158957

Sauget Area 2
Site Q

Site Health and Safety Plan

CET ENVIRONMENTAL SERVICES, INC.

13120 Cardiere Court
New Orleans, LA

Certifies that

Billie Kilgore

Has successfully completed the
HazMat Eight Hour Emergency Response Refresher course
Complies with OSHA's 29 CFR 1910.120
and is hereby awarded this

Certificate

EXPIRES 09/09/2000

Training Coordinator

H & S Director

EQ RESPIRATOR QUALIFICATION CARD

NAME: Billie Killgore

DATE QUALIFIED: 2/22/00

EXPIRATION DATE: 2/22/01

TYPE RESPIRATOR	MODEL	SIZE
MSA	Full Face	Medium

CERTIFIED BY: [illegible]

ENVIRONMENTAL RESTORATION, LLC

1998 Certificate of Training

Presented To

JASON KEYS

For Completion of

Initial Training (40 hours) for Hazardous Waste Site Workers

in accordance with OSHA in 29 CFR 1910.120(c)

S98-003

Certificate #

JUNE 5, 1998

Date Awarded

Debbie Laramie

DEBBIE LARAMIE

Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

JASON KEYS

For Completion of

Annual Training (8 hours) for Hazardous Waste Site Workers

in accordance with OSHA in 29 CFR 1910.120(e)

S99-072

Certificate #

December 30, 1999

Date Awarded

Debbie Laramie

Debbie Laramie

Instructor

Concentra Medical Centers
83 Progress Parkway Maryland Heights, MO 63043
Phone: (314) 434-8174 Fax: (314) 434-8706

Non-Injury Status Report

Patient: Keys, Jason
SSN: 495-94-3677
Address: 633 Minnie Ave
DUPO, IL 62239
Home: (618) 288-4867
Work: (314) 227-7477 **Ext.:**

Employer Location: Environmental Restoration
Address: 16333 Westwoods Business
ELLISVILLE, MO 63021
Auth. by:

Contact: Mike Broderick
Role: Safety Manager
Phone: (314) 227-7477 **Ext.:**
Fax: ( ) -

This Visit:

Time In: 01:21 pm **Time Out:** 03:57 pm

HazMat Physical - Annual
- Respitator Fit-Quantative
- DOT Recertification
- Blood Lead
- Pulmonary Fun.Test W/Interp.
- U/A Micro
- Audiogram
- Metabolic Panel
- Hepatic Function
- CBC w/diff
- Lipid Panel
- GGT - Gamma Gluty! Transferase
- Hazardous Material Physical (HazMat)

Result Status:

Able to perform essential functions
No medical restrictions
Pending - Results

lab work results

Remarks:

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HEALTHLINE®

NAME: Joann Keys DATE: 10 / 27 / 99

SS#: 495-94-3677 SEX: M EXAM: 10-21-99

BIRTHDATE: 06 / 02 / 77 OC#: _____

PHYSICIAN'S WRITTEN OPINION REGARDING EMPLOYEE EXPOSED TO HAZARDOUS SUBSTANCES

1.0 Results of medical examination?

Satisfactory [✓] Unsatisfactory [ ]

2.0 Has employee any detected medical condition which would place employee at an increased risk due to exposure to hazardous substances?

Yes [ ] No [✓]

3.0 Are there recommended limitations on the employee's exposure to hazardous substances or on the use of protective clothing and equipment such as respirators?

Yes [ ] No [✓] (?) Adequate protection provided around lead

4.0 Has employee been informed by the physician of the results of the health examination?

Yes [ ] No [✓]

5.0 Are there medical conditions which require further examination or treatment?

Yes [ ] No [✓] (OK for workers)

Remarks: mildly elevated Blood lead compared to general Population signifying some exposure - not clinically significant ? adequate PPE utilization & work practices

DATE: 10 / 27 / 99 SIGNED: [illegible] M.D.
M. Warmington ANP

The written opinion has been reviewed and explained to me, and a copy provided.

DATE: ___/___/___ SIGNED: _____ EMPLOYEE

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

JASON KEYS

For Completion of
Fork Lift Safety and Operations Training
in accordance with 29 CFR 1910.178.

S99-059
Certificate #

December 30, 1999
Date Awarded

Debbie Laramie
Instructor

HealthLine®
CORPORATE HEALTH SERVICES METRO ST. LOUIS

☐ Center 1
1212 South Grand
St. Louis, Missouri 63104
(314) 577-8060
Fax (314) 776-2793

☒ Center 2
83 Progress Parkway
Maryland Heights, Missouri 63043
(314) 434-8174
Fax (314) 434-8706

☐ Center 3
2626 North Broadway
St. Louis, Missouri 63102
(314) 241-5804
Fax (314) 241-3558

☐ Center 4
801 Hazelwest Drive
Hazelwood, Missouri 63042
(314) 895-2811
Fax (314) 919-2710

☐ Center 5
1617 South 3rd Street
St. Louis, Missouri 63104
(314) 421-2557
Fax (314) 421-2046

☐ Center 6
1709 Gilsinn Lane
Fenton, Missouri 63026
(314) 349-6850
Fax (314) 343-6641

RESULTS OF MEDICAL EXAMINATION

PT/INJ/VST ID No. (293719#341)DETRICH, ADAM

Patient Name SSN#: 496-98-4775 D-O-B: 10/25/78 117700101B ENVIRONMENTAL RESTORATION DOB

Employer ID No. _____ Employer Name _____

Today's Date 6-1-99

☐ Drug Screen Only ☐ Alcohol Only ☐ Drug Screen and Alcohol

☒ Able ☐ Unable to perform job functions as described by:
- ☒ Employee
- ☐ Written job description

If "unable" is checked, the reason is:
- ☐ Delay in job placement pending:
  - ☐ Further tests to be ordered/information to be reviewed
  - ☐ JCA
  - ☐ Personal physician follow-up
  - ☐ Other
  - ☐ Patient has a medical condition not anticipated to interfere with described job functions
- ☒ Review of outstanding results
  - ☒ Lab
  - ☐ Drug screen
  - ☐ X-ray
- ☐ Unable to perform essential job functions safely

Recommended physical restrictions _____

☒ Based on the Medical Evaluation for fitness to wear respirator:
- ☒ No restrictions on respirator use
- ☐ Some specific use restrictions

Restrictions _____

☐ No respirator use permitted

Time in _____ Physician/Nurse Practitioner [signature] Date 6-1-99
Signature

Time out _____ Employee X [signature] Date 6-1-99
Signature

91071 (7/98)

FROM :ENVIRONMENTAL RESTORATION 314 227 7477 1900,01-24 15:08 #015 P.04/04

HealthLine®

CORPORATE HEALTH SERVICES METRO ST. LOUIS INC.

(293719*(*1) DETRICH, ADAM
SSN#: 496-98-4775 D-O-B: 12/25/78
1177001215 ENVIRONMENTAL RESTORATION

☐ Corporate Health Center I
1212 Smith Grand
St. Louis, Missouri 63104
(314) 577-0060

☒ Corporate Health Center II
83 Progress Parkway
Maryland Heights, Missouri 63043
(314) 434-0174

☐ Corporate Health Center III
2026 Broadway
St. Louis, Missouri 63102
(314) 241-5804

☐ Corporate Health Center IV
801 Hazelwest Drive
Hazelwood, Missouri 63042
(314) 895-2811

☐ Corporate Health Center V
1517 South 3rd Street
St. Louis, Missouri 63104
(314) 421-2557

☐ Corporate Health Center VI
1706 Gilsinn Lane
Fenton, Missouri 63026
(314) 349-6850

CERTIFICATE OF FITNESS / EXAM

Date: 7-1-98 Date of Injury: _____

☐ **FIT FOR FULL DUTY ON:** _____

☐ **UNABLE TO WORK - ESTIMATE TIME FOR RETURN TO WORK:** _____

☐ **FIT FOR RESTRICTED DUTY ON:** _____

Estimated Date for Full Duty: _____

Work Restrictions:* _____

☐ **DISCHARGED FROM TREATMENT ON:** _____ Return to see Doctor on: _____

☐ **DIAGNOSIS:** 1. _____

2. _____

☐ **COMMENTS:** _____

If suitable work restrictions cannot be provided, the employee should be off work and return as scheduled.

MEDICAL EXAMINATION

☒ Medically qualified for position

☐ Delay placement pending: ☐ Further tests/information ☐ Job evaluation ☐ Private physician follow-up

☒ May begin/continue work pending: ☒ Lab ☐ Drug screen ☒ X-ray results ☒ [illegible]

☒ May wear respiratory protection if clean shaven

☐ Work limitations identified – Description: _____

☐ Unable to perform essential functions of job safely

TIME IN _____ INITIALS _____ PHYSICIAN [signature] DATE 7-1-98

TIME OUT _____ EMPLOYEE SIGNATURE [signature] DATE 7-1-98

12953 (REV 8/96)

FROM : ENVIRONMENTAL RESTORATION 314 227 7477 1900.01-04 15:38 #019 P.03/04

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ADAM DETRICH

For Completion of

Annual Training (8 hours) for Hazardous Waste Site Workers

in accordance with OSHA in 29 CFR 1910.120(e)

S99-043

Certificate #

June 2, 1999

Date Awarded

Dennis Greaney

HEALTHLINE®

NAME: Adam Petrich DATE: 7 / 1 / 98

SS#: _____ SEX: _____ Environmental Restoration

BIRTHDATE: ___/___/___ LOC#: _____

PHYSICIAN'S WRITTEN OPINION REGARDING EMPLOYEE EXPOSED TO HAZARDOUS SUBSTANCES

1.0 Results of medical examination?

Satisfactory [X] Unsatisfactory [ ]

2.0 Has employee any detected medical condition which would place employee at an increased risk due to exposure to hazardous substances?

Yes [ ] No [X]

3.0 Are there recommended limitations on the employee's exposure to hazardous substances or on the use of protective clothing and equipment such as respirators?

Yes [X] No [ ]

4.0 Has employee been informed by the physician of the results of the health examination?

Yes [X] No [ ]

5.0 Are there medical conditions which require further examination or treatment?

Yes [X] No [ ]

Remarks: Avoid Bone marrow toxic substances (Benzene, Radiation etc) until Abnormal blood test is evaluated

DATE: 7 / 7 / 98 SIGNED: [signature] M.D.

The written opinion has been reviewed and explained to me, and a copy provided.

DATE: ___/___/___ SIGNED: _____ EMPLOYEE

APR 1 0 1991

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V
SITE SAFETY PLAN

Date: October 25, 1999

Project Name: Sauget Site Q
70 Cargill Elevator Road
Sauget, St. Clair County, Illinois 62206

ERRS Delivery Order #: 9801-05-047

ERRS Task Order Numbers: 35 (CERCLA)

START Technical Direction Document #: S05-9909-015

U.S. EPA Site I.D.#: CERCLA- 05XX

CERCLIS ID#ILD000605790

ERRS Job #: 3141-47

Adopted By: _____ Date: 10/29/99
ERRS Response Manager

Adopted By: _____ Date: 10/29/99
E & E Lead START Member

Adopted By: _____ Date: 11-3-99
U.S. EPA Federal On-Scene Coordinator

Adopted By: _____ Date: _____
ERRS Safety Manager

Adopted By: _____ Date: 11/5/99
E & E Safety Officer

Emergency and Enforcement Response Branch
Office of Superfund, U.S. EPA, Region V
OSC Report Standard Appendices List *

Site Name:

Site ID#:

Delivery Order #:

1. Operational Files	ID#
- Action Memos/Additional Funding	1-A
- POLREPs	1-B
- Site Entry/Exit Log	1-C
- Hot Zone Entry/Exit Log	1-D
- Site Safety Plan	1-E
- Equipment & Expendables Log	1-F
- Site Logs	1-G
- Site Computer Disks	1-H
- Daily Work Orders	1-I
- Site Monitoring Logs	1-J
- Site Maps	1-K
- Site Contacts/Business Cards	1-L
- Site Photos/Videos	1-M
- General Correspondence/Information	1-N
- Newspaper Articles	1-O
- Site Photos/Videos	1-P
- Enforcement	1-Q
- Other: _____	1-R

* ARRANGE ALL FILES IN CHRONOLOGICAL ORDER

* Portions of these OSC Report Appendices may contain confidential business information or enforcement-sensitive information and must be reviewed by the Office of Regional Counsel prior to release to the public.

