Practices" are given in parentheses.)

A. GENERAL PRINCIPALS FOR WORK WITH LABORATORY CHEMICALS.

In addition to the more detailed recommendations listed below in sections B-E. "Prudent Practices" expresses certain general principles, including the following:

1. It is prudent to minimize all chemical exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals (2, 10). Skin contact with chemicals should be avoided as a cardinal rule (198).

2. Avoid under estimation of risk. Even for substances of no known significant hazard, exposure should be minimized; for work with substances which present special hazards, special precautions should be taken (10, 37, 38). One should assume that any mixture will be more toxic than its most toxic component (30, 103) and that all substances of unknown toxicity are toxic (3, 34).

3. Provide adequate ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices (32, 198).

4. Institute a chemical hygiene program. A mandatory chemical hygiene program designed to minimize exposures is needed; it should be a regular, continuing effort, not merely a standby or short-term activity (6, 11). Its recommendations should be followed in academic teaching laboratories as well as by full-time laboratory workers (13).

5. Observe the PELs, TLVs. The Permissible Exposure Limits of OSHA and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists should not be exceeded (13).

B. CHEMICAL HYGIENE RESPONSIBILITIES

Responsibility for chemical hygiene rests at all levels (6, 11, 21) including the:

1. Chief Executive Officer, who has ultimate responsibility for chemical hygiene within the institution and must, with other administrators, provide continuing support for institutional chemical hygiene (7, 11).

2. Supervisor of the department or other administrative unit, who is responsible for chemical hygiene in that unit (7).

3. Chemical hygiene officer(s), whose appointment is essential (7) and who must:

   (a) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices (7);

   (b) Monitor procurement, use, and disposal of chemicals used in the lab (8);

   (c) See that appropriate audits are maintained (8);

   (d) Help project directors develop precautions and adequate facilities (10);

   (e) know the current legal requirements concerning regulated substances (50); and

   (f) Seek ways to improve the chemical hygiene program (8, 11).

4. Laboratory supervisor, who has overall responsibility for chemical hygiene in the laboratory (21) including responsibility to:

   (a) Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided (21,22)

(b) Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment (21, 171);

(c) Know the current legal requirements concerning regulated substances (50, 231);

(d) Determine the required levels of protective apparel and equipment (156, 160, 162); and

(e) Ensure that facilities and training for use of any material being ordered are adequate (215).

5. Project director or director of other specific operation, who has primary responsibility for chemical hygiene procidures for that operation (7).

6. Laboratory worker, who is responsible for:

(a) Planning and conducting each operation in accordance with the institutional chemical hygiene procedures (7, 21, 22, 230); and

(b) Developing good personal chemical hygiene habits (22).

C. THE LABORATORY FACILITY

1. Design. The laboratory facility should have:

(a) An appropriate general ventilation system (see C4 below) with air intakes of contaminated air (194);

(b) Adequate, well-ventilated stockrooms/storerooms (218, 219);

(c) Laboratory hoods and sinks (12, 162);

(d) Other safety equipment including eyewash fountains and drench showers (162, 169); and

(e) Arrangements for waste disposal (12, 240).

2. Maintenance, Chemical - hygiene related equipment (hoods, incinerator, etc.) should undergo continuing appraisal and be modified if inadequate (11,12).

3. Usage. The week conducted (10) and its scale (12) must be appropriate to the physical facilities available and, especially, to the quantity of ventilation (13).

4. Ventilation

(a) General laboratory ventilation. This system should. Provide a source of air for breathing and for input to local ventilation devices; (199) it should not be relied on for protection for toxic substances released into the laboratory (198); ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day (194); direct air flow into the laboratory from non - laboratory areas and out to the exterior of the building (194).

(b) HOODS. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals (199)); each hood should have a continues monitoring device to allow convenient confirmation of adequate hood performance before use (200, 209). If this is not possible, work with substances of unknown toxicity should be avoided (13) or other types of local ventilation devices should be provided (199). See pp. 201-201 for a discussion of hood design, construction, and evaluation.

(c) OTHER LOCAL VENTILATION DEVICES. Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed (199). Each canopy hood and snorkels should have a separate exhaust duct. (207).

(d) Special ventilation areas. Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system (208). Cold rooms should have provisions for rapid escape and for escape in the event of electrical failure (209).

(e) MODIFICATIONS. Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate (12, 193, 204).

(f) PERFORMANCE RATE: 4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control (194).

(g) QUALITY. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas (194, 195); hood face velocity should be adequate (typically 60-100 lfm) (260, 204).

(h) EVALUATION. Quality and quantity of ventilation should be evaluated upon installation (202), regularly monitored (at least every 3 months) (6, 12, 18, 195), and reevaluated whenever a change in local ventilation devices is made (12, 195, 207). See pp. 195-198 for methods of evaluation and for calculation of estimated airborne contaminant concentrations.

D. COMPONENTS OF THE CHEMICAL HYGIENE PLAN

1. Basic rules and procedures (Recommendations for these are given in section E. below).

2. Chemical Procurement, Distribution, and storage

(a) Procurement. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved (215, 216). No container should be accepted without an adequate identifying label (216). Preferably, all substances should be received in a central location (216).

(b) Stockrooms/storerooms. Toxic substances should be segregated in a well identified area with local exhaust ventilation (221). Chemicals which are highly toxic (227) or other chemicals whose containers have been opened should be in unbreakable secondary containers (219). Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity (216-19). Stockrooms/storerooms should not be used as preparation or repackaging areas, should be open during normal working hours, and should be controlled by one person (219).

(c) Distribution. When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used if possible (223).

(d) Laboratory Storage. Amounts permitted should be as small as practical. Storage or bench tops and in hoods is inadvisable. Exposure is heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom (225-6, 229).

3. Environmental Monitoring

Regular instrumental monitoring of airborne concentrations is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devices (12) or when a highly toxic substance is stored or used regularly (e.g.3 times/week) (18).

4. Housekeeping, Maintenance, and Inspections.

(a) Cleaning. Floors should be cleaned regularly (24).

(b) Inspections. Formal housekeeping and chemical hygiene inspections should be held at least quarterly (6, 21) for units which have frequent personnel changes and semiannually for others; informal inspections should be continual (21).

(c) Maintenance. Eye wash fountains should be inspected at intervals of not less than 3 months (6). Respirators for routine use should be inspected periodically by the laboratory supervisor (169). Safety showers should be tested routinely (169). Other safety equipment should bge inspected regularly. (e.g. every 3-6 months) (6, 24, 171). Procedures to prevent

restarting of out of service equipment should be established (25).

(d) Passageways, Stairways and hallways should not be used as storage areas (24). Access to exits, emergency equipment, and utility controls should never be blocked (24).

5. MEDICAL PROGRAM

(a) Compliance with regulations. Regular medical surveillance should be established to the extent required by regulations)12).

(b) Routine surveillance. Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable (11, 50).

(c) First aid. Personnel trained in first aid should be available during working hours and an emergency room with medical personnel should be nearby (173). See pp. 176-178 for description of some emergency first aid procedures.

6. PROTECTIVE APPAREL AND EQUIPMENT

These should include for each laboratory:

(a) Protective apparels compatible with the required degree of protection for substances being handled (158-161);

(b) An eyewash fountain (162):

(c) A fire extinguisher (162-164);

(e) Respiratory protection (164-9), fire alarm and telephone for emergency use (162) should by available nearby; and

(f) Other items designated by the laboratory supervisor (156, 160).

7. RECORDS

(a) Accident records should be written and retained (174).

(b) Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations (7).

(c) Inventory and usage records for high risk substances should be kept as specified in sections E3e below.

(d) Medical records should be retained by the institution in accordance with the requirements of state and federal regulations (12).

8. SIGNS AND LABELS

Prominent signs and labels of the following types should be posted:

(a) Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers (28);

(b) Identify labels, showing contents of containers (including waste receptacles) and associated barrels (27, 48);

(c) Location signs for safety showers, eyewash stations, other safety and first aid equipment, exits (27) and areas where food and beverage occupations and storage are permitted (24); and hazards exist (27).

(d) Warnings at areas or equipment where special or unusual hazards exist (27).

9. SPILLS AND ACCIDENTS

(a) A written emergency plan should be established and communicated to all personnel; it should include procedures for ventilation failure (209), evacuation, medical care, reporting, and drills (172).

(b) There should be an alarm system to alert people in all parts of the facility including isolation areas such as cold room (173).

(c) A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting (175).

(d) All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit (9, 26).

10. INFORMATION AND TRAINING PROGRAM

(a) Aim: To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if and accident occurs (5, 15).

(b) Emergency and Personal protection training. Every laboratory worker should know the location and proper use of available protective apparel and equipment (154, 169). Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures (6).

(c) Receiving and stockroom/storeroom personnel should know about hazards, handling equipment, protective apparel, and relevant regulations (217).

(d) Frequency of Training: The training and education program should be a regular, continuing activity, not simply and annual presentation (15).

(e) Literature/Consultation: Literature and consulting advice concerning chemical hygiene should be readily available to laboratory personnel, who should be encouraged to use these information resources (14).

11. WASTE DISPOSAL PROGRAM.

(a) Aim: To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals (5).

(b) Content (14, 232, 233, 240): The waste disposal program should specify how waste is to be collected, segregated, stored, and transported and include consideration of what materials can be incinerated. Transport from the institution must be in accordance with DOT regulations (244).

(c) Discarding Chemical Stocks: Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened (24,27). Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage (226).

(d) Frequency of Disposal· Waste should be removed from laboratories to a central waste storage area at least once per week and form the central waste storage area at regular intervals (14).

(e) Method of Disposal: Incineration in an environmentally acceptable manner is the most practical disposal method for combustible laboratory waste (14, 238, 341). Indiscriminate disposal by pouring waste chemicals down the drain (14, 231, 242) or adding them to mixed refuse for landfill burial is unacceptable (14). Hoods should not be used as a means of disposal for volatile chemicals (40, 200). Disposal by recycling (233, 243) or chemical decontamination (40, 230) should be used when possible.

E. BASIC RULES AND PROCEDURES FOR WORKING WITH CHEMICALS

The Chemical Hygiene Plan should require that laboratory workers know and follow its rules and procedures. In addition to the procedures of the sub programs mentioned above, these should include the rules listed below.

1. GENERAL RULES

The following should be used for essentially all laboratory work with chemicals:

(a) Accidents and Spills

Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention (33, 172).

Ingestion. Encourage the victim to drink large amounts of water (176).

Skin Contact. Promptly flush the affected area with water (33, 172,176)and remove any contaminated clothing (172, 178). If symptoms persist after washing, seek medical attention (33).

Clean-up. Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal (24, 33). See pp. 233-237 for specific clean-up recommendations.

(b) Avoidance of "routine" exposure. Develop and encourage safe habits (23); avoid unnecessary exposure to chemicals by any route (23);

Do not smell or taste chemicals (32). Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices (199).

Inspect gloves (157) and test glove boxes (208) before use.

Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained recirculated atmospheres (209).

(c) Choice of Chemicals: Use only those chemicals for which the quality of the available ventilation system is appropriate (13).

(d) Eating, smoking, etc: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present (22, 24, 32, 40); wash hands before conducting these activities (23, 24).

Avoid storage, handling or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations (23, 24, 226).

(e) Equipment and glassware: Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware (25). Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur (25). Use equipment only for its designed purpose (23, 26).

(f) Exiting: Wash areas of exposed skin well before leaving the laboratory (23).

(h) Mouth suction: Do not use mouth suction for pipeting or starting a siphon (23, 32).

(i) Personal apparel: Confine long hair and loose clothing (23, 158). Wear shoes at all times in the laboratory but do not wear sandals, perforated shoes, or sneakers (156).

(j) Personal housekeeping: Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored: clean up the work area on completion of an operation or at the end of each day (24).

(k) Personal Protection: Assure that appropriate eye protection (154-156) is worn by all persons, including visitors, where chemicals are stored or handled (22,23,33,154).