* Note that certain files for this site are maintained elsewhere by EERB; these appendices are those files maintained by the OSC during the removal action.

Emergency and Enforcement Response Branch
Office of Superfund, U.S. EPA, Region V
OSC Report Standard Appendices List (cont'd)

2. Financial Files	ID#
- Delivery Orders	2-A
- START Technical Direction Documents	2-B
- Daily Cost Reporting US EPA Form 1900-55's	2-C
- ERCS Invoices	2-D
- RCMS Cost Estimates	2-E
- Subcontractor Bid Sheets	2-F
- START Cost Documentation	2-G
- Other: _____	2-H

3. Technical Files	ID#
- START Site Assessment	3A1
- Other Reports: _____	3A2
- Analytical Results/QA/QC	3-B
- Manifests	3-C
- Disposal Information	3-D
- Drum/Vat/Sample Logs	3-E
- Compatibility Results	3-F
- Chains of Custody	3-G
- Waste Profile Sheets	3-H
- Other: _____	3-I

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V
SITE SAFETY PLAN

Date: October 25, 1999

Project Name: Sauget Site Q
70 Cargill Elevator Road
Sauget, St. Clair County, Illinois 62206

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U.S. EPA Site I.D.#: CERCLA- 05XX

CERCLIS ID#ILD000605790

ERRS Job #: 3141-47

Adopted By: _____ Date: 10/29/99
ERRS Response Manager

Adopted By: _____ Date: 10/29/99
E & E Lead START Member

Adopted By: _____ Date: 11-3-99
U.S. EPA Federal On-Scene Coordinator

Adopted By: _____ Date: 11-17-99
ERRS Safety Manager

Adopted By: _____ Date: 11/5/99
E & E Safety Officer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V
SITE SAFETY PLAN

Date: October 25, 1999

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CERCLIS ID#ILD000605790

ERRS Job #: 3141-47

Adopted By: _____ Date: 10/29/99
ERRS Response Manager

Adopted By: _____ Date: 10/29/99
E & E Lead START Member

Adopted By: _____ Date: 11-3-99
U.S. EPA Federal On-Scene Coordinator

Adopted By: _____ Date: _____
ERRS Safety Manager

Adopted By: _____ Date: 11/5/99
E & E Safety Officer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V
SITE SAFETY PLAN

Date: October 25, 1999

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U.S. EPA Site I.D.#: CERCLA- 05XX

CERCLIS ID#ILD000605790

ERRS Job #: 3141-47

Adopted By: _____ Date: 10/29/99
ERRS Response Manager

Adopted By: _____ Date: 10/29/99
E & E Lead START Member

Adopted By: _____ Date: 1.3.99
U.S. EPA Federal On-Scene Coordinator

Adopted By: _____ Date: _____
ERRS Safety Manager

Adopted By: _____ Date: _____
E & E Safety Officer

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MANDATORY ATTACHMENTS

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- ATTACHMENT B SITE MAPS
- ATTACHMENT C CHEMICAL HAZARD INFORMATION
- ATTACHMENT D PERSONAL PROTECTION EQUIPMENT AND RESPIRATORY PROTECTION SOP'S
- ATTACHMENT E DRUG AND ALCOHOL PROCEDURES
- ATTACHMENT F ACCIDENT REPORTING/INVESTIGATION
- ATTACHMENT Z SITE SAFETY PLAN ACKNOWLEDGMENT FORM

OPTIONAL ATTACHMENTS

HAZARDS AND SOPS ASSOCIATED WITH:

G OSHA Guidance and Regulations
H Confined Space
I Drum Handling, Sampling, Opening Drums and Overpacks, and Drum Staging and Overpacking
J Drum Excavation
M Empty Drum Crushing
___ Drill Rig
N Site Walkthroughs/Entry
O Housekeeping and Material Storage
P Hazardous Waste Storage
Q Demolition
R Working Around Heavy Equipment
S General Heavy Equipment Operations
T Excavation
U Truck Loading
V Soil Sampling
W Liquid Sampling
X Compatibility Testing and Compositing of Samples
Y Lab Packing and Lab Inventory
AA Flammable/Combustible Liquid Transfer and Corrosive Liquid Transfer
CC Use of High Pressure Water Cleanup
___ Use of a High Pressure Water Cleaner in Vats
DD Compressed Gas Cylinders

EE	Heat Stress
FF	Cold Stress
GG	Electrical Safety
__	Traffic Control
HH	Fire Prevention and Protection
__	Work from Elevated Surfaces
__	Cranes
__	Rigging
II	Lockout/Tagout
JJ	Welding/Cutting/Grinding
KK	Asbestos Sampling, Air and Bulk
__	Safe Work Practices for Small Boats
__	Gas Welding and Cutting
PP	Real Time Particulate Sampling
QQ	Nuisance Dust

GLOSSARY OF ACRONYMS

ANSI	-	AMERICAN NATIONAL STANDARDS INSTITUTE
APR	-	AIR PURIFYING RESPIRATOR
ACGIH	-	AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS
ACM	-	ASBESTOS CONTAINING MATERIAL
CERCLA	-	COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT
CFR	-	CODE OF FEDERAL REGULATIONS
CGI	-	COMBUSTIBLE GAS INDICATOR
CLEAN ZONE	-	SUPPORT ZONE
CSEP	-	CONFINED SPACE ENTRY PERMIT
DECON	-	DECONTAMINATION
ER	-	ENVIRONMENTAL RESTORATION
ERRS	-	EMERGENCY RESPONSE CLEAN-UP SERVICES
EQM	-	ENVIRONMENTAL QUALITY MANAGEMENT
FOSC	-	FEDERAL ON-SCENE COORDINATOR (U.S. EPA)
FPN	-	FEDERAL PROJECT NUMBER
HNU-PID	-	HNU PHOTOIONIZATION DETECTOR
HOT ZONE	-	EXCLUSION ZONE
IAW	-	IN ACCORDANCE WITH
IDLH	-	IMMEDIATELY DANGEROUS TO LIFE & HEALTH
IEPA	-	ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
MREM/hr	-	MILLI-ROENTGENS EQUIVALENT IN MAN PER HOUR
NIOSH	-	NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY & HEALTH
OPA	-	OIL POLLUTION ACT
OSHA	-	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION LIMIT
OVA	-	ORGANIC VAPOR ANALYZER
PAPR	-	POWERED AIR PURIFYING RESPIRATORS
PEL	-	PERMISSIBLE EXPOSURE LIMIT
PPM	-	PARTS PER MILLION
PRCS	-	PERMIT REQUIRED CONFINED SPACE
RM	-	RESPONSE MANAGER
SCBA	-	SELF-CONTAINED BREATHING APPARATUS
SOP	-	STANDARD OPERATING PROCEDURE
SPCC	-	SPILL PREVENTION CONTROLS & COUNTERMEASURES
START	-	SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM
TLV	-	THRESHOLD LIMIT VALUE
TWA	-	TIME WEIGHTED AVERAGE
USCG	-	UNITED STATES COAST GUARD
U.S. EPA	-	U.S. ENVIRONMENTAL PROTECTION AGENCY

INTRODUCTION AND SITE ENTRY REQUIREMENTS

This document describes the health and safety guidelines developed for the **Sauget Site Q Landfill (Q)** site, to protect on-site personnel, visitors, and the public from physical harm and exposure to hazardous materials or wastes. The procedures and guidelines contained herein were based upon the best available information at the time of the plan's preparation. Specific requirements will be revised when new information is received or conditions change. A written amendment will document all changes made to the plan. Any amendments to this plan will be included in Attachment A. Where appropriate, specific OSHA standards or other guidance will be cited and applied.

All work practices and procedures implemented on site must be designated to minimize worker contact with hazardous materials and to reduce the possibility of physical injury. All work will be performed in accordance with applicable Federal 29 CFR 1910 and 1926 Health and Safety Regulations and the Federal 29 CFR 1910.120 Hazardous Waste Site Safety Regulations. The States of Indiana, Michigan, and Minnesota are State OSHA states and their regulations will be followed as applicable.

DAILY SAFETY MEETINGS

Daily safety meetings will be held at the start of each shift to ensure that all personnel understand site conditions and operating procedures, to ensure that personal protective equipment is being used correctly and to address worker health and safety concerns.

SITE SAFETY PLAN ACCEPTANCE ACKNOWLEDGMENT

The FOSC or designated representative shall be responsible for informing all individuals entering the exclusion zone or decontamination zone of the contents of this plan and ensuring that each person signs the Safety Plan Acknowledgment Form in Attachment Z. By signing the Safety Plan Acknowledgment Form, individuals are recognizing the potential hazards present on-site and the policies and procedures required to minimize exposure or adverse effects of these hazards.

1.0 SITE BACKGROUND AND SCOPE OF WORK

1.1 Roles and Responsibilities

On-Scene Coordinator (FOSC):

The FOSC, as the representative of the U.S. EPA, is responsible for overall project administration and for coordinating health and safety standards for all individuals on-site at all times. All U.S. EPA and contractors health and safety guidelines and requirements as well as all applicable OSHA standards shall be applied. The FOSC is the overall site safety officer and will be responsible for the health and safety of on-site visitors. However, each contractor (as an employer under OSHA) is also responsible for the health and safety of its employees. If there is any dispute with regards to health and safety, the following procedures shall be followed:

1) Attempt to resolve the issue on-site; and,
2) If the issue cannot be resolved, on-site personnel shall consult off-site health and safety personnel for assistance and the specific task operation, in dispute, shall be discontinued until the issue is resolved.

Response Manager (RM):

The RM, as the field representative for the ERRS clean-up contractor, has the responsibility for fulfilling the terms of the delivery order. The RM must oversee the project and ensure that all technical, regulatory, and safety requirements are met. It is the RM's responsibility to communicate with the FOSC as frequently as dictated by the FOSC, but at least daily, regarding site clean-up progress and any problems encountered. The following listing of work to be conducted and is not limited to the following. The RM will oversee the ERRS clean-up:

1. Excavated any contaminated soil on site that is considered hazardous.
2. Consolidate similar wastestreams.
3. Temporarily stage individual wastestreams.
4. Solidify contaminated sludge.
5. Conduct water transfer from work areas as required on site.
6. Collection of disposal samples.
7. Arrange for disposal of the hazardous and special waste
8. The site health and safety and the daily safety meetings
9. Conduct hazard categorization of all materials suspected of being waste or hazardous material.

Superfund Technical Assessment and Response Team (START):

The Superfund Technical Assistance and Response Team is responsible for providing the FOSC with assistance and support in regards to all technical, regulatory and safety aspects of site activity. The START is also available to advise the FOSC on matters relating to sampling, treatment, packaging, labeling, compatibility, transport, and disposal of hazardous materials, but is not limited to the above-mentioned.

Site Health and Safety Officer (HSO):

The ERRS and START Site Safety Officers will be assigned to the site on a full-time basis with functional responsibility for implementing the Site Health and Safety Plan as it applies to ERRS and START personnel. The Response Manager is the designated ERRS HSO. The Lead START Member is the designated START HSO unless otherwise appointed. Site audits may be conducted by the ERRS Health and Safety manager, START personnel and/or the U.S. EPA.

Specific Duties Include (but not limited to):

a. Assume responsibility for health and safety of ERRS and/or START personnel.
b. Supervise confined space entries.
c. Document safety problems.
d. Supervise decontamination of personnel and equipment.
e. Ensure that monitoring equipment is calibrated/operational.
f. Conduct personal air monitoring on all ERRS and/or START employees as outlined in 29 CFR 1910.120(h)(4).

g. Perform respiratory fit tests.
h. Inventory/inspect PPE prior to personnel entries.
i. Prepare summary letter of personal air sampling results.
j. Select protective equipment levels based upon chemical properties, method of contact and air sample results.
k. Prepare and maintain OSHA Log within 3 days of accident.
l. Insure all ERRS and/or START personnel are fit for duty.
m. Competent person for excavation/trench entry jobs.
n. Inspect first aid kits/fire extinguishers/SCBA.

Other:

Any persons who observe safety problems should immediately report observations/concerns to appropriate key personnel listed in Section 1.2.

SUBCONTRACTORS

COMPANY: Environmental Restoration

CONTACT NAME: Jim Davis PHONE: 314-227-7477

ADDRESS: 16333 Westwoods Business Park Dr.

Ellisville, MO 63021

SCOPE OF WORK: Subcontractor to EQM, OPA and CERCLA removal activities

TRAINING REQUIRED: OSHA 40 hr HAZWOPER

CONTRACTOR PREQUALIFIED? [yes] YES [___] NO

COMPANY: EQM

CONTACT NAME: John Mullane PHONE: 800-500-0575

ADDRESS: 1310 Kemper Meadow Drive

Cincinnati, OH 45240

SCOPE OF WORK: Prime contractor for Region 5 ERRS

TRAINING REQUIRED:

CONTRACTOR PREQUALIFIED? [X] YES [___] NO

COMPANY:

CONTACT NAME: PHONE:

ADDRESS:

SCOPE OF WORK:

TRAINING REQUIRED: CONTRACTOR

PREQUALIFIED? [___] YES [___] NO

1.2 Key Personnel

1.2 Key Personnel

U.S. EPA On-Scene Coordinator (FOSC)/ Site Safety Officer:	Kevin Turner U.S. EPA 8588 Rt. 148 Marion, IL 62959 (618) 997-0115
Alternate FOSCs:	Len Zintak
Principal ERRS Contractor	Environmental Quality Management 1310 Kemper Meadow Drive Cincinnati, Ohio 45240 800-500-0575 (Office) 513-825-9728 (fax)
Response Manager (RM):	Jim Davis (ER)
Subcontractors:	Environmental Restoration, L.L.C.
ERRS Health & Safety Officer:	Gene Koesters
START Health & Safety Officer:	Ronald Bugg
Superfund Technical Assessment and Response Team (START):	Ecology & Environment, Inc. 33 North Dearborn Street Chicago, Illinois 60602 312/578-9243 (office) 312/578-9345 (fax) Ecology & Environment, Inc. 501 W. DeYoung Center Bld. 1, Suite 3 Marion, IL 62959 618/998-9237 (office) 618/998-1106 (fax)
START Representative:	Tracey Fitzgerald (Marion, IL office)

1.3 Site Background

Site Q was actively used as a waste disposal area by Sauget and Company for industrial and municipal wastes from 1966 to 1973. The site is presently owned by Eagle Marine Industries, Inc. of St. Louis, Missouri.

According to aerial photographs disposal activities were noticed initially in 1955, with a marked increase in activity in 1962. In 1973, landfill activities appeared to have ceased in the northern portion of the site but continued in the southern portion. In January of 1975, Illinois EPA inspected the site and determined that disposal practices had ceased. In 1980, Illinois EPA received notice that chemical wastes and drums were uncovered during excavation activities for the rail spur that cuts across Site Q. In 1981, the Illinois Attorney General filed suit against Sauget and Company for alleged violations against Illinois EPA regulations. In October of 1981, Illinois EPA sampled seeps along the boundaries of the Site Q which indicated the present of organics at elevated concentrations. In March 1987, an Expanded Site investigation was conducted by Illinois EPA. Results from monitor well EE-09 located in the borrow pit area indicated that volatile organics were present in groundwater below the site. In June of 1993, as a result of finding buried drums at the northern section of Site Q, a U.S. EPA Field Investigation Team (FIT) contractor collected 33 subsurface soil samples at the site. A total of 63 of 112 organic compounds from the priority pollutant list were detected, including dioxins. As a result of severe flooding of the Mississippi River in the summer of 1993, waste materials including drums were left exposed along the shoreline side of Site Q. Samples collected by U.S. EPA from the exposed wastes indicated elevated levels of semi-volatile organics and polychlorinated biphenyls (PCBs) (maximum concentration of total PCBs at 260,000 ppm). Subsequently, a removal action was conducted by U.S. EPA to remove the waste materials and repair the exposed sections of the fill area. As a follow-up to the severe flooding of the Mississippi River the Illinois EPA collected 11 surface soil and waste samples from the borrow area in November 1994. These samples indicated the presence of heavy metals and PCBs at elevated concentrations remained. In April of 1997 U.S. EPA conducted a Preliminary Ecological Risk Assessment of the two pit areas located in the southern portion of Site Q. The presence of heavy metals and PCBs at the site was determined to pose a threat to the Black-Crowned Night Heron. Local fisherman who use the Site and consume their catch could be exposed to elevated levels of metals and PCBs as well.

1.4 Scope of Work for ERRS Contractor under CERCLA

1. Develop and implement a site health and safety plan; emergency contingency plan, and site work plan;
2. Implement appropriate site security measures;
3. Remove and treat water from the pits;
4. Secure and containerize all drums and containers and remove and dispose of drums;
5. Exhume, transport, and dispose and/or incinerate hazardous substances at an EPA approved facility; and
6. Backfill and stabilize the soil covering any excavated areas with clean fill.

1.5 Scope of Work for START

The START are to maintain CERCLA paperwork; monitor clean-up contractor performance; assist the FOSC in providing site safety direction; assist in the preparation of a removal action health and safety plan; conduct air monitoring; prepare sampling plans; conduct multimedia sampling; conduct compatibility testing; prepare POLREPs; provide photo documentation; organize site files according to FOSC appendices; and prepare outline of after-action-report; assist sample hazard categorization and disposal characterization; complete compatibility testing, if requested; assist in defining wastestreams and document disposal samples; and assist the FOSCs as requested per the START Statement of Work.

2.0 TASK SAFETY AND HEALTH RISK ANALYSIS

2.1 Task Specific Hazards and Controls

This section is to be addressed in the daily tool box safety meeting as each task is to be attempted. Each Task-Specific Safety Assessment is designed to develop awareness to chemical and physical hazards specific to each task. It would be impractical to repeat in complete detail each control measure and SOP for each job task. Sources and Hazards will be addressed for each job task with reference made to applicable control measures in Sections 2.2, 2.3 and SOP's. The tables in Section 2.2 and 2.3 should be posted in the break area and command post. When the Task-Specific Safety Assessment are discussed additional hazards may need to be addressed.

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Site preparation - Mobilization

PERSONAL PROTECTIVE EQUIPMENT: Level D - Operations restricted to clean area only

HAZARD	SOURCES	CONTROL MEASURES	REF.
Ergonomics	Lifting and bending. Heavy equipment.	Utilize proper lifting techniques. Use mechanical devices for lifting materials greater than 50 pounds when possible. Utilize the buddy system.	Sect 2.3
Slips, trips, and falls	Debris in building, materials from unloading, wet floor	Clear walk areas during set up to eliminate tripping hazards. Avoid wet floor areas, clean up as needed. Practice good housekeeping.	Sect 2.3 SOP G, O, N
Chemical exposure	Inside building area	Limit set up operations to office area only. See next task for other building areas. Perform air monitoring in office area during clearing to assure proper PPE	Sect4.0 2.2 SOP G Table 6.1
Overhead hazards	Light fixtures in office.	Identify hazard areas and inform all employees. Remove hanging debris from office areas to eliminate overhead hazards. Employees will wear hard hats. See next task for other building areas.	Sect 2.3 SOP G
Cuts, puncture	Debris	Clear walkway, use proper lighting, use buddy system, and use absorbents as needed. Practice good housekeeping	SOP G
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Cleanup of Debris and Set Up

PERSONAL PROTECTIVE EQUIPMENT: Level C or Level B depending on air monitoring.

HAZARD	SOURCES	CONTROL MEASURES	REF.
Muscle strain, cut, and pinch points	Lifting and bending. Heavy objects.	Utilize proper lifting techniques and the buddy system. Use mechanical devices (wheel barrel or cart) to move debris. Wear appropriate PPE (e.g. leather work gloves).	Sect 2.3,
Slips, trips, and falls	Debris, pipes, openings in floor	Clear walkways in work area. Practice good housekeeping. Cover open sump in floor and identify.	Sect 2.3 SOP N O
Chemical exposure	Dust, fumes from drums and tanks	Wear appropriate PPE. Use caution when moving drums or avoid contact with liquid material in tanks. Keep dust generation to a minimum. Conduct air monitoring to assure proper PPE is utilized.	Sect 2.2, 4.0 Table 6.1
Illumination	No lights inside site buildings	Light stands if natural light is insufficient	Sect 2.3
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF
Overhead hazards	Falling debris, unstable joists	Identify areas that are unstable and inform all employees. Remove hanging debris.	Sect 2.3

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Asbestos abatement

PERSONAL PROTECTIVE EQUIPMENT: Level C

HAZARD	SOURCES	CONTROL MEASURES	REF.
Exposure	Asbestos	Use of proper PPE and engineering techniques to reduce the amount of exposure of the contaminants.	Sect 4.0 SOP G, O, EE, FF, KK
Slip, trip, falls	Debris, poor lighting, wet surface	Clear walkways, use proper lighting, use buddy system, use absorbents as needed, and practice good housekeeping	SOP G, O, R, MM
Cuts and punctures	Debris and rough corners/edges	Clear walkways, use proper PPE, and use proper lighting	SOP G, R, O
Head injury	Overhead hazards	Wear hard at all times, use buddy system, and use proper lighting.	SOP G, R
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF
Ergonomics	Lifting, bending, heavy equipment	Use proper lifting techniques and have qualified personnel operating heavy equipment. Use buddy system when lifting objects greater than 40 pounds.	SOP G, S

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Site Excavation of Contaminated Soil