Wear appropriate gloves when the potential for contact with toxic materials exists (157); inspect the gloves before each use, wash them before removal, and replace them periodically (157). (A table of resistance to chemicals of common glove materials is given p. 159).

Use appropriate (164-168) respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls (1164-5), inspecting the respirator before use (169).

Use any other protective and emergency apparel and equipment as appropriate (22,157-162)

Avoid use or contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken (155).

Remove laboratory coats immediately on significant contamination (161).

(l) Planning: Seek information and advice about hazards (7), plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation (22, 23).

(m) Unattended operations: Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation (27, 128)

(n) Use of Hood: Use the hood for operations which might result in release of toxic chemical vapors or dust (196-9).

As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm (13).

Confirm adequate hood performance before use, keep hood closed at all times except when adjustments within the hood are being made (200); keep materials stored in hoods to a minimum and do not allow them to block vents or air flow (200).

Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off" (200).

(o) Vigilance: Be alert to unsafe conditions and see that they are corrected when detected (22).

(p) Waste Disposal: Assure that the plan for each laboratory operation includes plans and training for waste disposal (230).

Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan (22,24).

Do not discharge to the sewer concentrated acids or bases (231); highly toxic, malodorous, or lachrymatory substances (231); or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow (242).

(q) Working alone: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous (28).

2. WORKING WITH ALLERGENS AND EMBRYOTOXINS

(a) Allergens (examples. diazomethalne, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity (35).

(b) Embryotoxins (34-5) (examples. organomercurials, lead compounds, formamide): If you are a woman of child bearing age, handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.

Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.

Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

3. WORK WITH CHEMICALS OF MODERATE CHRONIC OR HIGH ACUTE TOXICITY

Examples: diisopropylflurophosphate (41), hydrofluoric acid (43), hydrogen cyanide (45). Supplemental rules to be followed in addition to those mentioned above (Procedure B of "Prudent Practices",.PP. 39-41):

(a) Aim: To minimize exposure to these toxic substances by any route using all reasonable precautions (39).

(b) Applicability: These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities (39).

(c) Location: Use and store these substances only in areas of restricted access with special warning signs (40, 229). Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) (40) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance (39); trap released vapors to prevent their discharge with the hood exhaust (40).

(d) Personal protection: Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate) (39) Always wash hands and arms immediately after working with these materials (40).

(e) Records: Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved (40, 229).

(f) Prevention of spills and accidents: Be prepared for accidents and spills (41). Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity (39). Store breakable containers of these substances in chemically resistant trays, also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper (40). If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment (41).

(g) Waste: Thoroughly decontaminate or incinerate contaminated clothing or shoes (41). If possible, chemically decontaminate by chemical conversion (40). Store contaminated waste in closed, suitably labeled, impervious containers (for liquids, in glass or plastic bottles half-filled with vermiculite) (40).

4. WORK WITH CHEMICALS OF HIGH CHRONIC TOXICITY

(Examples; dimethylmercury and nickel carbonyl (48), benzo-a-pyrene (51), N-nitrosodiethylamine (54), other human carcinogens or substances with high carcinogenic potency in animals (38).) Further supplemental rules to be followed, in addition to all these mentioned above, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance) (47). (Procedure A of "prudent Practices" pp. 47-50).

(a) Access: Conduct all transfers and work with these substances in a "controlled area"· a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substances being used and necessary precautions (48).

(b) Approvals: Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor (48)

(c) Non-contamination/Decontamination: Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood (49). Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area (49, 50). Decontaminate the controlled area before normal work is resumed there (50).

(d) Exiting: On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck (49).

(e) Housekeeping: Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder (50).

(f) Medical surveillance: If using toxicologically significant quantities of such a substance on a regular basis (e.g. 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance (50).

(g) Records: Keep accurate records of the amounts of these substances stored (229) and used, the dates of use, and names of users (48).

(h) Signs and labels: Assure that the controlled area is conspicuously marked with warning and restricted access signs (49) and that all containers of these substances are appropriately labeled with identity and warning labels (48).

(i) Spills: Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available (223-4).

(j) Storage: Store containers of these chemicals only in a ventilated, limited access (48, 227, 229) area in appropriately labeled, unbreakable, chemically resistant, secondary containers (48, 229).

(k) Glove boxes: For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water (48) For a positive pressure glove box, thoroughly check for leaks before each use (49). In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood (49).

(1) Waste: Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel (49, 50, 233).

5. Animal Work with Chemicals of High Chronic Toxicity

(a) Access: For large scale studies, special facilities with restricted access are preferable (56).

(b) Administration of the toxic substance: When possible, administer the substance by injection or gavage instead of in the diet, use a caging system under negative pressure or under laminae air flow directed toward HEPA filters (56).

(c) Aerosol suppression: Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood) (55,56).

(e) Waste disposal: Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products (238); otherwise, package the waste appropriately for burial in an EPA-approved site (239).

F. SAFETY RECOMMENDATIONS

The above recommendations from "Prudent Practices" do not include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, we list below page references for recommendations concerning some of the major categories of safety hazards which also have implications for chemical hygiene:

1. Corrosive agents: (35-6)

2. Electrically powered laboratory apparatus: (179-92)

3. Fires, explosions: (26, 57-74, 162-4, 174-5, 219-20, 226-7)

4. Low temperature procedures: (26, 88)

5. Pressurized and vacuum operations (including use of compressed gas cylinders): (27, 75-101).

G. MATERIAL SAFETY DATA SHEETS

Material safety data sheets are presented in "Prudent Practices" for the chemicals listed below. (Asterisks denote that comprehensive material safety data sheets are provided).

* Acetyl peroxide (105)
* Acrolein (106)
* Acrylonilrile (107)
  Ammonia (anhydrous) (91)
* Aniline (109)
* Benzene (110)
* Benzo[a]pyrene (112)
* Dis(chloromethyl) ether (113)
  Boron trichloride (91)
  Boron trifluoride (92)
  Bromine (114)
* Tert-butyl hydroperoxide (148)
* Carbon disulfide (116)
  Carbon monoxide (92)
* Carbon tetrachloride (116)
* Chlorine (119)
  Chlorine trifluoride (94)
* Chloroform (121)
  Chloromethane (93)
* Diethyl ether (122)
  Diisopropyl fluorophosphate (41)
* Dimethylformamide (123)
* Dimethyl sulfate (125)
* Dioxane (1260)
* Ethylene dibromide (126)
* Fluorine (95)
* Formaldehyde (130)
* Hydrazine and salts (132)
  Hydrofluoric acid (43)
  Hydrogen bromide (98)
  Hydrogen chloride (98)

* Hydrogen cyanide (133)
* Hydrogen sulfide (135)
  Mercury and compounds (52)
* Methanol (137)
* Morpholine (138)
* Nickel carbonyl (99)
* Nitrobenzene (139)
  Nitrogen dioxide (100)
  N-nitrosodiethylamine (54)
* Peracetic acid (141)
* Phenol (142)
* Phosgene (143)
* Pyridine (144)
* Sodium azide (145)
* Sodium cyanide (147)
  Sulfur dioxide (101)
* Trichloroethylene (149)
* Vinyl chloride (150)

Appendix B to 1910.1450--References (non-Mandatory)

The following references are provided to assist the employer in the development of a Chemical Hygiene Plan. The materials listed below are offered as non-mandatory guidance. References listed here do not imply specific endorsement of a mood, opinion, technique, policy or a specific solution for a safety or health problem. Other references not listed here may better meet the needs of a specific laboratory.

(a) Materials for the development of the Chemical Hygiene Plan:

1. American Chemical Society, Safety in Academic Chemistry Laboratories, 4th edition, 1985.

2. Fawcett, H.H. and W.S. Wood, Safety and Accident Prevention in Chemical Operations, 2nd edition, Wiley-Interscience, New York, 1962.

3. Flury, Patricia A., Environmental Health and Safety in the Hospital Laboratory, Charles C.Thomas Publisher, Springfield Ill., 1978.

4. Green, Michael E. and Turd, Amos, Safety in Working with Chemicals, Macmillan Publishing Co., NY, 1978.

5. Kaufman, James A., Laboratory Safety Guidelines Dow Chemical Co., Box 1713, Midland, MI 48640, 1977

6. National Institutes of Health, NIH Guidelines for the Laboratory use of Chemical Carcinogens. NIH Pub. No. 81-2385, GPO, Washington, DC 20402,1981.

7. National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, DC, 1983

8. National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington, DC, 1981.

9. Renfrew, Malcolm, Ed., Safety in the Chemical Laboratory, Vol. IV.J. Chem. Ed., American Chemical Society, Easlon, PA, 1981.

10. Steere, Norman V., Ed., Safety in the Chemical Laboratory, J. Chem. Ed. American Chemical Society, Easlon, PA. 18042. Vol. I. 1967, Vol. II, 1971, Vol.III 1974.

11. Steere, Norman V., Handbook of Laboratory Safety, the Chemical Rubber Company Cleveland, OH, 1971.

12. Young, Jay A., Er., Improving Safety in the Chemical Laboratory, John Wiley & Sons, Inc. New York, 1987.

(b) Hazardous Substances Information:

1. American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes, P.O. Box 1937 Cincinnati, OH 45201 (latest edition).

2. Annual Report on Carcinogens, National Toxicology Program U.S. Department of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington, DC. (latest edition).

3. Best Company, Best Safety Directory, Vols. I and II, Oldwick, N.J., 1981.

4. Bretherick, L., Handbook of Reactive Chemical Hazards, 2nd edition, Butterworths, London, 1979.

5. Bretherick, L., Hazards in the Chemical Laboratory, 3rd edition, Royal Society of Chemistry, London, 1986

6. Code of Federal Regulations, 29 CFR part 1910 subpart Z. U.S. Govt. Printing Office, Washington, DC 20402 (latest edition).

7. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. World Health Organization Publications Center. 49 Sheridan Avenue, Albany, New York 12210 (latest edition).

8. NIOSH/OSHA Pocket Guide to Chemical Hazards. NIOSH Pub. No. 85-114, U.S. Government Printing Office, Washington, DC, 1985 (or latest edition).

9. Occupational Health Guidelines, NIOSH/OSHA NIOSH Pub. No. 81-123 U.S. Government Printing Office, Washington, DC, 1981.

10. Patty, F.A., Industrial Hygiene and Toxicology, John Wiley & Sons, Inc., New York, NY 9 Five Volumes).

11. Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Revised Annually, for sale from Superintendent of Documents U.S. Govt. Printing Office, Washington, DC 20402.

12. The Merck Index: An Encyclopedia of Chemicals and Drugs. Merck and Company Inc. Rabway, N.J., 1976 (or latest edition).

13. Sax. N.J. Dangerous Properties of Industrial Materials, 5th edition, Van Nostrand Reinhold, NY., 1979.

14. Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals, Noyes Publications, Park Ridge, NJ, 1981.

(c) Information on Ventilation:

1. American Conference of Governmental Industrial Hygienists Industrial Ventilation, 16th edition Lansing, MI. 1980.

2. American National Standards Institute, Inc. American National Standards Fundamentals Governing the Design and Operation of Local Exhaust Systems ANSI Z. 9.2-1979 American National Standards Institute, N.Y. 1979

3. Imad, A.P. and Watson, C.I. Ventilation Index: An Easy Way to Decide about Hazardous Liquids, Professional Safety pp 15-16, April 1980.

4. National Fire Protection Association, Fire Protection for Laboratories Using Chemicals NFPA-45, 1982. Safety Standard for Laboratories in Health Related Institutions, NFPA, 56c, 1980. Fire Protection Guide on Hazardous Materials, 7th edition, 1978. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

5. Scientific Apparatus Makers Association (SAMA), Standard for Laboratory Fume Hoods, SAMA LF-1980, 1101 16th Street, NW., Washington, DC 20036

(d) Information on Availability of Referenced Material:

1. American National Standards Institute(ANSI), 1430 Broadway, New York, NY 10018.

2. American Society for Testing and Materials (ASTM). 1916 Race Street, Philadelphia, PA 19103.

(Approved by the Office of Management and Budget under control number 1218-0131) [FR Doc. 90-1717 Filed 1-30-90; 8:45 am].

APPENDIX B

List of Carcinogens Used at ATI

List of Carcinogens that can be found at ATI

The following is a list of the carcinogens that A T I has on hand for use in the various Laboratories. This list is subject to change as chemicals are added or subtracted The only people authorized to make changes are the Chemical Hygiene Officer or the CHO's alternate.

Aldrin
Aniline
Benz[a]anthracene
Benzene
Benzidine
Benzo [b] floranthene
Benzo [k] floranthene
Benzo [a] pyrene
Bis (cloromethyl) ether
Bis (cloroethyl) ether
Bromochloromethane
Chlorodane
Chrysene
3,3-Dichlorobenzidine
1,1-Dichloroethane
Dichloromethane (Methylene chloride)
1,2-Dichloropropane
1,3-Dichloropropene
Dieldrin
Epichlorohydrin
Ethyl acrylate
Ethylene Thiourea
Heptachlor
N-Nitrosodiumethylamine
N-Nitresodiuphenylamine
Thiourea
Toluene 2,3-Diisocyanate
Toxaphene
Trichloroethylene

APPENDIX C

ATI Emergency Contingency Plan

EMERGENCY CONTINGENCY PLAN
TABLE OF CONTENTS

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4.0	Emergency Response Plan	7
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EMERGENCY CONTINGENCY PLAN

1.0 OVERVIEW

1.1 Business Name: Analytical Technologies, Inc.

1.2 Business Site Address: 225 Commerce Drive, Fort Collins

1.3. Business Telephone: (303) 490-1511
24 Hour: (303) 484-8044 (Steve Workman)
(303) 482-3561 (Paul J. Valentinelli)

1.4 Brief description of service: An environmental analytical laboratory.

1.5 Evacuation procedures.

1.5.1 Emergency Alarm:

Vocal alarm over the public address system, or a smoke alarm will initiate an emergency evacuation. Once the alarm is activated, or someone announces an emergency over the public address system, evacuation is to be immediate. The alarm will activate in the instance of fire and all other emergencies will be announced over the public address system.

1.5.2 Emergency Exits:

Exits are all clearly marked and emergency evacuation maps are posted throughout the laboratory. These exits, along with access to them shall be maintained free of obstructions at all times to allow safe egress from all areas of the building to the outside.

Locate the emergency exit nearest your workstation and familiarize yourself with your primary and secondary escape routes. If you work in various parts of the lab, follow this procedure for all of your workstations If exits or access to them are ever blocked, notify the Safety Officer immediately or person responsible for the blockage, if known.

1.5.3 Evacuation Procedure:

When the alarm sounds, leave the building by the nearest exit immedeately. Do not wait to finish a project or piece of work. By the time the alarm sounds, the emergency has already progressed beyond its incipient stage.

Once outside the building, all employees shall gather at the Designated Assembly Area (see attached map). Do not assemble in driveway areas as this may obstruct access for emergency vehicles and equipment.

NOTE: Lab personnel should not worry about removing protective clothing before evacuating. Leave the lab immediately upon hearing the alarm.

1.5.4 Accounting for Personnel:

Once assembled, each supervisor will locate, count and otherwise account for all personnel within his or her department.

1.6. Notification Procedures:

In the event of a large release of a hazardous material the following agencies are to be notified:

1.6.1 Under all circumstances

1.6.1.1 Hazardous Materials Management call 911

1.6.1.2 National Response Center 1-(800) 424-8802

1.6.1.4 Laboratory Manager (303) 226-6217

1.6.2 B. If in need of medical assistance

1.6.2.1 Monday thru Friday 8 am to 5 pm call Doctor's Neighborhood Care 221-5811

1.6.2 2 After 5 pm. Monday thru Friday or weekends call Poudre Valley Hospital at 911.

The notification procedures, (Section 3.0) Emergency Information Sheet is included. In summary give name, date, time, company name, address, telephone number, nature of the emergency, location, extent of emergency, types of chemicals involved, extent of injuries, and potential hazard to human health and the environment outside the facility.

2.0 EMERGENCY COORDINATOR INFORMATION

2.1 Name of Emergency Coordinator: Paul Valentinelli

2.2 Title: Safety Officer

2.3 Work Number: 490-1511 Home 24/hr Phone: 482-3561

2.4 Address: 314 Edwards St. Fort Collins, CO 80524

2.5 Name of Alternate: Steve Workman
Title: Production Manager
Work Number: 490-1511 Home 24/hr Phone: 484-8044
Address: 2925 W. Vine Dr. Fort Collins, CO 80521

3.0 EMERGENCY INFORMATION REPORT

1. Date 2. Time of Incident
3. Company Name: Analytical Technologies, Inc.
4. Address: 225 Commerce Drive Fort Collins, CO 80526
5. Phone: (303) 490-1511
6. Nearest cross street: East Lincoln
7. Location of incident:
8. Extent of emergency:

9. Type of incident:
   Fire Fire explosion Chemical Release
   Chemical Spill into air Occupational Accident

10. Cause of Emergency:
    Process Release/Spill Fire Explosion
    Other, Explain

11. Identification of Hazardous Material:
    Shipping Name UN or NA Number

    Chemical Name Label Information

    Trade Name Other

    Physical Description of Material:
    Solid Gas Granule Liquid Powder

12. If material has run off site; explain amount and location:
    (If yes, make all required notifications)
    No Yes

13. Environment Effected:
    Storage Area(s) Roadway (Public) Facility
    Other Buildings Air Release Parking Areas
    Entered: Sewer Roadway Storm Drain(s)
    Threat to Environment/Wildlife: (Explain)

14. Health:

Exposure to employees	Yes	No	Number
Exposure to public	Yes	No	
Employees injured	Yes	No	Number
Public injured	Yes	No	
Medical attention	Yes	No	
Hospitalized	Yes	No	

15. Evacuation Necessary· Yes No
Number evacuated from onsite sources
Number evacuated from offsite sources (if known)
Names: Staff Exposed/Injured

Hospital(s) transported to

Describe injuries or exposure (symptoms)

16. Agencies you have notified:
Regional Water Board State Health(DOHS) Fire
Sewer District Air Pollution Control Police
EPA Coast Guard County Health Other

17. Actions taken to control problem:

18. Emergency/Coordinator

19. Name of reporter

20. Phone number

4.0 EMERGENCY RESPONSE PLAN

This plan is designed to minimize potential hazards to human health and the environment from fires, explosions or hazardous materials spills.

4.1 Emergency Procedures

4.1.1 If a spill, release, fire, loss of power, loss of water pressure or explosion occurs, immediately alert a supervisor and anyone in the vicinity of the emergency; then contact the Emergency Coordinator (EC) or designated alternate and give the following information.

* Type of incident
* Location of incident
* Your estimation of the extent, amount of material involved, known nearby hazards which might come into play, etc.

4.1.2 During an emergency, you must take reasonable measures to ensure that fires, releases, or exposures do not spread. These measures include:

* Stopping operations
* Isolating area where hazard exists
* Remove/relocate nearby materials which may compound the problem
* Secure air and/or electrical supply to device or problem area

4.2 If there is a loss of power you must close all hood sashes in your area. By doing this you will help prevent the spread of unwanted airborne contamination. After this is complete, exit the space carefully. You must then go to the designated meeting space and wait for further instruction. If the situation arises after normal daytime working hours then contact the EC and Lab Manager.

4.3 If there is a loss of water pressure you must stop working in spaces where there is an immediate danger of chemical exposure to exposed body parts. General work can be conducted such as data crunching, data entry, etc. Only when the water is restored can you begin work with hazardous chemicals. If a situation like this arises, contact the EC or your supervisor and explain the situation. They will in turn evaluate the situation and give you further instructions.

4.4 Chemical Spills and Leaks

When a spill occurs:

4.4.1 Contain the spill or leak by isolating the area where it occurred and vacate the area. Label the area with "Chemical Spill" signs at all routes of entry.

4.4.2 Identify the material and quantity spilled or leaked. Amounts less than 100 mls can be addressed by the employee. For amounts greater than 100 mls, contact the EC or your supervisor.

4.4.3 Once identified, take precautions to assure there is adequate protection to clean up personnel by selecting a level of protective clothing suitable for handling the material spilled.

4.4.4 Utilize spill control equipment and materials to neutralize, absorb and containerize the material.

4.4.5 Once the material is removed from the floor, bench top surface, hood, etc., decontaminate the exposed areas with soap and water and/or a solvent suitable for removing all of the material. In some cases, a wipe test should be performed to insure adequate decontamination as determined by the EC.

4.5 Explosions, Poisonous Gas Releases, Fires, Etc.

4.5.1 Isolate area where hazard exists.

* Close hood
* Leave room and close door

4.5.2 Once isolated, try to determine the nature of the materials involved. Contact supervisor and EC.

4.5.3 Do not re-enter area until you are instructed it is safe to do so.

4.6 Spill Cleanup Precautions for Categories of Hazardous Materials.

4.6.1 Acids and Caustics

For spills of less than 100 mls, Solid-a-sorb spill absorbent should be placed on the spill; the absorbent should be transferred to the appropriate waste barrel in the waste disposal area. The spill area should be cleaned with soap and water after the adsorbent is removed. For spills in excess of 100 mls, contact the EC or your supervisor for further instructions.

CAUTION: WHEN WATER IS POURED ON SPILLS OF CONCENTRATED SULFURIC ACID, THERE IS A PROBLEM WITH HEAT GENERATION AND SPATTERING.

4.6.2 Solvents:

If minor quantities of solvents (100 mls or less) are spilled, wipe up liquid with toweling, allow the solvent on the toweling to evaporate in a fume hood, and then discard the toweling in the proper waste receptacle.

For large solvent spills, isolate the area with chemical spill signs and contact the EC or your supervisor for futher instructions.

4.7 Other Exposure Accidents

4.7.1 Skin:

If a solvent, acid or other solution is spattered on the face, hands or clothing, immediately remove contaminated clothing and flush affected area with large volumes of water for 30 minutes. Seek medical attention if more than a minor amount of chemical is involved.

CAUTION: SOME CHEMICALS (SUCH AS ACID CHLORIDES) REACT WITH WATER PRODUCING CORROSIVE DECOMPOSITION PRODUCTS. THE EXOTHERMIC REACTION INVOLVES HEAT THAT CAN VAPORIZE THE CHEMICAL, GIVING RISE TO IRRITATING VAPORS. USE LARGE QUANTITIES OF WATER IN THESE CASES BY STANDING UNDER A SAFETY SHOWER.

4.7.2 Eyes:

Safety glasses, goggles, or an approved face shield should be worn at all times in the chemical laboratory An emergency eyewash station is located in the glassware lab. If acid, caustic, or any other chemical gets in your eyes, flush your eye at once with plenty of water for at least 15 minutes to prevent serious eye damage and to remove any foreign matter. See a physician immediately.

4.7.3 Inhalation:

Handling of dilute solutions normally used in analytical work presents no inhalation hazards except in the case of an accident. Fume hoods are provided for hazardous analytical work. Sub-sampled soils contaminated with HSL compounds are hazardous because of the potential for inhalation. These samples must always be handled under fume hoods.

In case of overexposure by inhalation, remove person from area to fresh air and seek medical attention or immediately call Poison Control Center. (1-800-332-3073)

4.7.4 Ingestion:

Always avoid touching the face or eyes with contaminated gloves. In case of ingestion, refer to MSDS's or call the Poison Control Center (1-800-332-3073), to seek a response. Most chemicals should be diluted with water as soon as possible. However, some of the most commonly used chemicals have different treatments. NEVER GIVE LIQUIDS TO AN UNCONSCIOUS PERSON. Seek medical attention immediately.