PERSONAL PROTECTIVE EQUIPMENT: Level C

HAZARD	SOURCES	CONTROL MEASURES	REF.
Ergonomics	Lifting and bending. Heavy equipment.	Utilize proper lifting techniques. Use mechanical devices for lifting materials greater than 50 pounds when possible. Utilize the buddy system.	Sect 2.3
Slips, trips, and falls	Debris in building, materials from unloading, wet floor	Clear walk areas during set up to eliminate tripping hazards. Avoid wet floor areas, clean up as needed. Practice good housekeeping.	Sect 2.3 SOP O
Chemical exposure	While excavating contaminated soil	Perform air monitoring in office area during clearing to assure proper PPE	Sect 2.2 ,4.0 Table 6.1
Heavy Equipment	Noise levels, blind spots, pinch points, lines	Maintain eye contact with operators, use hearing protection if required, use caution, and know location of overhead/underground lines.	SOP R
Overhead hazards	Excavator Arm.	Identify hazard areas and inform all employees. Remove hanging debris from office areas to eliminate overhead hazards. Employees will wear hard hats. See SOP for working next to heavy equipment.	Sect 2.3 SOP R
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary.	SOP, EE, FF

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Hazard categorization (HAZCAT) and compatibility testing			
PERSONAL PROTECTIVE EQUIPMENT: Level B & C (No hood - level B; in hood Level C)			
HAZARD	**SOURCES**	**CONTROL MEASURES**	**REF.**
Cuts, puncture, injury, pinch points	Small containers	Watch pinch points, wear proper gloves, use caution when handling containers	SOP G, O, P, W, X, Y
Chemical spill, chemical reaction	Sampling (handling and opening containers), HAZCAT testing, compatibility testing, fires/incompatible mixtures.	Wear proper PPE, have absorbents in work area, use good housekeeping procedures, stage containers appropriately (avoid incompatibilities, keep fire extinguisher within 15 feet of work area, and maintain adequate work area and proper ventilation.	SOP G, O, P, W, X, Y, HH
Exposure	Contaminants	Use proper PPE and engineering techniques to reduce the amount of exposure to the contaminants.	G, O, P, W, X, Y
Heat/cold stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary.	SOP EE, FF

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Labpacking			
PERSONAL PROTECTIVE EQUIPMENT: Level B & C			
HAZARD	**SOURCES**	**CONTROL MEASURES**	**REF.**
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF
Chemical spill, chemical reaction	Handling containers	Wear proper PPE, ensure compatibilities, have absorbents in work area, use good housekeeping procedures, and maintain adequate work area.	SOP G, O, P, W, X, Y
Exposure	Contaminants	Use proper PPE and engineering techniques to reduce the amount of exposure to the contaminants.	SOP G, O, P, W, X, Y

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Drum handling, drum staging, and overpacking

PERSONAL PROTECTIVE EQUIPMENT: Level B or C, dependent on air monitoring

HAZARD	SOURCES	CONTROL MEASURES	REF.
Cuts, puncture, injury, and pinch points	Moving and staging drums	Watch pinch points, wear proper gloves, and move drums properly, maintain constant communication.	SOP G, I, K, L, U
Chemical contact - splash	Moving and staging drums, drum integrity.	Wear proper PPE, have absorbents in work area, move drums carefully, utilize proper equipment (grappler, dolly)	SOP G, I
Chemical spill	Improper moving techniques, drum integrity	Have absorbents in work area, move containers carefully, use proper equipment, ensure drum integrity	SOP G, I
Slip, trip, falls	Debris, wet surfaces	Practice good housekeeping, use proper techniques	SOP G, I, O
Exposure	Contaminants	Use proper PPE and engineering techniques to reduce the amount of exposure to the contaminants.	SOP G, O, P, W, X, Y

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Small container and drum sampling

PERSONAL PROTECTIVE EQUIPMENT: Level B or C, dependent on air monitoring

HAZARD	SOURCES	CONTROL MEASURES	REF.
Chemical contact - splash	Improper sampling techniques.	Wear proper PPE, have absorbents in work area, use proper sampling techniques.	SOP G, J, K, W
Chemical spill	Improper moving techniques, drum integrity	Have absorbents in work area, move containers carefully, use proper equipment, ensure drum integrity	SOP G, R
Slip, trip, falls	Debris, wet surfaces	Practice good housekeeping, use proper techniques	SOP G, I, O
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF
Exposure	Contaminants	Use proper PPE and engineering techniques to reduce the amount of exposure to the contaminants.	SOP G, O, P, W, X, Y

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Drum bulking, and containerization

PERSONAL PROTECTIVE EQUIPMENT: Level B & C (to be determined based on air monitoring results)

HAZARD	SOURCES	CONTROL MEASURES	REF.
Cuts, puncture, injury, and pinch points	AST and connecting pipes	Watch pinch points, wear proper gloves, and PPE.	SOP G
Chemical contact - splash	Handling sample containers, compatibility testing.	Wear proper PPE, have absorbents in work area, use proper hazcat techniques.	SOP G, I, X
Chemical spill	Handling sample containers	Have absorbents in work area, move containers carefully.	SOP G, I, X
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF
Slip, trip, falls	Debris, wet surfaces	Practice good housekeeping, use proper techniques	SOP G
Exposure	Contaminants	Use proper PPE and engineering techniques to reduce the amount of exposure to the contaminants.	SOP G, I, X

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Liquid transfer (corrosive, flammable, and petroleum)

PERSONAL PROTECTIVE EQUIPMENT: Level C & D (to be determined based on air monitoring results)

HAZARD	SOURCES	CONTROL MEASURES	REF.
Fire	Transfer of flammables	Use proper liquid transferring methods and equipment, keep from ignition sources, and keep fire suppression sources nearby.	G, I, K, O, P, AA, HH
Chemical contact - splash	Handling sample containers, compatibility testing.	Wear proper PPE, have absorbents in work area, use proper hazcat techniques.	SOP G, X
Chemical reaction	Cross contamination leading to mixtures of incompatible substances	Verify cleanliness of containers/tankers prior to transfer of liquids, begin transfer slowly with appropriate air monitoring, and check for reactions (steam, heat production, odors)	SOP G, K, AA, BB, HH
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF
Chemical spill	Handling sample containers	Have absorbents in work area, move containers carefully.	SOP G, X
Ergonomics	Lifting, bending, heavy equipment	Use proper lifting techniques and have qualified equipment operators. Utilize buddy system for lifting objects over 40 pounds	SOP G, K, AA, BB

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Drum/container high pressure cleaning (may be confined space if not demolished)

PERSONAL PROTECTIVE EQUIPMENT: Level B or C, dependent on air monitoring

HAZARD	SOURCES	CONTROL MEASURES	REF.
Physical injury	Water blast	Wear proper PPE, follow equipment manufacturer directions, point hoses away from personnel at all times, use proper lighting	SOP G, CC
Chemical exposure	Residual contamination	Air monitor periodically, wear proper PPE, and provide appropriate ventilation.	SOP G, I, H, S, EE, FF
Confined space	Insufficient light and oxygen. Spark hazards	Air monitor, wear proper PPE, use harness, and have back-ups	SOP H
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF
Ergonomics	Lifting, bending, and heavy equipment	Use proper lifting techniques and have qualified personnel operating the equipment. Utilize the buddy system for lifting objects over 50 pounds.	SOP G,
Slip, trip, falls	Debris, wet surfaces	Practice good housekeeping, use proper techniques	SOP G, CC,

TASK SPECIFIC SAFETY ASSESSMENT

JOB TASK: Treatment and disposal

PERSONAL PROTECTIVE EQUIPMENT: Level D

HAZARD	SOURCES	CONTROL MEASURES	REF.
Heavy equipment	Loader, truck	Use experienced operator and refer to operator manual for proper use of equipment	SOP G, R, U
Noise	Loader, truck	Use proper ear protection.	SOP G, U, Sect 6.4
Ergonomics	Lifting, bending, and heavy equipment	Use proper lifting techniques and have qualified personnel operating the equipment. Utilize the buddy system for lifting objects over 50 pounds.	SOP G
Drum handling	Drums	Use proper handling techniques and have experienced operators working the equipment.	SOP G, I, R
Heat/Cold Stress	Weather, PPE, & physical exertion	Frequent breaks, cool break area, stress drinks available, monitoring if necessary	SOP G, EE, FF
Truck loading	Truck traffic	Perform truck traffic control as needed. Barricade truck entrance/exit to warn other traffic.	SOP G, U

2.2Chemical Hazards

CHEMICAL	TLV/PEL/ IDLH	Physical Characteristics	Odor Threshold	Routes of Exposure	PPE Polymers	Symptoms Acute/Chronic	First Aid
Ammonia (aqueous)	50ppm/25ppm/300ppm	colorless	pungent odor	Inhalation, Ingestion, Skin	tyvek, inner gloves (latex)	Irr, chest pain, pulm edema, skin burns	Soap, flush, resp support Seek medical attention.
Benzene	10ppm/1ppm/500ppm	colorless to light yellow liquid with an aromatic odor	5ppm	Inhalation, Ingestion, Skin			Soap, flush, resp support Seek medical attention.
Ethyl benzene	100ppm/100ppm/800ppm	colorless liquid with aromatic odor	140ppm	Inhalation, Ingestion, Skin	tyvek, inner gloves (latex)	Irr, H, coma	water, flush, resp support Seek medical attention.
Mercury	0.1 mg/m^3 - 10 mg/m^3	silver-white heavy, odorless liquid	Odorless	Inhalation, Ingestion, Absorption, Skin	tyvek, inner gloves	Irr eyes, skin, cough, chest pain, bronchial pneuitis, tremors, H, Fatigue, weak, stomatitis, GI disturbances, weight-loss	water soap, Seek medical attention.
Toluene	50ppm/100ppm/2000ppm	colorless liquid	0.17 ppm	Inhalation, Ingestion, Skin	tyvek, inner gloves (latex)		
Xylene	100ppm/100ppm/900ppm	colorless liquid	aromatic odor	Inhalation, Ingestion, Absorption	tyvek, inner gloves (latex)	Irr, drowsiness, dizziness, staggering gait, N, abdominal pain	water, flush, resp support Seek medical attention.
2,3,7,8 Tetrachlorodibenzo P dioxin	Not Determined	Clear liquid aromatic odor		Inhalation, Skin, Ingestion		Harmful or fatal if swallowed. Harmful if inhaled. Hallucination, dizziness, kidney, lung damage	Medical assistance immediately, flush with water.
Lead	PEL 50 $\mu g/m^3$ TLV 150 $\mu g/m^3$	Bluish white soft metal		Inhalation, Ingestion		Can be fatal, appetite loss, nausea, metallic taste, kidney damage, neuropathy	Flush with water, consult physician.

PCB-Aroclor 1242	0.09 ppm 0.09 ppm 1 mg/m^3	Clear; colorless; oily; light to dark yellow resin; white-yellow solid		Inhalation, dermal absorption, ingestion, eye contact		Irritation of eyes, skin, mucous membrane, throat, mouth; nausea, drowsiness; anorexia	Move to fresh air. Remove contaminated clothing. Wash affected area.
PCB-Aroclor 1248	General 1 mg/ m^3	Clear; colorless; oily; light to dark yellow resin; white-yellow solid		Inhalation, dermal absorption, ingestion, eye contact		Irritation of eyes, skin, mucous membrane, throat, mouth; nausea, drowsiness; anorexia	Move to fresh air. Remove contaminated clothing. Wash affected area.
PCB-Aroclor 1254	0.03 ppm 0.03 ppm 0.5 mg/m^3	Clear; colorless; oily; light to dark yellow resin; white-yellow solid		Inhalation, dermal absorption, ingestion, eye contact		Irritation of eyes, throat, mouth; nausea, drowsiness; anorexia; edema	Move to fresh air. Remove contaminated clothing. Wash affected area.
Asbestos	PEL 0.2 f/cc TLV 2.0 f/cc	White or greenish, grayish fibrous solids		Inhalation, Ingestion, skin		Nose, throat, eye irritation, asbestosis, lung cancer	Flush with water, fresh air.

The above listing should not be taken as a complete assessment of the hazards posed by materials at the SCT site. The known and unknown mixed chemical hazards at this site prevent a clear determination of the specific effects of discrete compounds. Therefore, personnel must be alert for symptoms of possible exposure such as unusual smells, stinging, burning eyes, nose and throat, skin irritation, as well as feeling extremely well, depressed, sleepy or tired. Symptoms must be immediately reported to the site supervisor.

KEY: IR1-Irretates eyes, nose, & throat, IH-Inhalation, IN-Ingestion, SK-Skin contact, A-Absorption, AC-Abdominal cramps, D-Diarrhea, DZ-Dizziness, H-Headache, N-Nausea, O-Eye contact, V-Vomiting

See Attachment C for Chemical Hazard Information and MSDS'.

2.3 Physical Hazards

PHYSICAL/ENVIRONMENTAL HAZARD ANALYSIS

HAZARD	PRE PLANNING TO CONTROL HAZARD	ACTIVE CONTROL MEASURES
Ergonomic	1. All operations evaluated for ergonomic impact. 2. Procedures written to define limits of lifting, pulling, etc. 3. Procedures to define how personnel will utilize proper ergonomic concepts and utilize mechanical material handling equipment. 4. Necessary mechanical material handling equipment specified and ordered for project.	1. Proper body mechanics techniques stressed and enforced on a daily basis. 2. Mechanical handling equipment maintained and utilized. 3. Proper body mechanics stressed in scheduled safety meetings. 4. Injuries reported and medically treated if in doubt about severity. 5. Operations changed as necessary based on injury experience or potential.
Existing Site Topography	1. Survey site prior to layout. Identify areas unsafe for personnel or equipment due to physical conditions. 2. Identify/locate existing utilities. 3. Determine impact of site operations on surrounding properties, communities, etc. 4. Identify mechanized equipment routes both on site and onto and off the site. 5. Layout site into exclusion and contamination reduction zones based on initial site evaluation.	1. Awareness to work environment - regular inspection/audits to identify changing conditions. 2. Shut down operations when unknown conditions encountered.
Fires & Explosions	1. Evaluate all operations for fire and explosion potential. 2. Define specific procedures for unique operations presenting unusual hazard such as flammable tank demolition. 3. Ensure that properly trained personnel and specialized equipment is available. 4. Define requirements for handling and storage of flammable liquids on site, need for hot work permits and procedures to follow in the event of fire or explosion. 5. Define the type and quantity of fire suppression equipment needed on site. 6. Coordinate which local fire fighting agencies to discuss unique fire hazards, hazardous materials, etc. 7. Ensure site operations comply with 29CFR 1910.157G.	1. Inspect fire suppression equipment on a regular basis. 2. Store flammables away from oxidizers and corrosives. 3. Utilize Hot Work Permit for all hot work on site. 4. Follow any site-specific procedures regarding work around flammables. 5. Review and practice contingency plans. Discuss on regular basis at scheduled safety meetings.

Flammable Vapor and Gases	1. Evaluate site to determine sources of likely flammable gas or vapor generation. 2. Develop specific procedures to be followed in the event of exposure to flammables. 3. Specify specialized equipment needs for inerting flammable atmospheres, ventilating spaces and monitoring flammable vapor concentrations. 4. Define requirements for intrinsically safe equipment. 5. Develop contingency plan to follow in the event of fire or explosion.	1. Calibrated monitoring equipment available and utilized by trained personnel whenever working where flammable gas or vapor is present. 2. Monitoring performed at regular frequency and in all areas where vapor could generate or pool. 3. Equipment and operations shut down when threshold levels are exceeded. 4. Contingency plans reviewed regularly by all involved personnel. 5. Work areas are carefully inspected to look for possible ignition sources. Sources are removed. 6. Operations shut down if specific task procedures can't be followed to the letter.
Heat Stress	1. Anticipate possible elevated temperatures (summer months). 2. Awareness to stress placed on body by specific PPE. 3. Awareness to levels of heat stress symptoms.	1. Proper work/rest schedule and monitoring. 2. Drink plenty of fluids. 3. Buddy system/awareness. 4. First aid on site. 5. Medical care if symptoms persist.
Heavy Equipment Operation	1. Define equipment routes and traffic patterns for site. 2. Insure that operators are properly trained on equipment operation for all equipment required on project. 3. Define safety equipment requirements, including back up alarm and roll over, for all equipment on site. 4. Define equipment routes and traffic patterns for site. 5. Implement SOP of requiring operators to safety inspect equipment on a daily basis in accordance with manufacturer requirements. 6. Evaluate project requirements to ensure that equipment of adequate capacity is specified.	1. Equipment inspected as required. Equipment repaired or taken out of service. 2. Ground spotters are assigned to work with equipment operators. Utilize standard hand signals and communication protocols. 3. Personnel wear the proper PPE, utilize hearing protection, gloves for handling rigging, etc. 4. Equipment safety procedures discussed at daily scheduled safety meetings. 5. Personnel do not exceed lifting capacities, load limits, etc. for equipment in question. 6. Personnel follow basic SOP's which prohibit passengers on equipment, activating brakes and grounding buckets, securing loads prior to movement, etc.

Illumination	1. Evaluate all operations and work areas to determine lighting requirements. 2. Specify specialized lighting requirements including explosion proof, intrinsically safe, lighting needs. 3. Determine if nighttime outdoor operations are necessary. Evaluate tasks to be performed and number of light plants necessary to allow operations. 4. Ascertain if outdoor lighting from nighttime operations will have an impact on surrounding communities.	1. Inspect specialized equipment and discard or replace as needed. 2. Add additional lighting to areas with lighting deficiencies. 3. Inspect drop cords and portable lights on regular basis. Replace or repair as necessary.
Noise	1. Local community noise standards examined. 2. Expected loud operations evaluated to determine compliance with community standards. 3. Loud operations scheduled for approved time periods. 4. Noise level standards established for equipment brought onto site. 5. Hearing protection requirements defined for personnel expected to have excessive exposures.	1. Personnel receive annual audiogram. 2. Personnel required to wear hearing protection. 3. Routine noise level monitoring and dosimetry performed. 4. Defective equipment repaired as needed. 5. Ongoing hearing conservation education promoted at scheduled safety meetings. 6. Medical evaluation following noise (impact) exposure if symptoms present themselves.
Personal Injuries	1. Site operations will be evaluated for exposures with serious injury potential such as falling objects, pinch points, flying objects, falls from elevated surfaces, etc. 2. A written Fall Prevention Program will be developed if workers will be required to work at heights greater than 10 feet from unguarded work locations. 3. PPE requirements will be based on potential for injury.	1. Personnel will wear required PPE. 2. Specialized equipment such as rope grabs, winches, etc. will be inspected prior to each use. Defective equipment will be immediately replaced. 3. All injury and near miss incidents will be reported to the HSO. 4. First aid/CPR trained person on site at all times. 5. All injuries will be treated on site with advanced medical treatment being sought if doubt about severity.
Radiation	1. Evaluate potential for exposure to radioactive materials. 2. If likely, develop specialized training program for personnel. 3. Develop plan and specify equipment for monitoring potential radiation sources. 4. Establish health physics dosimetry program. 5. If not likely, implement SOP of stopping work should any sign of radioactive materials become apparent.	1. Perform monitoring as defined in safety plan. 2. Perform necessary calibration and maintenance on monitoring equipment. 3. Employees participate in health physics monitoring program. 4. Notify Project Manager when suspect materials are detected.

Small Equipment Usage	1. Site operations evaluated to determine need for specialized intrinsically safe, explosion-proof and UL approved equipment and instruments. 2. Implement requirement for G.F.I., double insulated tool usage, or assured grounding program in all outdoor operations, will be utilized. 3. Specify equipment needs to ensure that equipment used only for the purpose for which it is designed and to prevent abuse or misuse of the equipment. 4. Specify requirements for the inspections and maintenance of specialized equipment. 5. Specify that all equipment utilized on the project meets all OSHA requirements.	1. First aid on site. 2. Transport for medical care if necessary.
Wildlife	1. Inspect work environment where tasks are being performed. 2. Awareness to bites. 3. Dogs, animals, poison ivy, etc.	1. First aid on site. 2. Seek medical attention if symptoms-signs persist.
Weather Conditions	1. Evaluate prevailing weather conditions for the site. 2. Contingency plans developed for likely severe weather conditions such as tornado, and extreme thunderstorm. 3. Provide for daily weather forecast service in extreme weather areas. 4. Plan to weatherize safety systems, such as showers and eye washes, that would be impacted by extreme cold weather. 5. Order necessary specialized cold weather clothing. 6. Grounding and bonding requirements defined for thunderstorm areas. 7. Sheltered air conditioned break areas provided for extreme hot and cold weather zones.	1. Employees trained in contingency plan for severe weather conditions. 2. Emergency water sources inspected regularly in cold areas. 3. Weather service contacted regularly during storm conditions. 4. Supervisory personnel cease operations during extreme storm conditions (i.e., thunderstorms). Personnel evacuate to safe assembly area.

3.0 PERSONNEL TRAINING

[1] Initial Training

a. 40 Hour Training

All field employees receive forty hours of classroom training on safe work practices and hazardous waste sites.

b. Supervisor/Managers

Manager and Supervisors receive eight hours of training on safe management of hazardous waste sites. All training complies with 29 CFR 1910.120.

The following individuals are Site Supervisors:

[1] Kevin Turner
[2] Jim Davis

[2] Site Specific Training

a. All assigned personnel will receive site specific training on routes of exposure and adverse health effects associated with the chemicals listed on the attachment.

b. At least one member of each work crew shall have training in the use of portable fire extinguishers in accordance with 29 CFR 1910.157G.

c. IAW 29CFR 1910.120, all personnel newly assigned to hazardous waste work will receive 3 days of on the job training by an experienced supervisor. This typically is achieved by coordinating the work schedule so that they perform 25% of the expected workload the first day; 50% the second day, and 75% the third day.

d. Each person entering the site shall sign a statement attesting to the fact that they have read and understand the Site Specific Safety Plan. (Attachment Z)

[3] Annual Refresher

All field employees are required to receive eight hours of refresher training on the above topics within the anniversary date of their initial 40-hour class.

[4] First Aid/CPR

All field employees receive initial and recertification training. Treatment limited to Good Samaritan/minor first aid. All traumatic/major first aid, and cardiac problems will be referred to medical facilities.

[5] Subcontractor Requirements

All subcontractors entering the contamination reduction zone and exclusion zone will have adequate training satisfying 29 CFR 1910.120.

4.0 PERSONAL PROTECTIVE EQUIPMENT

The following is a brief description of the personal protective equipment which may be required during various phases of the project. The U.S. EPA terminology for protective equipment will be used; Levels A, B, C and D.

Respiratory protective equipment shall be NIOSH-approved and use shall conform to OSHA 29 CFR Part 1910.134 Requirements. Each employer shall maintain a written respirator program detailing selection, use, cleaning, maintenance and storage of respiratory protective equipment. The written Respirator Program will be maintained at the local and regional offices.