4.7.5 Cuts, Scrapes, or Other Minor Injuries:

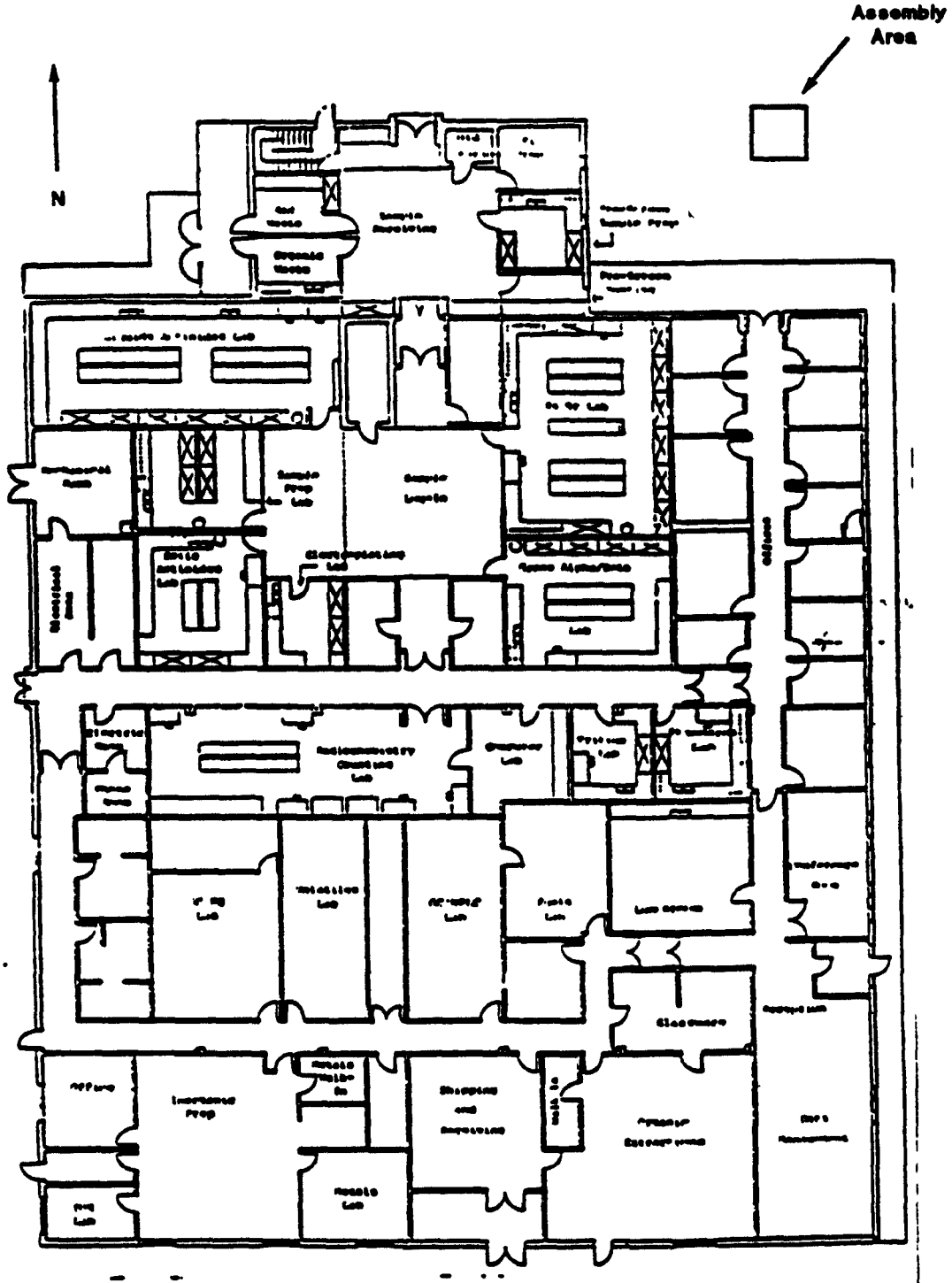
A First Aid Kit is located in the lunch room area. All injuries should be addressed as soon as possible.

4.8 Accident Reporting Procedure

All injuries, whether major or minor, shall be reported to a supervisor and to the Safety Officer. It is the supervisor's or lead person's responsibility to assure that an accident follow-up report is filed with the Safety Officer within twenty-four hours of the incident.

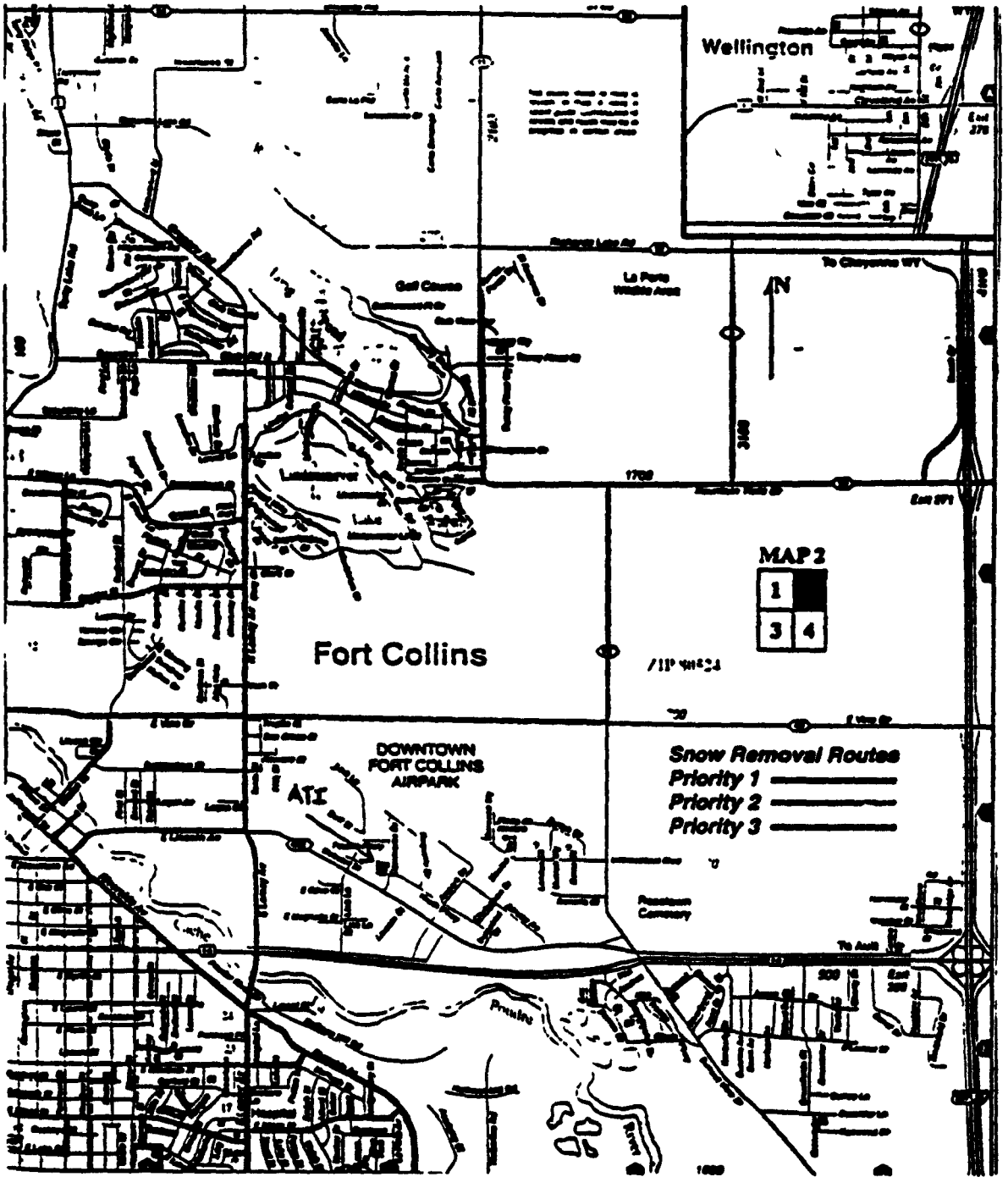
5.0. FLOOR PLANS AND AREA MAP

FLOOR PLAN



ANALYTICAL TECHNOLOGIES, INC.
Fort Collins, Colorado

AREA MAP


Wellington
Fort Collins
MAP 2
1
3
4
DOWNTOWN
FORT COLLINS
AIRPARK
ATI
Snow Removal Routes
Priority 1
Priority 2
Priority 3
N

APPENDIX D

ATI Respiratory Protection Program

ANALYTICAL TECHNOLOGIES INC. RESPIRATORY PROTECTION PROGRAM

1.0 BACKGROUND

The primary objective of this respiratory protection program is to limit the inhalation of harmful dusts, fumes, mists, vapors, or gases Normally, control of toxic airborne contaminants shall be accomplished through the proper engineering design of the process, containment, and ventilation equipment. The use of respiratory protection devices shall be limited to special, infrequent or emergency operations. The use of respiratory protection devices as a substitute for engineering control measures subjects the wearer to increased stress, lowers efficiency, and increases the risk of injury be interfering with vision, freedom of motion, and the ability to communicate

This procedure establishes responsibilities for the program management, the method for obtaining approval, and specifies available respiratory equipment This procedure does not apply where respiratory equipment is used for protection against airborne radioactivity

The effective use of respirators requires a planned program extending to all ATI operations, and includes supervision by trained and experienced personnel This procedure provides for the Company's compliance with the legal requirements of the Federal (and State, if applicable) Occupational Safety and Health Act

2.0 RESPONSIBILITIES

The Corporate Health and Safety Officer of Analytical Technologies Inc is assigned primary responsibility for the respiratory protection program, and for assuring that the program is in compliance with federal and state regulations

2 1 Health and Safety Officer (HSO)

The HSO, designated for each ATI laboratory is capable of issuing, fit testing and training ATI staff who have been approved to wear respiratory protection The HSO is also responsible for the procurement and issuing of all respiratory protection products

2.2 User Responsibilities

People who use respiratory protection are responsible for the proper use, storage and maintenance of respiratory protective equipment issued for their personal use' The equipment shall be stored in a convenient and sanitary manner The individual respirators shall be stored in a plastic bag because this will help keep the canisters from aging as rapidly as they would if they were exposed to the open air. Respiratory equipment shall be maintained in a clean, sanitary condition with treated towelettes, which may be obtained from the HSO. The user shall not loan, transfer or interchange a respiratory protection device with another person. Users shall guard against damage to the respiratory protective equipment, routinely inspect and fit-test the respirator before each use and shall report any apparent defect or malfunction to their location or site HSO

Defective equipment must be turned in to the HSO for repair or replacement Respiratory equipment no longer in use shall be returned to the HSO for evaluation and disinfecting if still useable

2 3 Qualifying and Disqualifying Requirements

2.3 1 Medical

Personnel to whom resistance-creating respiratory protective devices are to be issued shall be examined initially and annually thereafter by a physician retained by ATI The exam shall include a medical history, clinical examination of the heart and lungs, a chest X-ray, and a spirometry test

The spirometry test shall measure the forced expiratory volume in 1 second (FEV1) and the forced vital capacity (FVC) The ratio of the FEV1 to the FVC shall be calculated to determine lung fitness All spirometry shall be performed on American Thoracic Society approved equipmnent and by a trained NIOSH-certified pulmonary technician

Annually, each worker who has been issued and uses a resistance-creating respirator will be re-examined by the physician. The details of the medical exam are addressed in the ATI Medical Surveillance Program.

2 3 2 Disqualifying Conditions

The physician may consider the following conditions as disqualifying for respiratory equipment use.