4.1 Level A Protection Shall Be Used When:

- ? The extremely hazardous substance requires the highest level of protection for skin, eyes and the respiratory system;
- ? Substances with a high degree of hazard to the skin are known or suspected;
- ? Chemical concentrations are known to be above IDLH levels; or,
- ? Biological hazards requiring Level A are known or suspected.

4.1.1 Level A Protective Equipment at a Minimum Shall Consist of:

Specific protective equipment for each level of protection is as follows:

Protective Gear - Level A	(Check and list required type)
Supplied Air	To be determined
5-minute Egress	
Spare Air Tanks	
Encapsulated Suit (type)	
Inner Gloves (type)	
Boot Covers (booties)	
Outer Chemical Gloves (type)	
Outer Work Gloves (type)	_____
Safety Shoes/Boots (type)	_____
Hard Hat	
Respiratory Inserts_____	
Other (List_____)	
Other (List_____)	_____
Other (List_____)	
Other (List_____)	_____
Other (List_____)	_____
Modifications:	

Level A PPE will not be used on this site.

4.2 Level B Protection Shall Be Used When:

- The substance(s) has been identified and requires a high level of respiratory protection but less skin protection;
- Concentrations of chemicals in the air are IDLH or above the maximum use limit of an APR with full-face mask;
- Oxygen deficient or potentially oxygen deficient atmospheres (< 19.5%) are possible; and/or,
- Confined space entry may require Level B.
- Incomplete identification of gases and vapors, but not suspected to be harmful to skin or skin absorbable.

4.2.1 Level B Protective Equipment at a Minimum Shall Consist of:

Protective Gear - Level B	(Check and list required type)	
Supplied Air		SCBA/Cascade system
5-minute Egress		Required
Chemical Resistant/Protective Coveralls	___	Acid suits/saranex
Full Body Apron or Others (type)		---
Inner Gloves (type)		Latex/nitrile
Outer Chemical Gloves (type)		Nitrile
		Outer Work Gloves (type)
Safety Shoes/Boots (type)		Chemical Resistant/Steel Toe
Boot Covers (booties)	_____	As needed
Hard Hat		Required
Respiratory Inserts		If necessary
Other (List Hearing Protection)		As needed
Other (List_____)	_____	
Other (List_____)	_____	
Other (List_____)	_____	
Other (List_____)		

Modifications: Cotton glove liners may be used for cold stress relief, except when handling/pumping liquids.
NOTE: Use of Level B personal protective equipment requires that one (1) person must be available as backup ready to provide emergency assistance.

4.3 Level C Protection Shall Be Used When:

- The same level of skin protection as Level B, but a lower level of respiratory protection is required;
- The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove contaminants; or,
- The substance has adequate warning properties and all criteria for the use of APR respirators has been met.

4.3.1 Level C Protective Equipment at a Minimum Shall Consist of:

Protective Gear - Level C	(Check and list required type)	
MSA Air Purifying Respirator		Full face APR
Cartridges (type)		GME-PI00 Mersorb too if encountering mercury
Escape Mask	_____	
Chemical Resistant/Protective Coveralls		Acid Suits or Saranex
Full Body Apron or Other (type)		
Inner Gloves (type)		Latex or Surgical Type
Outer Chemical Gloves (type)	_____	Nitrile
Outer Work Gloves (type)		
Safety Shoes/Boots (type)	_____	Chemical Resistant/Steel Toe
Boot Covers/Booties	_____	As needed
Hard Hat	_____	Required _____
Respiratory Inserts		If necessary
Other (List_____)	_____	
Other (List_____)	_____	
Other (List_____)	_____	
Other (List_____)	_____	
Other (List_____)		

4.4 Level D Protection Shall Be Used When:

- The atmosphere contains no known hazard; and,
- Work functions preclude splashes, immersion or the potential for unexpected inhalation of, or contact with, hazardous concentrations of harmful chemicals.

4.4.1 Level D Protection Equipment at a Minimum Shall Consist of:

Protective Gear - Level D (Check and list required type)

Chemical Resistant/Protective Coveralls	Tyvek, saranex, or nomex coveralls	
Rain Suit	not applicable	
Safety Shoes/Boots (type)	Steel Toe & Shank	
Boot Covers (booties)	As needed	
Work Gloves (type)	Cotton	
Hard Hat	Required	
Face Shield	As needed	
Safety Glasses	Required	
Modifications:		

Specific operating procedures for PPE and Respiratory Protection are in Attachment D.

4.5 Decisions to Upgrade/Downgrade PPE

[1] All decisions to downgrade from Level B to C or D must be accompanied by air monitoring results. The Regional Safety Managers (ERRS, START) must be advised of on-site decisions to downgrade. All decisions must be documented with an Addendum to the Health & Safety Plan.

[2] The following conditions will necessitate reevaluation of PPE use.

a. commencement of a new work not previously identified
b. change of job tasks during a work phase
c. change of season/weather
d. contaminants other than those identified in Safety Plan
e. change in ambient levels of contaminants
f. change in work which affects degree of chemical contact

[3] Action Levels (See Section 6.0)

5.0 MEDICAL SURVEILLANCE

5.1 Pre-Employment Physical

a. Pre-employment and periodic update medical examinations are required for persons working at hazardous waste sites.
b. All physicals must be completed and documented prior to assignment to this site.
c. All physical exams will be conducted following parameters established by the respective employee's Corporate Physicians.

5.2 Site Specific Physical Examination

a.
b.
c. A current fitness for duty statement will be kept on site for all personnel.

5.3 Annual Physical Exam

The medical examination must have been within a 12-month period prior to on-site activity and repeated annually.

5.4 Accidental/Suspected Exposure Physical

a. Following any accidental or suspected uncontrolled exposure to site contaminants, personnel should be scheduled for a special physical examination.

b. The physical examination will be specific for the contaminants and the associated target organs or physiological system.

c. Exposure to blood/body fluids required adherence to 29 CFR 1910.1030 (bloodborne Pathogens)

d. Questions regarding the type of physical can be directed to the employer's Directors of Health and Safety or their Corporate Physicians. See Section 10.2 for their respective phone numbers.

5.5 Contractor Physical Examination Requirements

All subcontractors entering the contamination reduction or exclusion zone will have adequate medical surveillance satisfying 29 CFR 1910.120.10 (f).

5.6 Site Documentation

All personnel on-site must have the following documentation available on site:

[1] Copy of 40-hour certificate
[2] Copy of Manager's/Supervisor's 8 hour certificate
[3] Copy of 8-Hour Annual Refresher (if > 12 months since 40 hour)
[4] CPR/First Aid Certificate (annual)
[5] Respirator Fit Test (annual)
[6] Medical Fitness For Duty
[7] Worksite Exposure Documentation (If within the last six months)

6.0 AIR MONITORING AND ACTION LEVELS

According to 29 CFR 1910.120 (h) Air Monitoring shall be used to identify and quantify airborne levels of hazardous substances and health hazards in order to determine the appropriate level of employee protection needed on-site.

6.1 Routine Air Monitoring Requirements

- Upon initial entry to rule out IDLH conditions;
- When the possibility of an IDLH condition or flammable atmosphere has developed;
- When work begins on a different portion of the site;
- Contaminants other than those previously identified are being handled;
- A different type of operation is initiated;
- Employees are handling leaking drums or containers or working in areas with obvious liquid contamination; and,
- During confined space work.

Air monitoring will consist at a minimum of the criteria listed below. All air monitoring data will be documented and submitted to the FOSC and available in the command post site files for review by all interested persons. Air monitoring instruments will be calibrated and maintained in accordance with the manufacturer's specifications. Calibration and maintenance performed will be entered in the site log and/or instrument log book.

6.2 Site Specific Air Monitoring Requirements

INSTRUMENT	COMPOUNDS TO DETECT	FREQUENCY	COMMENTS/ ACTION LEVEL
Combustible Gas Indicator (CGI)	Explosive/ Flammable Atmospheres	Periodic During drum work	>10% LEL proceed with caution continual monitoring, >25% LEL evacuate area and reevaluate conditions
PID/FID	Organic Vapors and Gases	Periodic, during drum and tank work.	Unidentified contaminants* >Background - <1ppm over background Level D ≥ 1 over Background - < 5 ppm over Background Level C ≥5 over Background - 500 ppm over Background Level B
Personal Air Pumps	Asbestos-Like fibers	During asbestos abatement	>0.01 fibers/cc for PCM (asbestos contaminated) > 1% for bulk samples (asbestos contaminated)
MiniRam	Dust Particulates, Respirable Dust	During Demo or dusty conditions	>7.5 mg/m3 - Level C >2.5 mg/m3 - Respirable dust - level C
Detector Tubes	Various	Periodic	Chemical-dependent
Oxygen Meter	Oxygen	Periodic (continuously in a confined space).	<19.5% - use supplied air >23.5% O_2 - exit area

* The reading must be sustained for one (1) minute in the breathing zone.

6.3 Personnel Monitoring

Explain strategy or why not required: To be determined by real-time air monitoring. To be conducted during ACM removal and/or confined space activities.

6.3.1 Sampling Methods (media type, analyses, NIOSH Method Number, etc.): Personal CO/O_2/LEL alarms to be used during confined space entries. Personal air pumps to be used during asbestos removal activities

6.3.2 Describe calibration procedures: To be conducted in accordance with the manufacturers specifications for the sampling pump/device to be used.

6.3.3 Analytical laboratory to be used: To be determined for ACM samples and waste characterization for disposal.

6.4 Noise Monitoring: [ ] Yes [X] No

Describe monitoring strategy: No monitoring of noise, all crew members will be wearing hearing protection when working around heavy equipment.

6.5 Heat/Cold Stress Monitoring: [X] Yes [ ] No

Heat stress monitoring for the Sauget Area 2 site will begin when temperatures exceed 70°F. Heat stress monitoring for personnel working in permeable clothing, such as cotton or synthetic work clothes, will be conducted in accordance with The American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for heat stress. The SSO will be responsible for verifying the work/rest schedules; calculating WBGT using a black globe thermometer, a natural wet bulb thermometer, and a dry bulb thermometer (or WBGT monitor); notifying workers of results; and documenting results.

The SSO will also monitor workers wearing impermeable or semi-impermeable clothing for physiological results by the following checks:

- Heart rate - Count the radial pulse during a 30-second period as early as in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

- Oral temperature - Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking). If oral temperature exceeds 99.6^{0}F, shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6^{0}F, at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a

worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100 .6°F.

- Body water loss, if possible. Measure weight on a scale accurate to ± 0.25 lb at the beginning and end of each workday to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, is nude. *The body water loss should not exceed 1.5 percent total body weight loss in a workday.*

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for sol radiation and the level of physical work. A form is provided in Attachment Y to document physiological results.

Cold stress monitoring will be completed IAW ACGIH TLVs for cold stress. See Attachment FF for cold stress monitoring procedures.

6.6 Perimeter: [X] Yes [ ] No

Describe: To be conducted during waste excavation and consolidation during removal activities.

[ ] Yes [ ] No

Other:

Describe: not applicable

6.7 Name(s) of Monitoring Technician(s):

START members on-site.

6.8 Location of Monitoring Records:

Copies of monitoring records will be retained in the job file upon the completion of the job. Additional copies will be maintained in the Health and Safety Department.

7.0 SITE CONTROL AND STANDARD OPERATING PROCEDURES

7.1 Work Zones

The primary purpose for site controls is to establish the hazardous area perimeter, to reduce migration of contaminants into clean areas and to prevent access or exposure to hazardous materials by unauthorized persons. At the end of each workday, the site should be secured or guarded, to prevent unauthorized entry. Site work zones will include:

7.1.1 Clean Zone/Support Zone

This uncontaminated support zone or clean zone will be the area outside the exclusion and decontamination zones and within the geographic perimeters of the site. This area is used for staging of materials, parking of vehicles, office and laboratory facilities, sanitation facilities, and receipt of deliveries. Personnel entering this zone may include delivery personnel, visitors, security guards, etc., who will not necessarily be permitted in the exclusion zone. All personnel arriving in the support zone will upon arrival, report to the command post and sign the site entry/exit log. There will be one controlled entry/exit point from the clean zone to the decontamination zone.

[1] Location of Clean Zone Along north site road at main gate (see map in attach B)

7.1.2 Decontamination Zone

The decontamination zone will provide a location for removal of contaminated personal protective equipment and final decontamination of personnel and equipment. All personnel and equipment should exit via the decon area. A separate decontamination area will be established for heavy equipment.

[1] The decontamination zone is a buffer zone between contaminated and clean areas.
[2] Identified by yellow banner guard.
[3] Decon line is located north of decontamination trailer along utility right-of-way.

7.1.3 Exclusion Zone/Hot Zone

The exclusion zone will be the "hot-zone" or contaminated area inside the site perimeter. Entry to and exit from this zone will be made through a designated point and all personnel will be required to sign the hot zone entry/exit log located at the decon area. Appropriate warning signs to identify the exclusion zone should be posted (i.e. "DANGER - AUTHORIZED PERSONNEL ONLY", "PROTECTIVE EQUIPMENT REQUIRED BEYOND THIS POINT", etc.) Exit from the exclusion zone must be accompanied by personnel and equipment decontamination as described in Section 8.0.

[1] Will be identified by red banner guard.
Exclusion Zone
[2] These areas will be identified by caution tape.
Decon / Transition zone
[3] General Safety Rules for the Exclusion Zone:

a. wear the appropriate level of PPE defined in plan
b. do not remove any PPE or break the integrity to pick, scratch, or touch parts of your body
c. no smoking, eating or drinking
d. no horseplay
e. no matches or lighters in this zone
f. implement the communication and line of sight system

A map of the work zones for this site follows.

MAP OF WORK ZONES

7.2 General Field Safety Rules

- All visitors must be sent to the command post and referred to the FOSC.
- It is EPA policy to practice administrative hazard control for all site areas by restricting entrance to exclusion zones to essential personnel and by using operational SOPs.
- Whenever possible, avoid contact with contaminated (or potentially contaminated) surfaces. Walk around (not through) puddles and discolored surfaces. Do not kneel on the ground or set equipment on the ground. Stay away from any waste drums unless necessary. Protect equipment from contamination by bagging.
- Eating, drinking, or smoking is permitted only in designated areas in the support zone.
- Hands and face must be thoroughly washed upon leaving the decon area.
- Beards or other facial hair that interferes with respirator fit will preclude admission to the hot zone.
- All equipment must be decontaminated or discarded upon exit from the exclusion zone, as determined by the FOSC or designate.
- All personnel exiting the exclusion zone must go through the decontamination procedures described in Section 8.0.
- Safety Equipment described in Section 4.0 will be required for all field personnel in the exclusion zone.
- Personnel will only travel in vehicles where individual seats (for each occupant are provided. Seat belts will be worn as required.
- Six fire extinguishers will be available on site and in all areas with increased fire danger such as the refueling area.
- A minimum of two personnel will always be on site whenever heavy equipment is operated. Only necessary personnel need to be on or around heavy equipment.
- Employees will not interfere with or tamper in any way with air monitoring equipment.
- Backhoes or other equipment with booms shall not be operated within 10 feet of any electrical conductor.
- Visitor log will be maintained at the command post or with the security guard. All personnel coming on site will sign in and out on a daily basis.
- Security will be maintained at the site by closing all gates during normal work hours. The FOSC will assume responsibility for personnel entering site. Site will be locked up in the evening.
- EPA FOSC will allow only those individuals authorized to enter the site. If unauthorized members of the public are found on site, contact security immediately and do not leave the individual unattended.
- Visitors are not allowed in the work areas without authorization and not without appropriate levels of PPE as determined by site safety personnel. Access to the properties is restricted to the EPA and authorized representatives. All personnel must sign in at the Command Post and receive authorization to enter the site.
- Buddy System
  - [1] The buddy system is mandatory at anytime that personnel are working in the exclusion zone, remote areas, on tanks, or when conditions present a risk to personnel.
  - [2] A buddy system requires at least two trained/experienced people who work as a team and maintain at a minimum audible and/or visual contact while operating in the exclusion zone.
- Communication Procedures
  - [1] Radios will be used for on site communications and Channel 1 will be the designated channel.
  - [2] The crews should remain in constant radio or visual contact while on site.
  - [3] The site evacuation signal will be 3 blasts on the air or vehicle horn.

8.0 DECONTAMINATION PROCEDURES

In general, everything that enters the exclusion zone at this site, must either be decontaminated or properly discarded upon exit from the exclusion zone. All personnel, including any state and local officials must enter and exit the hot zone through the decon area. Prior to demobilization, contaminated equipment will be decontaminated and inspected by the FOSC or FOSC designate before it is moved into the clean zone. Any material that is generated by decontamination procedures will be stored in a designated area in the exclusion zone until disposal arrangements are made.

All personnel must be documented on the "HOT ZONE ENTRY/EXIT LOG" when entering and exiting the exclusion zone.

NOTE: The type of decontamination solution to be used is dependent on the type of chemical hazards. The decontamination solution for this site is alconox and water. Decontamination solution will be changed daily (at a minimum) and collected and stored on-site until disposal arrangements are finalized.

8.1 Procedures for Equipment Decontamination

Following decontamination and prior to exit from the hot zone, the FOSC or a designated alternate, shall be responsible for insuring that the item has been sufficiently decontaminated. This inspection shall be included in the site log.

Equipment decontamination will consist of the following steps:

1) Gross removal of debris
2) Wash in alconox solution
3) Rinse in water
4) Repeat as needed until clean

8.2 Procedure for Personnel Decontamination

This decontamination procedure applies to personnel at this site wearing Level B and C protection. These are the minimum acceptable requirements:

Station 1: Equipment Drop
Deposit equipment used on-site (tools, sampling devices and monitoring instruments, radios, etc.) on plastic drop cloths. These items must be decontaminated or discarded as waste prior to removal from the exclusion zone.

Station 2: Outer Boot and Outer Glove Wash and Rinse
Scrub outer boots, outer gloves and/or splash suit with decontamination solution or detergent water. Rinse off using water.

Station 3: Outer Boot and Glove Removal
Remove outer boots and gloves. If outer boots are disposable, deposit in container with plastic liner. If non-disposable, store in a clean dry place.

Station 4: Tank Change
If person leaves exclusion zone to change air tank, this is the last step in the decontamination procedure. Air tank is exchanged, new outer gloves and boot covers donned, joints taped, and person returns to hot zone.

Station 5: Outer Garment Removal
If applicable, remove SCBA back-pack and remain on air as long as possible. Remove Chemical Resistant Outer Garments and deposit in container lined with plastic. Decontaminate or dispose of splash suits as necessary.

Station 6: Respiratory Protection Removal
Remove hard-hat, face-piece, and if applicable, deposit SCBA on a clean surface. APR cartridges will be discarded as appropriate. Wash and rinse respirator at least daily. Wipe off and store respiratory gear in a clean, dry location. (See Attachment D)

Station 7: Inner Glove Removal
Remove inner gloves. Deposit in container for disposal.

Station 8: Field Wash
Thoroughly wash hands and face with soap and water. Shower as soon as possible.

Eating, drinking, chewing gum/tobacco, smoking, or any practice that increases the probability of hand to mouth transfer and/or ingestion of materials is prohibited in any areas where the possibility of contamination exists and is permitted only in the designated break area.

Personnel will not wear or bring dirty/decontaminated clothing into the break areas.

8.3 Emergency decontamination will consist of the following steps:

(Any blood contaminated material will be bagged, labeled and accompany the individual to the hospital.)

8.4 The following decontamination equipment is required:

Pressure washer, scrub brushes, pails, alconox

8.5 Disposition of Decontamination Wastes

[1] All equipment and solvents used for decontamination shall be properly cleaned if reusable, properly containerized per individual wastestream if discarded, and disposed of with the appropriate waste streams in accordance with all applicable regulations.

[2] Commercial laundries or cleaning establishments that decontaminate or are used to launder contaminated clothing shall be informed of the presence and potentially harmful effects of the contaminants.

[3]

A sketch of the decon area for this site is shown in Attachment B.

9.0 HAZARD COMMUNICATION PROGRAM

Each contractor will be responsible for maintaining a copy of their Hazardous Communication Program and MSDS' on site. The following items are specific to this job site:

9.1 Material Safety Data Sheets

[1] Material Safety Data Sheets will be maintained at the Command Post in the Health and Safety Binder.
[2] MSDS' will be available to all employees for review during the work shift.
[3] See Attachment C and/or the ERRS Health and Safety Binder.

9.2 Container Labeling

[1] All containers received on site will be inspected by the contractor using the material to ensure the following:
a. all containers clearly labeled
b. appropriate hazard warning
c. name and address of the manufacturer

9.3 The following chemicals were brought to the site

9.3.1 START: Materials will be stored in equipment trailer

[1] Calibration gases: 2.5% methane, 100 ppm isobutylene
[2] Compressed breathing air
[3] Vermiculite
[4] Alconox

9.3.2 ERRS:

[1] Diesel Fuel
[2] Kerosene
[3] Alconox (equipment trailer)
[4] Starter fluid
[5]
[6]
[7]
[8]

9.4 Employee Training and Information

[1] Prior to starting work, each employee will attend a health and safety orientation and will receive information and training on the following:
a. an overview of the requirements contained in the Hazardous Communication Standard
b. Hazardous chemicals present at the site
c. the location and availability of the written Haz Comm Program
d. physical and health effects of the hazardous chemicals
e. methods of preventing or eliminating exposure
f. emergency procedures to follow if exposed
g. how to read labels and review MSDS' to obtain information
h. location of MSDS file and location of hazardous chemical list

See ERRS/START Health and Safety Binder for Hazard Communication Program and applicable MSDS'.

10.0 EMERGENCIES/ACCIDENTS/INJURIES

It is essential that site personnel be prepared in the event of an emergency. Emergencies can take many forms; illnesses or injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather. The following sections outline the general procedures for emergencies. Emergency information should be posted as appropriate.

10.1 Emergency Contacts for the SCT Site

Fire: 911

Police: 911

Sheriff: 911

Ambulance: 911

Hospital: St. Mary's Hospital of East St. Louis

Address: 129 North Eighth Street
East St. Louis, Illinois 62201

Telephone: (618) 274-1900

Chemical Trauma Capabilities? YES (However, they do not have an indoor decontamination area; decon can be completed outdoors under canopy)

Poison Control Center: 1-800-942-5969

*Directions from Site to Hospital

Take Cargill Road east to Route 3 and turn left. Proceed north and turn right and proceed east on Eighth Street to East St. Louis Hospital

NOTE: Maps and directions to the hospital will be posted in the office, decon trailers and decontamination area.