1. Facial deformities and facial hair Facial deformities or the presence of excessive facial hair, sideburns or other conditions that interfere with proper sealing of the respirator may disqualify the potential user. According to ATI policy, staff involved in the handling of or potential exposure to hazardous materials must not have facial hair which would interfere with a proper facial seals An obstructed seal renders the respiratory protection ineffective and can cause exposures to the wearer Such a situation can jeopardize the health and safety of the wearer and co -workers

2. History of restrictive or obstructive lung diseases Pulmonary conditions verified by chest X-ray, clinical findings or spirometry shall disqualify an employee for respirator use

3 History of cardiovascular disease, hypertension-symptomatic coronary artery disease, arrhythmias, or recent history of myocardial infarction shall disqualify the employee for respiratory use

4 Individuals with perforated tympanic membranes (eardrums) cannot wear respirators in hazardous exposure areas where inhalation or absorption of toxic materials or vapors through the perforation may occur Existence of perforation by itself shall not immediately disqualify the employee for respirator use, but the examining physician shall consider both the environment of the employees workplace and possible control measures before reaching a final decision

5 Individuals with prescription eyeglasses who are required to wear full-face respiratory equipment shall use special frames for their glasses that do not interfere with the facepiece seal. Special visual acuity and visual field requirements shall depend upon the nature of the work to be performed.

3.0 IDENTIFICATION AND RECORDS

Each respirator issued to a user must be identified with the name of the person to whom it is issued. This marking of each respirator will occur at the time of equipment issuance An ATI form, "Respirator Fit Test" will be prepared and retained by the Health and Safety Officer Records shall be maintained by the HSO for review by federal, state or local regulatory agencies

4.0 INSTRUCTIONS AND TRAINING

At the time of issuance, all users will be instructed and trained as to the need to wear respiratory protective devices, the protection the device will provide, its limitations, sanitary care, and proper fitting The users shall sign the ATI issuance form, indicating that they received the required equipment, instruction and a fit test Once per year the user will be required to attend classroom training that will cover the physiology of the respiratory system, elements of the Respiratory Protection Program, and description of the respiratory system, elements of the Respiratory Protection Program, and description of respirators (atmosphere supplying and air purifying), uses and limitations A written quiz accompanies the training class where retention of at least 70% of the information given must be demonstrated Attendance rosters and completed exams are maintained on file with the Safety Officer

5.0 FIT TESTING

5 1 Negative pressure sealing test

5 1 1 With a cartridge in place, have the wearer cover the porous area of the cartridge with their hand

5 1 2 Instruct the wearer to inhale attempting to achieve a negative pressure in the face piece

5 1 3 Inability to achieve or maintain negative seal may be indicative of poor respirator fit or malfunction

5 1 4 Recheck integrity of the respirator for better seal.

5 1 5 Repeat steps 5.1 1 and 5 1 2

5 1 6 Do not use respirator if unable to achieve a negative pressure.

5 1 7 This is not considered a qualitative fit test, but rather a quick check of respirator integrity and seal

5.2 Positive pressure sealing test

5 2 1 Have the wearer remove the protective covering of the exhalation valve and seal the exhalation port with their hand

5 2.2 Instruct them to exhale slightly

5 2 3 Inability to maintain a slight positive pressure without indications of leakage may be indicative of poor respirator fit or malfunction

5 3 Isoamyl acetate qualitative fit test

5 3 1 After successful completion of the negative and positive fit test, the HSO will perform a qualitative fit test

5.3 2 Remember the respirator must be fitted with an organic vapor air purifying cartridge (either black organic vapor, or yellow organic vapor/acid gas) Isoamyl acetate is an organic vapor

5.3 3 The HSO crushes an isoamyl acetate (banana oil) ampule and begins the test by moving the ampule around the area of the cartridges During the test if the wearer smells or tastes anything in the mask that resembles bananas, they should let the HSO know immediately

5 3 4 Have the wearer lean their head from side to side, chin-up, and chin down all the time moving the ampule along the mask face seal

5.3 5 Have the wearer speak by reciting their first, middle and last name or social security number

5.3 6 Ask the wearer to remove the mask and confirm that they can smell the isoamyl acetate A small percentage of the population cannot smell the banana like-odor

6.0 INSPECTION AND MAINTENANCE

On a day-to-day basis, it is the responsibility of the users to inspect, clean, and properly store their respiratory equipment. The HSO is required to see that the equipment in use is clean, functioning properly and that the user has a suitable place to store respiratory protective equipment Treated towelettes are provided to aid in maintaining equipment in a sanitary condition Users are instructed to bring their respirator to the HSO at any time when the equipment is not functioning properly, is damaged, or is missing parts Once per year, coinciding with the initial dates of issuance, users will be notified to bring their respiratory equipment to the HSO for inspection, repair, and cleaning The HSO will dismantle all equipment of good condition for inspection and cleaning with the sanitizer Any damaged equipment will be repaired or replaced Once maintenance is complete, the cleaned/repaired respiratory equipment will be reissued to the user The Respirator Maintenance Checklist will be completed by the HSO and will be retained as a record of respirator inspection and maintenance

6 1 Maintenance Guidelines

The following are inspection guidelines to follow when maintaining a half- or full-face air purifying respirator

6 1 1 Examine the facepiece for

- Excessive dirt
- Cracks, tears, holes, or distortion
- Inflexibility (stretch and massage to restore flexibility)
- Cracked or broken element holders, badly worn threads, or missing gaskets

6 1 2 Examine headstraps for

- Breaks
- Loss of elasticity
- Broken buckles and attachments

6 1 3 Examine valves for

- Foreign materials, detergent residue, dust particles, or human hair under the valve seat
- Cracks, tears, or distortions of the valve materials
- Improper insertion of the valve body in the facepiece
- Cracks, chips, or breaks in the valve body particularly the sealing surfaces
- Missing or defective valve cover

6 1.4 Examine air purifying elements for

- Incorrect cartridge or filter for the hazard you are working with
- Incorrect installation of cartridge or filter
- Expired shelf or working life of the element
- Evidence of internal rattling, if this occurs the cartridge is defective

7.0 EQUIPMENT TYPES AND LIMITATIONS

Respiratory protection is of primary importance as the lungs present the body's greatest exposed surface area Respiratory protective devices (respirators) consist of a facepiece connected to an air or oxygen source The three major categories of respirators differ with respect to the air or oxygen source

- Self-contained breathing apparatus (SCBAs) supply air from a source carried by the user.

- Air-line respirators (ALRs) respirators supply air from a source located some distance away and connected to the user by a hose, sometimes called an umbilical cord.

- Air-purifying respirators enable the user to inhale "purified" ambient air.

Because they both supply air to the user, ARLs and SCBAs are sometimes categorized together as Supplied-air respirators

Respirators are further differentiated by the type of air flow supplied to the facepiece:

- Negative-pressure respirators (also referred to as demand respirators) draw air into the facepiece via the negative pressure created by user inhalation. The disadvantage of demand respirators is if any leaks develop in the system, (i.e., a crack in the hose or an ill-fitting mask/facepiece), the user draws contaminated air into the facepiece during inhalation.

- Positive-pressure respirators (also referred to as pressure-demand respirators) maintain a slight positive pressure in the facepiece during both inhalation and exhalation A pressure regulator and an exhalation valve on the mask maintain the mask's positive pressure at all times If a leak develops, the regulator sends a continuous flow of clean air into the facepiece, preventing penetration of contaminated ambient air Only positive-pressure respirators are recommended for work at hazardous waste sites

- Continuous-flow respirators send a continuous stream of air into the facepiece at all times. Continuous air flow prevents infiltration by ambient air, but exhausts the air supply much more rapidly than positive-pressure or negative-pressure respirators

Different types of facepieces are available for the various types of respirators.

- Full Facepieces cover the face from the hairline to below the chin. They are recommended for use on uncontrolled sites (i.e the hazardous waste storage area) since they provide eye, as well as respiratory, protection.

- Half masks cover the face from below the chin to over the nose They can be used when the airborne contaminants have been identified and are judged unlikely to irritate the eyes

Federal regulations require the use of approved respirators. Approval numbers are clearly written on all approved respiratory equipment. Respirators are tested by NIOSH and, if they pass the OSHA requirements specified in OSHA 30 CFR 11, are jointly approved by the Mine Safety and Health Adminstration (MSHA) and NOISH Test procedures are described in 30 CFR 11.

8.0 EQUIPMENT SELECTION AND ISSUANCE

Selection and issuance of the proper respirator for the protection required shall be made in accordance with General Industry Safety Orders, 29 CFR 1910.134 sections "a through g" inclusive, and the American National Standards (ANSI) standard, Practices for Respiratory Protection (Z88.2-1969). An industrial hygienist should be consulted in each instance where there is a concern over the adequacy or proper type of respiratory protection to use to protect against a particular contaminant.

The user shall be instructed in the need, use, sanitary care, and limitations of the equipment to be issued. Every respirator wearer shall be instructed in how to check the facepiece for proper fit and shall have the opportunity to wear the respirator in normal air, and to wear it in a test atmosphere generated by isoamyl acetate (banana oil) to qualitatively test for equipment facial fit.

Respiratory equipment will be issued on an individual basis and respiratory protective devices shall not be exchanged or loaned among users Any equipment returned or turned in after the intended use will be cleaned and sanitized after use and before reissue

Any equipment that shows wear or deterioration will be replaced or repaired. Users are instructed on proper storage of equipment to protect their respirator from dust, sunlight, extremes in temperature, excessive moisture, damaging chemicals, or workplace contaminants

9.0 USE OF RESPIRATORY PROTECTION DEVICES TO CONTROL HAZARDOUS SUBSTANCE EXPOSURE

9 1 Procedure

Prior to assignment of an employee to tasks requiring the use of a respiratory protection device, a physician shall determine that the user is physically able to perform the work and use the respiratory protection equipment. The supervisor will request at the time of hire or assignment to activities requiring the possible use of respiratory protection that each individual potentially requiring respiratory equipment be medically certified or recertified. The HSO will arrange for a pulmonary function test to be conducted at Doctor's Neighborhood Care Center or an equivalent medical facility The HSO will then notify the potential user of his/her appointment. The physician is to determine that health and physical conditions are pertinent. Prior to the issuance of respiratory protection equipment, the completed Medical Restrictions and Limitations Report from the physician must be completed and on file with the HSO The pulmonary fitness exams will be conducted annually for all ATI employees who are required to wear respiratory protection in the course of their job tasks

Upon receipt of the medical clearance, the HSO will issue the appropriate equipment

The user shall be instructed and trained as to the need to wear the protective device, the protection the device will provide, its limitations, and proper fitting

The user of the respiratory protection device will be advised that he/she may leave the area any time for relief from the use of the device in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions or any other condition that might require such relief

When respiratory protection equipment is used, provisions must be made for adequate skin protection.

Provisions must be made by the Project Manager or HSO for visual surveillance of, and communication with, the worker wearing atmosphere supplying respiratory protection equipment

In the instances where atmosphere supplied respiratory protective devices must be used, only certified breathable air will be acceptable. Special quick disconnects designed exclusively for breathable air will be the only kind of fittings allowed.

REFERENCES

29 CFR 1910.134, and Cal/OSHA Title 8, Section 5144

APPENDIX E

Contractual Agreement with and Statement of Qualifications of our Medical Consultant

The Contractual Agreement with and Statement of Qualifications of our Medical consultant is maintained on file with the Corporate Health and Safety Officer

APPENDIX F

List and Location of Available Safety References and Material Safety Data Sheets

List and Location of Safety References at A.T.I.

The following safety references will be found in the safety officers office:

1. Current issue of 29 CFR PARTS 1900 TO 1910 (1901.1 TO 1910.441)

2. Prudent Practices for Handling Hazardous Chemicals in Laboratories

3. Prudent Practices for Disposal of Hazardous Chemicals from Laboratories

4. American Red Cross Standard First Aid Workbook

5. American Red Cross Adult CPR Workbook

6. Managing Safety in the Chemical Laboratory

7. BBP Safety Management Handbook

8. UCSD Emergency Preparedness Program Coursebook

9. ACS Laboratory Health and Safety Coursebook

10. Safety Specialists, Inc. Emergency Response Coursebook

11. J.T. Baker Saf-t-Training Manual

12. Hazardous Waste Worker Training Manual (OSHA 1910.120)

13. The Health and Safety Officer also has a copy of Computer-Aided Management of Emergency Operations (CAMEO), which contains material safety and emergency response data for 2,629 chemicals, installed on his or her computer. Hard copies of Material Safety Data Sheets are maintained in the Health and Safety office. These MSDS's shall be kept as current as possible. OSHA requires only one set MSDS's in each Laboratory facility, this set must be kept updated as new chemicals come into the Laboratory. Here at ATI each individual Lab is to maintain a set of MSDS's for the commonly used chemicals in that particular Laboratory. This makes it easier for people to find MSDS's for the chemicals in their Laboratories.

APPENDIX G

Terms and Definitions

TERMS AND DEFINITIONS

The following is a list of acronyms and their definitions. The majority will not be found in the Chemical Hygiene Plan. They appear on this list for your benifit and use when dealing with chemicals, as well as to assist you when reading various publications around the Laboratory.

ACGIH American Conference of Governmental Industrial Hygienists.

ACS American Chemical Society.

AEA Atomic Energy Act of 1954

ANSI American National Standards Institute.

AQCR Air Quality Control Region.

ASTM American Society for Testing and Materials.

BLM Bureau of Land Management.

BOD Biochemical Oxygen Demand.

CAA Clean Air Act as amended in 1977

CAC Citizens Advisory Council.

CAS Chemical Abstract Service

CEQ Council on Environmental Quality.

CERCLA Comprehensive Environmental Response, Compensation and Liability Act (EPA).

CFR Code of Federal Regulations.

CIH Certified Industrial Hygienist.

CMA Chemical Manufacturers Association.

COD Chemical Oxygen Demand.

CPI Chemical Process Industries.

CWA Clean Water Act of 1977, FWPCA as amended.

DHS Designated Hazardous Substances.

DO Dissolved Oxygen

DOD Department of Defense

DOE	Department of Energy.
DOT	Department of Transportation.
ECSL	Environmental Compliance Schedule Letters.
EIA	Environmental Impact Assessment.
EPA	Environmental Protection Agency.
FDA	Food and Drug Administration.
FEPCA	Federal Environmental Pesticide Act.
FFDCA	Federal Food, Drug and Cosmetic Act.
FHSLA	Federal Hazardous Substance Labeling Act.
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act of 1972.
FR	Federal Register
FWPCA	Federal Water pollution Control Act of 1972.
GLC	Ground Level Concentration.
HEPA	High-Efficiency particulate air (filter).
HMTA	Hazardous Materials Transportation Act of 1973 (DOT).
HSWA	Hazardous & Solid Waste Amendment of 1984.
HWM	Hazardous Waste Management.
HWMF	Hazardous Waste Management Facility.
IARC	International Agency for Research on Cancer.
IDLH	Immediately dangerous to life and health.
IRPTC	International Register of Potentially Toxic Chemicals.
LD	Lethal Dose
NAAQS	National Ambient Air Quality Standard.
NCI	National Cancer Institute
NEA	National Energy Act.
NEPA	National environmental Policy Act.
NFPA	National Fire Protective Association.
NIEHS	National Institute of Environmental Health Sciences.

NIOSH	National Institute for Occupational Safety and Health.
NRC	Nuclear Regulatory Commission.
NRT	National Response Team.
OPP	Office of Pesticide Programs (EPA).
OSHA	Occupational Safety and Health Administration.
OSHACT	Occupational Safety and Health Act.
OSW	Office of Solid Waste (EPA).
PAC	Public Advisory Committee.
PEL	Permissible Exposure Limits.
PPC	Preparedness, Prevention and Contingency.
QA	Quality Assurance.
RCC	Resource Conservation Committee.
RCRA	Resource Conservation and Recovery Act.
RQ	Reportable Quantity.
SARA	Superfund Amendments and Reauthorization Act of 1986.
SARA/ TITLE III	Emergency Planing & Community Right-to-Know.
SDWA	Safe Drinking Water Act.
SIC	Standard Industrial Classification.
SRM	Standard Reference Material.
SS	Suspended Solids.
STEL	Short Term Exposure Limits
SWA	Solid waste Administration
TA	Technical Assistance-aid given to states and localities by EPA.
TAC	Technical Advisory Committee.
TDS	Total Dissolved Solids.
TLV	Treshold Limit Value.
TS	Total Solids.

TSCA Toxic Substances Control Act (EPA).

TSDF Treatment, Storage, Disposal Facility.

TSS Total Suspended Solids.

UNEP United National Environment Program.

WHO World Health Organization.

WRC Waste Resources Council.

The following is a list of some general terms and their definitions. Some of these terms appear frequently in the Chemical Hygiene Plan. Others are listed for your use, and assistance when reading other publications around the Lab.

LD_{50} - Is defined as the quantity of material that, when ingested or applied to the skin in a single dose, will cause the death of 50% of the test animals. It is expressed in grams or milligrams per kilogram of body weight.

LC_{50} - The concentration in air that causes death of 50% of the test animals: The test animal and the test conditions should be specified; the value is expressed in mg/liter, mg/m^3, or ppm

ALC - The approximate lethal concentration in air for experimental animals: The test animal and the test condition should be Specified; the value is expressed in mg/liter, mg/m^3, or ppm.

STEL - Is the maximum concentration to which workers can be exposed for periods up to 15 minutes. Such expolures should be limited to no more than four per day with periods of at least 60 minutes eace between exposures; the total time-weighted exposure per day should not exceed the TLV value.

TLV-TWA Time-weighted average concentration for a normal 8-hour workday to which nearly all workers may be repeatedly exposed without adverse effect.

PEL - Permissible exposure limits for the workplace, set by regulation and enforced by OSHA; most of these limit values were originally set, by consensus, by the ACGIH to assist industrial hygienists in implementing exposure control programs. As law, these are listed in 29 CFR 1910.1000 and subject to revision through the regulatory process.

CARCINOGENIC - Causing malignant (cancerous) tumors (OSHA, NIOSH, and FDA consider any tumor to be either a cancer or a precursor of a cancer).

ONCOGENIC - Causing tumors

TUMORIGENIC - Causing tumors

MUTAGENIC - Causing a heritable change in the gene structure.

EMBRYOTOXIC - Poisonous to an embryo (without necessarily poisoning the mother).

TERATOGENIC - Producing a malformation of the embryo.

HUMAN CARCINOGEN - A substance that has been shown by valid, statistically significant experimental evidence to induce cancer in animals.

EXPERIMENTAL CARCINOGEN - A substance that has been shown by valid, statistically significant experimental evidence to induce cancer in animals.

APPENDIX B

Quality Assurance Addendum for the
Solvent Extraction Bench-scale Treatability Study Work Plan

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Table 5-1 Solvent Extraction Treatability Study Analytical and Data Quality Requirements

APPENDIX B
QUALITY ASSURANCE PROJECT PLAN

1.0 PURPOSE

The purpose of this Quality Assurance Addendum (QAA) is to identify quality assurance (QA) requirements, as well as specific measures for implementing these requirements, that are applicable to the bench-scale treatability study to be performed by Resources Conservation Company (RCC) in support of remedial activities at Rocky Flats Plant (RFP). RCC's bench-scale treatability study will specifically evaluate solvent extraction with triethylamine as a remediation technology for soil and vegetation at RFP This QAA is intended to supplement the "Rocky Flats Plant Site-wide Quality Assurance Project Plan for CERCLA Remedial Investigation/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities" (referred to as the RFP Site-wide QAPjP, or simply QAPjP) As a supplement to the QAPjP, this QAA establishes the specific measures and QA controls applicable to the actions described in the Solvent Extraction Bench-scale Treatability Study Work Plan (Work Plan). These QA measures and controls are designed to support the overall objective of the solvent extraction treatability study, which is to assess the ability of solvent extraction to remove the contaminants of concern (COCs), including plutonium (Pu), uranium (U), and americium (Am) from RFP soil and vegetation to below established treatability study benchmarks (TSBs)

2.0 SCOPE

This QAA addresses all QA affecting activities described in the Work Plan to be performed by EG&G Rocky Flats and its subcontractors for this task, which include RCC and Analytical Technologies, Inc. (ATI) This QAA applies to the following major treatability study activities as described in the Work Plan.

- Feed sample preparation
- Phase I and Phase II solvent extraction testing of RFP soil and vegetation
- Sample collection and analysis
- Data analysis and interpretation
- Data management and reporting

3.0 BASIS FOR TECHNICAL ACTIVITY

This work indirectly supports legally binding requirements stated in the Interagency Agreement (IAG) regarding mitigation and/or remediation of contamination at RFP, especially soil within Operable Unit (OU) 2 and potentially OU 9 The work specifically supports Task 2 of the EM-50 funded "Technical Task Plan (TTP) for Plutonium in Soils Integrated Demonstration Sampling Support."

4.0 BASIS FOR QUALITY ASSURANCE REQUIREMENTS

The QAPjP was prepared to identify the QA requirements and methods applicable to the RFP Environmental Restoration (ER) Program activities, as identified in the Attachment 2 of the IAG Statement of Work. Section IV.A of the IAG Statement of Work specifies the minimum quality elements that the QAPjP must include, and references U S. Environmental Protection Agency (EPA) QAMS/005/80, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, for guidance in preparing the QAPjP.

5.0 QUALITY REQUIREMENTS

5.1 Organization and Responsibilities

Figure 13-1 of the Work Plan presents an organization chart identifying personnel responsible for the solvent extraction bench-scale treatability study The solvent extraction bench-scale treatability study has been structured such that those who have been assigned with performing the work are responsible for its quality, and conformance to quality requirements is verified by individuals and groups not directly responsible for performing the work. The EG&G Rocky Flats Environmental Restoration Management (ERM) organization, specifically the Environmental Science and Engineering (ES&E) department, is responsible for managing and coordinating the EG&G Rocky Flats resources dedicated to the project The roles and responsibilities of principal EG&G Rocky Flats personnel for this project are summarized as follows

RFO Technical Program Officer -	Provide contract oversight for RFO and update DOE/RFO on the progress of the project Provide a communication link between the Agencies (Colorado Department of Health [CDH] and EPA) and EG&G
EG&G Technical Program Manager -	Provide contract oversight to monitor the progress of the project for EG&G Provide a communication link with DOE/RFO Technical Program Officer and the EG&G Technical Project Manager
EG&G Technical Project Manager -	Provide technical oversight of the test work to monitor progress and quality Facilitate procurement actions within EG&G and RFO. Ensure that budgetary and schedule constraints are followed

Principal personnel and responsibilities of EG&G's subcontractors for the solvent extraction treatability study are presented in Section 13 0 of the Work Plan

5.2 Quality Assurance Program

The QA program established in the QAPjP is generally applicable to the solvent extraction treatability tests, unless other standard procedures addressing specific QA requirements are referenced in this QAA Where sitewide administrative and process controls are directly applicable to the testing program, the applicable section of the QAPjP is referenced in this QAA Additional study-specific standard procedures established by EG&G and its contractors that are applicable to the solvent extraction treatability testing (that may not have been addressed on a sitewide basis in the QAPjP) are also referenced in this QAA. Many of these experimental and quality process controls specific to the solvent extraction testing are addressed in the Work Plan.

The ERM Environmental Quality Support Division (EQS) is responsible for providing internal quality implementation support (including inspections and surveillance of system acceptance and performance) to assure that the quality requirements of this QAA and the QAPjP are being implemented EG&G shall also identify any RFP area-specific and/or specialized training requirements that are applicable to project personnel. Job-specific training will include theory of operations, system components, principles of operations, system interrelationships, protective devices, and practical factors. Training will also include any standard operating procedures of EG&G or its subcontractors that are specifically identified as applicable to the solvent extraction treatability study. These procedures include the solvent extraction bench-scale testing procedures described in Section 4.0 of the Work Plan, the safety and sample hygiene protocols defined in Attachment 5 of Appendix A, and the analytical and QA standard procedures defined in this QAA

Training and qualification records must be maintained by project personnel to document that they are qualified to perform their assigned tasks RCC and ATI procedures and documents should be available for review by ERM EQS and/or DOE at any time

5.3 Design Control and Control of Scientific Investigations

The QAPjP considers activities that generate analytical data, which require collection and analysis of environmental samples, to be scientific investigations. Controls for scientific investigations include developing data quality objectives, collecting and analyzing samples according to approved procedures,

establishing and implementing quality controls, and reducing and reporting data in a controlled manner.

Established procedures shall be used for gathering samples in the field and subsequent testing in the laboratory(s) When deviations from the operations procedures occur, or when new or nonstandard procedures are implemented, a Scientific Notebook System (SNS) will be used as the primary means of documenting quality-affecting information.

Data quality objectives (DQOs) quantitatively and qualitatively describe the uncertainty that decision makers are willing to accept in results derived from environmental data. This uncertainty is used to specify the quality of the data required to meet the objectives of the investigations. The process for developing DQOs for remedial investigations is summarized in Appendix A of the QAPjP. The development and description of specific DQO's for the solvent extraction bench-scale treatability study are included in Sections 5 12 and 5.13

Precision, accuracy, representativeness, completeness, and comparability (referred to as PARCC parameters) are fundamental parameters used to indicate data quality These parameters are defined below·

- Precision - a measure of mutual agreement among individual measurements of the same quantity under the same conditions

- Accuracy - the degree of agreement of a measured quantity with an accepted reference or true value

- Representativeness - the selection of analytical methods and sampling protocols such that results are representative of the media being sampled and the conditions being measured at the time of sampling

- Completeness - the amount of valid data obtained form a measurement system compared to the amount that was expected and needed to meet the project data goals

- Comparability - the degree of confidence with which one result or data set can be compared to another

The precision and accuracy of an analytical result are dependent on the analyte of interest, the sample matrix, analytical method, and the quality control (QC) procedures applicable to the method of analysis. Precision and accuracy of the analytical results will be quantitatively assessed in the final report, and the methods and criteria for assessing these parameters will be documented. Data completeness will also be quantitatively assessed and documented for the final report.

Comparability and representativeness are qualitative parameters that are ensured through careful development of and adherence to sampling and analysis plans and procedures. Deviations from established sampling and analysis protocols defined by the Work Plan and the QAA, and potential impacts to data quality, shall be documented in the SNS Samples sent to the laboratory for treatability testing shall represent physical and chemical characteristics of the soil and vegetation to be potentially remediated. For comparability purposes, similarities and differences between the tests for the different operating parameters and media tested must be discussed in the final report, as they pertain to interpretations of the test results.

A more detailed description of the PARCC parameters, and of specific PARCC protocols and requirements for the solvent extraction bench-scale treatability study, is included in Section 5.12.

5.4 Document Control

Documents produced by EG&G that control the work described in this Work Plan shall be controlled to ensure that key project personnel receive accurate and up-to-date information. Such documents shall be controlled per EG&G Procedure 3-21000-ADM-5 01, "Document Control."

5.5 Control of Purchased Items and Services

Procurement of items or services for this project shall be performed in accordance with the requirements of Section 7 0 of the QAPjP and ER Administrative Procedure ADM-4 01, "Procurement

Document Control," including retention of purchase order receipts, contracts, or any other documentation related to the integrity traceability of the purchased product or service.

5.6 Inspection and Assessment

Quality affecting activities are subject to QA assessments and inspections. These assessments will be performed formally, in accordance with EG&G procedures (e g., 3-21 000-ADM-1 0.01 and/or - ADM18 02), or informally, as requested by EG&G project management The work place and working records shall be accessible during normal working hours for verification or for ERM internal assessments and inspections by
EG&G or their representatives during the performance of this project Any nonconformances identified during formal QA assessments shall be documented using nonconformance reports. Independent audits of the project may be conducted by the Standard Audits and Assurance (SAA) organization in accordance with SAA procedures.

Internal assessments and inspections shall be performed by the EG&G Technical Program Manager or designee. These audits will be performed at a frequency deemed appropriate by EG&G Additionally, ERM EQS shall review and approve QA elements specific to this task

5.7 Sampling Procedures and Custody

A sample chain of custody (COC) will be initiated by EG&G at the time the samples are collected and prepared. This COC will be maintained through all transfers of custody until the sample is received at ATI and shipped back to EG&G for disposal. Procedure 5-21000-OPS FO 13 provides instructions for preparing COC forms and defines the procedures addressing sample containers, storage, handling, packaging, and shipping of samples collected at RFP Exceptions to the container requirements of Procedure 5-21000-OPS FO 13 will be allowed for the shipment of bulk feed soil and vegetation samples from EG&G to ATI These samples will be shipped in 5-gallon plastic drums.

Samples shall be logged in upon receipt at ATI, and sample tracking throughout the testing and analytical process shall be maintained in accordance with Section 6 0 of the Work Plan.

5.8 Measuring and Test Equipment

Measuring and test equipment (M&TE) used in the preparation, inspection, and performance of the bench-scale solvent extraction tests shall be selected, identified, calibrated, maintained, and documented in accordance with the methods established in RFP Administrative Procedure 1-50000-ADM-1 2 01, Control of Measuring and Test Equipment. The M&TE requirements of Section 12 0 of the QAPjP also will be implemented as appropriate through procedures specific to project sampling/analysis events, M&TE manufacturers instructions, and specific laboratory procedures.

5.9 Control of Nonconformances

Items, samples, and data that do not conform to specifications and/or requirements shall be identified, controlled, evaluated, and documented in accordance with approved procedures. Nonconformances related to the design, construction/installation, or testing of the testing system, and any waste-related nonconformance, shall be controlled in accordance with RFP Procedure 1-50000-ADM-15.01, "Control of Nonconforming Items, Samples, and Data."

5.10 Corrective Action

Significant conditions adverse to quality identified by RCC or ATI will be documented and submitted to ERM for evaluation Significant conditions adverse to quality and any corrective actions shall be identified, reported, closed out, and documented in accordance with RFP Procedures 1-50000-16 16, "Corrective Action Program."

5.11 Quality Assurance Records

Project records that are considered ERM QA records include the final report (including all appendixes), planning documents, procurement documents, construction installation records, supplier/subcontractor evaluations, inspection records, test records, logbooks, sampling records, sample COCs, analytical data packages, nonconformance reports, corrective action reports, audit reports, surveillance reports, self-assessment reports, personnel training and qualification records, the QAPjP, any administrative and control procedures referenced herein, and any other project records that are used to support observations and

conclusions in the final report. ERM QA records generated shall be submitted to the ERM Records Center for processing according to ERM Procedures 3-21000-ADM-17 01 and 3-21000-ADM-17 02.

5.12 Data Quality Objectives

The primary objective of this treatability study is to evaluate the ability of the B E.S T solvent extraction system using triethylamine to remove the COCs from contaminated RFP soil and vegetation. QA objectives have been developed to produce data that can be used to evaluate the effectiveness of this technology. The following sections discuss topics directly related to the QA objectives including· (1) data quality requirements based on PARCC parameters and (2) methods of assessing and assuring attainment of objectives for PARCC parameters.

5.12.1 Data Quality Requirements

Specific DQO's are defined below for the solvent extraction bench-scale treatability in a manner consistent with the QAPjP The intended data user and data types are summarized initially, after which specific data quality needs and requirements are defined to support the data use and data type objectives.

Data Uses

Data generated during the solvent extraction treatability study will be used for the following·

- Assessment of whether the technology extracts COCs from RFP soil and vegetation to less than the TSBs shown in Table 3-1 of the Work Plan.
- Identification and confirmation of optimized operating parameters (i e., number of extraction cycles, temperature, pretreatment requirements) for removing COC's from contaminated RFP soil and vegetation by solvent extraction with triethylamine.
- Calculation of Pu and material mass balance for each of the solvent extraction tests performed

Data Types

- Feed sample preparation data for soil and vegetation

- Test performance and observation data for Phase I optimization testing
- Test performance and observation data for Phase II verification testing
- Test sample analytical results

Data Quality Needs

- Sampling Requirements:
  - o Feed sample analytical levels: To adequately assess the removal efficiency of the solvent extraction process, the soil and vegetation to be tested should have an initial total activity of between 1 and 2 nanocuries per gram (nCi/g)
  - o Treatability contaminants of concern. Plutonium, uranium, americium.
  - o Additional analytes of interest. Gross α/β, Gross γ, oil and grease, pH, total solids.
  - o Sample size:
    - At a minimum, a 6-kilogram (kg) total bulk feed sample for each medium tested, after preparation as described in Section 4.0 of the Work Plan
    - At a minimum, a 1-kg aliquot of feed sample required for each test
    - At a minimum, 20-gram (g) sample for laboratory analysis of soil/solid test samples
  - o Critical analytical samples: Feed samples, treated solid samples, waste concentrates
  - o Additional analytical samples: Extracts, centrifuge solids, treated solids, recovered solvent
- Analytical method requirements and PARCC parameter requirements for all treatability test samples are shown in Table 5-1.

Table 5-1. Solvent Extraction Treatability Study Analytical and Data Quality Requirements

Measurement	Method[a]	Measurement Unit	Practical Quantitation Limit Requirements[b]	Precision Requirements (RPD)[c]	Accuracy Requirements (% Recovery)	Completeness Requirements (%)
Radionuclides						
Plutonium 238, 239, 240	U S A.C Reg Guide 45[d]	pCi/g or pCi/l	3 65	30	80 to 120	90
Americium 241	U S A.C Reg Guide 45[d]	pCi/g or pCi/l	2 38	30	80 to 120	90
Uranium (total)	RFP 4-16200-RHL-0013[e]	pCi/g or pCi/l	144	30	80 to 120	90
Gross α	EPA-600/4-80-032[f]	pCi/g or pCi/l	5 0	30	80 to 120	90
Gross β	EPA-600/4-80-032[f]	pCi/g or pCi/l	50 0	30	80 to 120	90
Gamma Spect	EPA-600/4-80-032[g]	pCi/g or pCi/l	-	30	80 to 120	90
Misc. Parameters						
Oil and grease	RCC[h]	mg/g or mg/l	-	50	50 to 150	90
Total solids	SW846-3550[i]	%	-	20	80 to 120	90
pH	SW846-9040 or 9045	pH units	-	-	-	90

Notes·

[a] Unless otherwise noted, methods used will be ATI standard operating procedures based on the methods listed below

[b] Practical quantitation limit requirements are for soil/solid analyses only and are based on treatability study benchmarks.

[c] RPD = Relative percent difference

[d] U S A C. Reg. Guide 45, "Measurement of Radionuclides in the Environment-Radiochemical Analysis of Plutonium in Soil " This method has been adapted by ATI for both soil/solid and water analyses.

[e] "Analysis of Uranium in Soil," Rocky Flats 4-16200-RHL-0013, Rev 01. This method has been adapted by ATI for both soil/solid and water analyses

[f] "Prescribed Procedures for Measurement of Radioactivity of Drinking Waters," Method 900.0, August 1980. This method has been adapted by ATI for both soil/solid and water analyses

[g] Prescribed Procedures for Measurement of Radioactivity of Drinking Waters, Method 901 1, August 1980. This method has been adapted by ATI for both soil/solid and water analyses.

[h] Oil and grease analysis will be performed according to an RCC SOP that requires a 16-hour soxhlet extraction with methylene chloride.

[i] Method 3550, SW-846, 3rd. Ed., September 1986, Section 7.2.

5.12.2 Procedures for Evaluating PARCC Parameters

5.12.2.1 Precision

As noted in Section 5.3, precision is the degree of mutual agreement among individual measurements of the same property under prescribed similar conditions. Precision is evaluated by collecting and analyzing laboratory replicate samples and/or spiked replicate samples.

For the measurements of both radiochemical and nonradiochemical parameters in solids and liquids, precision will be assessed for this project by analysis of laboratory duplicate samples and calculating the relative percent difference (RPD). RPDs of spiked replicate samples, such as matrix spike/matrix spike duplicates (MS/MSDs), may also be used to evaluate precision if these QC samples are required by the specific analytical method used RPD is calculated using Equation 5-1:

$$\% \text{ RPD} = \frac{|A - B|}{(A + B)/2} \times 100\ \% \qquad (5\text{-}1)$$

where

% RPD = relative percent difference
A = first replicate concentration
B = second replicate concentration

5.12.2.2 Accuracy

Accuracy is the degree of agreement between an analytical measurement and a reference accepted as true value The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, handling, sample matrix, sample preparation, and analytical techniques. Accuracy is

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evaluated through the use of standard reference materials (SRMs), blank spike samples (i.e., laboratory control samples [LCS]), MS/MSDs (if required for the analytical method), calibration standards, sampling and test equipment rinsate blanks, bottle rinsate samples, and laboratory blanks.

Accuracy for this project will be estimated by comparing the true to the measured analyte concentration from method-specified reference or spike samples using Equation 5-2.

$$\text{Accuracy} = \frac{MSC}{TAC} \times 100 \qquad (5\text{-}2)$$

where

MSC = measured concentration in the QC check sample
TAC = true analyte concentration in the QC check sample

In addition, blank data will be reviewed to assess whether any target analytes of interest are detected above method reporting limits. If detections are observed, the potential effects of processing and/or analytical activities on the accuracy of the reported test results will be evaluated.

5.12.2.3 Representativeness

For this project, representativeness involves sample selection, sample size, sample volume, sampling times, and sampling procedures. The QA goal is to consistently obtain samples in a manner such that they represent the various process matrices at the time that the samples were collected. Sufficient sample volume will also be collected to allow representative analyses to occur according to the requirements of the analytical methods, allowing for QC sample analyses and reanalysis, if needed.

Representative sampling of bulk soil and vegetation for radionuclide analyses is difficult to achieve without some pretreatment by physical methods Reproducibility of analytical methods is also complicated by heterogeneities in these matrices To minimize this experimental difficulty and maximize the information yielded by each solvent extraction test, RFP test soil and vegetation will be processed and homogenized as described in Section 4 0 of the Work Plan before bench-scale testing begins. As with previous studies (where Pu is associated with a particular size fraction in the RFP soil), sample fractions will be selected for bench-scale testing to optimize (1) experimental logistics and performance, (2) sampling and analytical reproducibility, and (3) the applicability of the tests to site conditions at RFP

The following aspects of the sampling design will also contribute to the representativeness of the treatability study data:

- An aliquot of the feed sample used in each individual Phase I and Phase II test will be collected and analyzed for direct comparison to the process stream and sidestream samples from that test.
- All major media processed, generated, and recovered from each test, including partially treated matrices (i.e., interstage samples) and sidestreams, will be sampled and analyzed to allow complete tracking of contaminants and the calculation of material and contaminant mass balance.
- Blending and compositing protocols for the collection of analytical samples, as described in Section 4 0 of the Work Plan, will minimize the effects of sample inhomogeneity on the reported results.

Additionally, the phased approach of the study will allow the most successful tests to be run in duplicate to assure representativeness and reproducibility

5.12.2.4 Completeness

As noted in Section 5 3, completeness is a measure of the percentage of project-specified data that are valid. Data collected during the solvent extraction treatability study will be considered valid if (1) samples are collected in accordance with the EMD Manual Operations Procedure, "Environmental Sample Radioactivity Content Screening," (5-21 000-OPS-FO.1 8, Rev. 1) and (2) the data are assessed by data users to be acceptable relative to the precision, accuracy, and representativeness goals of the program. The project completeness value will be calculated by dividing the number of valid sample results by the total number of sample analyses completed for this treatability study as shown in Equation 5-3.

$$\% C = \frac{V}{T} \times 100 \qquad (5\text{-}3)$$

where:

%C	= percent completeness
V	= number of measurements judged valid
T	= total number of measurements

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5.12.2.5 Comparability

The comparability of the data will be maintained though the consistent application of the detailed testing and sampling procedures outlined in the Work Plan, and of the laboratory standard operating procedures for sample analysis that are based on the standard analytical methods referenced in Table 5.1. Deviations from these procedures for testing, sampling, and analysis will be documented, and the analytical results will be reported in standard units as shown in Table 5-1. Laboratory instrumentation will be calibrated with standards traceable to the National Institute for Standards and Technology (NIST) or other EPA-approved sources

5.13 Internal Quality Control Checks

An internal QC system is a set of routine internal procedures for verifying that the data output of a measurement system meets prescribed criteria for data quality. This system contains methods for measuring and defining the quality of the data output. ATI personnel performing the laboratory analyses will use the following internal analytical laboratory QC measures, where appropriate, to verify that the precision and accuracy objectives are met. The control limits for the PARCC parameters are listed in Section 5 12. When these limits are exceeded, the project managers will be contacted.

The following sections summarize internal QC requirements for specific analytical parameters. QC checks will include laboratory QC and test QC.

5.13.1 Laboratory Quality Control

5.13.1.1 Radiochemistry Analyses

The QC checks to be performed in the laboratory for radiochemistry analyses consist of Standard Reference Materials (SRMs) (i e., calibration verification), LCSs, replicate analyses, laboratory blank analyses, calculation of MDAs, chemical recovery, and aliquot size.

5.13.1.1.1 Standard Reference Materials

SRMs shall be analyzed for all radiochemistry methods in accordance with the following requirements:

- SRMs shall consist of water, soil, or other test matrices as necessary, spiked with an NIST-traceable or EPA-prepared radionuclide of concern at an activity concentration sufficiently above the detection limit to give statistically valid results.
- SRMs shall be analyzed at a frequency of 5 percent, or one per batch, whichever is more frequent.
- SRM results shall meet precision and accuracy criteria listed in Table 5-1 or in ATI's method standard operating procedures, whichever are more stringent
- Failure of an SRM analysis to meet project or laboratory QA criteria shall result in reanalysis of the SRM.
- Repeated failure of an SRM analysis to meet project or laboratory QA criteria shall result in recalibration of the instrument before sample analysis is resumed.

5.13.1.1.2 Laboratory Control Samples

LCSs shall be analyzed in accordance with ATI standard operating procedures for Pu, U, Am, and gross α/β LCS analyses shall meet the following criteria

- LCSs shall be analyzed at a frequency of 5 percent per batch.
  LCSs shall be prepared and analyzed in the same manner as the samples.
- LCSs shall have the same aliquot size as the samples.
- LCSs shall have the same TSBs the samples.
- Using the Overall Counting Uncertainty, the observed value of the LCSs for alpha spectrometry parameters shall be within 1σ control limits of the expected LCS value and have a relative percent error that does not exceed 50 percent
- LCSs shall be counted for the same count durations as the samples.
- LCS data shall be submitted with each data package and shall include the expected values for all isotopes for which the samples are being analyzed.
- A spiked deionized water matrix or reagent sand matrix may be used as an LCS for liquid and solid matrices, respectively

5.13.1.1.3 Replicate Analyses

Replicate analyses shall be analyzed for all radiochemistry methods in accordance with the following requirements:

- Replicate analyses shall be analyzed at a frequency of 10 percent or one per batch, whichever is more frequent.
- Replicate samples shall be prepared and analyzed in the same manner as the samples.
- Replicate samples shall have the same aliquot size as the samples.
- Replicate samples shall have the same TSBs as the samples.
- Replicate analyses data shall be submitted with each data package
- The replicate analyses shall be within the 3σ range of the weighted average and its associated standard error. "Hot" particles may be present in solid matrices and unfiltered liquids and this will be taken into consideration when evaluating duplicates.

5.13.1.1.4 Laboratory Blank Analyses

Laboratory blanks shall be analyzed for all radiochemistry parameters in accordance with the following requirements:

- Laboratory blanks shall be analyzed at a frequency of 5 percent or one per batch, whichever is more frequent.
- Laboratory blanks shall be prepared and analyzed in the same manner as the samples.
- Laboratory blanks shall have the same aliquot size as the samples.
- Laboratory blanks shall be counted for the same count duration as the samples.
- Deionized water, reagent sand, or other standard matrices may be used as a laboratory blank for the samples.
- Laboratory blanks should contain no target analytes above method reporting limits.
- If target analytes are detected in laboratory blanks, the laboratory should assess the source of cross-contamination and perform additional blank analyses. Identification of cross-contamination at the laboratory based on blank data shall result in the flagging of affected data and the notification of data users

5.13.1.1.5 Calculation of Minimum Detectable Activities

Minimum Detectable Activities (MDAs) shall be calculated using ATI data reduction algorithms for all radiochemistry analyses in accordance with the following requirements:

- Count durations for samples, replicates, blanks, and backgrounds shall be optimized so that the MDAs achieve the TSBs. Interfaces, contaminants, and other matrix problems may cause the sample MDAs to exceed the desired MDAs; however, the laboratory shall demonstrate that the MDA could not be met due to the matrix and not because of inadequate count time, laboratory problems, or other limitations. Reanalysis due to matrix problems will be treated as an additional sample analysis. In all cases, MDAs that fail to achieve the required TSBs shall be fully explained in the case narratives.
- The MDAs shall be reported on sample calculations sheet. The last background taken (one month old or less) shall be used for calculations
- The MDAs shall be calculated as shown in Equation 5-4:

$$MDA\ (pCi/Aliquot\ in\ appropriate\ units) = \frac{4.65\ S_B + \frac{2.71}{T*E*Y}}{a*Aliquot} \qquad (5\text{-}4)$$

where:

S_B	=	Standard deviation of the population of quarterly RFP blank values (DPM)
T	=	Sample count duration in minutes
E	=	Detector efficiency
Aliquot	=	Aliquot in appropriate units
Y	=	Chemical recovery for the sample
a	=	2.22 conversion for Dams to picocuries

5.13.1.1.6 Chemical Recovery

Chemical recoveries shall be calculated in accordance with ATI SOPs for Pu and Am analyses. Chemical recoveries shall meet the following criteria.

- Chemical recovery for Pu and Am analyses shall be greater than 20 percent but less than 105 percent. Chemical recoveries outside these limits require the affected samples to be reanalyzed.
- Chemical recovery shall be calculated on the basis of latest instrument efficiency value.

- Counts obtained for the tracer peak, Dams of tracer used, and aliquot of tracer used shall appear in the raw data.

5.13.1.1.7 Aliquot Size

The aliquot size shall be optimized to achieve the TSBs. If the TSBs are not achieved and the aliquot sizes are less than method requirements, then the problem shall be addressed in the case narrative accompanying the reported results.

5.13.1.2 Nonradiochemistry Analyses

Internal QC requirements for the miscellaneous additional analytical parameters listed in Table 5-1 are defined in the referenced EPA methods and laboratory standard operating procedures.

5.13.2 Test Quality Control

Test duplicate samples and extraction decontamination blanks will be collected as internal QC checks on the performance of the bench-scale solvent extraction tests. Project requirements for these QC checks are summarized below.

5.13.2.1 Test Duplicates

During Phase I of the solvent extraction treatability study, a minimum of one duplicate sample will be collected from each medium processed or generated during the soil and vegetation testing. These media will include feed solid samples, interstage solid samples, interstage water samples, interstage solvent samples, treated solid samples, waste concentrates, and recovered solvent. Duplicate samples will be collected at random by test personnel during the five Phase I optimization tests and submitted with the test samples for laboratory analysis. During Phase II confirmation tests, duplicates of the final treated samples will be collected for each soil and vegetation matrix tested.

Duplicate samples shall be collected concurrently with the associated test samples using the same sampling protocols (see Section 6.0 of the Work Plan), and shall be analyzed for the same list of analytical parameters.

Duplicate sampling frequency may be increased for a given sample matrix if initial duplicate results do not meet precision goals listed in Table 5 1.

5.13.2.2 Extraction Decontamination Blanks

Aqueous blanks will be collected by washing the decontaminated extractor with deionized water following the performance of a bench-scale test. During Phase I, these decontamination blanks will be collected, at a minimum, following each series of five optimization tests that is performed for each soil and vegetation matrix. During Phase II, decontamination blanks will be collected following each confirmation test. Decontamination blanks shall be analyzed for the radiochemical parameters listed in Table 5-1.