The route to the hospital was verified by: Tracey Fitzgerald on 10/18/99. Distance from site to hospital is approximately 5 miles. Approximate driving time is 10 minutes. The fire, police, and hospital were notified of site operations by Jim Davis on 10/18/99.

The following individuals have been trained in CPR and First Aid

START Tracey Fitzgerald

FOSC Kevin Turner

10.2 Additional Emergency Numbers

National Response Center	800-424-8802
U.S. EPA Region V - E.R. Branch	312-353-2318 (24 hr)
Center for Disease Control	404-488-4100 (24 hr)
AT&F (Explosives Information)	800-424-9555
Chemtrec	800-424-9300
Illinois Environmental Protection Agency (24-hr hotline)	217-782-3637

Ecology & Environment, Inc. Contacts:

E & E Regional Office (for this site)	312-578-9243
E & E MEDTOX Emergency Medical Hotline	501-221-0463 (24 Hr.) 904-462-3277/3281
Dr. Harbison (Home)	501-370-8263
E & E Corporate H & S - Dr. Paul Jonmaire	716-684-8060
E & E Emergency Operations Center Hotline	716-684-8940 (24 Hr.) 716-684-8060
START Leader Region V - Mary Jane Ripp	312-578-9243

Environmental Quality Management, Inc. Contacts:

EQM Regional Office	513-825-7500
EQM ERRS Hotline	800-500-0575
EQM H&S Director - J. Kominsky, CIH, CSP	513-825-7500
EQM H&S Coordinator - G. Koesters	513-825-7500
EQM Program Manager - J. Greber	513-825-7500
EQM Deputy Program Manager - J. Mullane	513-825-7500

Subcontractor

Lead ERRS Team Subcontractor: Environmental Restoration L.L.C.

Regional Offices Ellisville , Missouri Corporate H&S - Dennis Greaney	314-227-7477
Illinois EPA Collinsville Regional Office Bureau of Land Tom Miller FOS	618-346-5120

10.3 Emergency Equipment Available On-Site
Communications Equipment Location

Private Telephones: 618/332-2528
618/332-2560

Public Telephones: N/A

Mobile Telephones: Kevin Turner 618/525-3665 / Jim Davis 314/616-0824

Two-Way Radios: Command post / decon trailer

Emergency Alarms/Horns: Three blasts on horn

Medical Equipment

First Aid Kits: Located under table on south side of command post

Inspection Date: _____ By: _____
Stretcher/Backboard: None

Eye Wash Station: Located on table next to emergency shower next to decon trailer (within 100 feet of hazard zone)

Safety Shower: Located in the decon trailer

Fire-Fighting Equipment

Fire Extinguishers (1): Located in office trailer

Inspection Date: 10/99 By: Tom Farace

Fire Extinguishers (2): Lunch Trailer
Inspection Date: _____ By: _____

Fire Extinguishers (3): Excavator (1)

Inspection Date: _____ By: _____

Fire Extinguishers (4): Excavator (2)

Inspection Date: _____ By: _____

Fire Extinguishers (5): Drum Staging

Inspection Date: _____ By: _____

Fire Extinguishers (6): Pickup Truck

Inspection Date: _____ By: _____

Other: _____

Spill or Leak Equipment
Absorbent Boom/Pads: Located in storage trailer.

Dry Absorbent: Located in storage trailer.

Additional Emergency Equipment

10.4 Accident Reporting/Investigations (See Attachment F for proper procedures.)

11.0 EMERGENCY RESPONSE CONTINGENCY PLAN

11.1 Project Personnel Responsibilities During Emergencies

ON-SCENE COORDINATOR (FOSC)

As the administrator of the project, the FOSC has primary responsibility for responding to and correcting emergency situations. The FOSC will:

- Take appropriate measures to protect personnel including: withdrawal from the exclusion zone, total evacuation and securing of the site or up-grading or down-grading the level of protective clothing and respiratory protection.
- Take appropriate measures to protect the public and the environment including isolating and securing the site, preventing run-off to surface waters and ending or controlling the emergency to the extent possible.
- Ensure that appropriate Federal, State and local agencies are informed, and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be summoned immediately. In the event of an air release of toxic materials, the local authorities should be informed in order to assess the need for evacuation. In the event of a spill, sanitary districts and drinking water systems may need to be alerted.
- Ensure that appropriate decon treatment or testing for exposed or injured personnel is obtained.
- Determine the cause of the incident and make recommendations to prevent the recurrence.
- Ensure that all required reports have been prepared.

RESPONSE MANAGER (RM)

The RM must immediately report emergency situations to the FOSC, take appropriate measures to protect site personnel and assist the FOSC as necessary in responding to and mitigating the emergency situation.

SUPERFUND TECHNICAL ASSESSMENT and RESPONSE TEAM (START)

The START must immediately report emergency situations to the FOSC, take appropriate measures to protect site personnel and assist the FOSC as necessary.

11.2 Medical Emergencies:

Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible when practical. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket.) First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must immediately be reported to the FOSC.

Any person transporting an injured/exposed person to a clinic or hospital for treatment should take with them directions to the hospital and information on the chemical(s) they may have been exposed to. This information is included in Table 2.3. Any vehicle used to transport contaminated personnel, will be cleaned or decontaminated as necessary.

If the first aid provided to an injured person presents the possibility of exposure to blood or other body fluids or potentially infectious material, the caregiver must wear surgical type impermeable gloves. The exposure must be reported to the FOSC, the individual's supervisor, and the SSO within 24 hrs of exposure, naming the injured person(s) and the person(s) administering first aid. Hepatitis B vaccination and treatment must be offered to exposed individuals within 24 hours or as soon as possible after exposure. Exposed individuals may decline the vaccination and treatment but must do so by means of a signed statement.

11.3 Fire or Explosion:

In the event of a fire or explosion, the local fire department should be summoned immediately. Upon their arrival the FOSC or designated alternate will advise the fire commander of the location, nature and identification of the hazardous materials on- site.

If it is safe to do so, site personnel may:

- Use fire-fighting equipment available on site.
- Remove or isolate flammable or other hazardous materials which may contribute to the fire.

11.4 Spills, Leaks or Releases:

In the event of a spill or a leak, site personnel will:

- Locate the source of the spillage and stop the flow if it can be done safely.
- Begin containment and recovery of the spilled materials.

11.5 Evacuation Routes and Resources:

Evacuation routes have been established by work area locations for this site. All buildings and outside work areas have been provided with two designated exit points. Evacuation should be conducted immediately, without regard for equipment under conditions of extreme emergency. See site map for evacuation routes.

- Evacuation notification will be three blasts on an air horn, vehicle horn, or by verbal communication via radio.
- Keep upwind of smoke, vapors or spill location.
- Exit through the decontamination corridor if possible.
- If evacuation is not via the decontamination corridor, site personnel should remove contaminated clothing once they are in a location of safety and leave it near the exclusion zone or in a safe place.
- The FOSC will conduct a head count to insure all personnel have been evacuated safely.
- In the event that emergency site evacuation is necessary, all personnel are to:
    1. Escape the emergency situation;
    2. Decontaminate to the maximum extent practical; and,
    3. Meet at the U.S. EPA command post.
- In the event that the U.S. EPA command post is no longer in a safe zone, meet: on Cargill Road up wind of any airborne emissions.

11.6 Adverse Weather Reaction Plan

Adverse weather can take many forms. Severe thunder and lighting storms, winter storms, hail, freezing rain, flash floods, and tornados are a few examples. Sudden changes in the weather, extreme weather conditions, and natural disasters can create a number of hazards. Generally, adverse weather can create hazards due to slip, trips, and falls, generation of airborne debris, electrical shock, etc. Natural disasters can create many secondary hazards such as release of hazardous materials into the environment, structure failure and fires.

In the event of impending adverse weather, continuous monitoring will provide current information regarding impending adverse weather. In addition, monitoring of weather broadcasts and television broadcasts will provide information on current weather conditions. The terms "tornado watch" and "tornado warning" may be used during the broadcasts. The former term means the conditions are favorable for their development although none have actually been sighted. The latter term means that a tornado has been visually sighted. Additional weather terminology includes:

Weather Watch - Tornado, severe t-storms, flash flood, winter storm, Conditions are favorable for the development/occurrence of hazardous weather.

Weather Warning - by county issuance

Tornado - tornado sighted of indicated by radar

Sever T-storm - winds > 50 mph an/or 1/4" hail stones sighted or predicted by radar
Flash Flood - sighted or indicated by radar.

12.0 CONFINED SPACE

A confined space is defined as a space or work area not designed or intended for normal human occupancy, having limited means of access and poor natural ventilation, and or any structure, including buildings or rooms which have limited means of egress. Examples include tanks and basements. Confined spaces identified at this site are listed below. If a confined space entry is conducted, it will be done in accordance with procedures presented in OSHA standards Attachment __H__.

The SSO will evaluate any confined space to determine if it is a Permit Required Confine Space (PRCS). If it is a PRCS, the SSO will perform a hazard evaluation and identify means of entry, work to e completed, exit procedures, emergency exit procedures, needed equipment, and assigned personnel. The CSEP will be completed to reflect this evaluation. The CSEP will be authorized by the RM and reviewed by the FOSC. The CSEP and SOP will be discussed with personnel assigned to the task (i.e. entrants, standby, supervisor, and emergency responder). The fire department must be notified in advance if they are to be emergency responders. The permit will be valid for only one shift and one task. The permit will be maintained with site safety files.

Type of Confined Space	Location On-Site	Comments
Tank		

ATTACHMENT A
SITE SAFETY PLAN AMENDMENTS

SITE SAFETY PLAN AMENDMENT: #____ : _____

SITE NAME: _____

DATE: _____

TYPE OF AMENDMENT: _____

REASON FOR AMENDMENT: _____

ALTERNATE SAFEGUARD PROCEDURES: _____

REQUIRED CHANGES IN PPE: _____

_____ _____ _____

ERRS Response Manager (Date) ERRS Safety Manager (Date)

_____ _____ _____

E & E Lead START Member (Date) E & E RSO (Date)

_____

U.S. EPA FOSC (Date)

SITE SAFETY PLAN AMENDMENT: #____ : _____

SITE NAME: _____

DATE: _____

TYPE OF AMENDMENT: _____

REASON FOR AMENDMENT: _____

ALTERNATE SAFEGUARD PROCEDURES: _____

REQUIRED CHANGES IN PPE: _____

_____ _____ _____

ERRS Response Manager (Date) ERRS Safety Manager (Date)

_____ _____ _____

E & E Lead START Member (Date) E & E RSO (Date)

_____

U.S. EPA FOSC (Date)

ATTACHMENT B
SITE MAPS

MAP OF DECON AREA

SITE FEATURES MAP

SITE LOCATION MAP

HOSPITAL ROUTE MAP

ATTACHMENT C
CHEMICAL HAZARD INFORMATION

ATTACHMENT D

PERSONAL PROTECTIVE EQUIPMENT AND RESPIRATORY PROTECTION SOP'S

INSPECTION OF PERSONAL PROTECTIVE CLOTHING

[1] Determine that clothing material is correct for specified task
- a. compatibility chart
- b. chemical hazard chart in Safety Plan
- c. MSDS

[2] Visually inspect material for:
- a. imperfect seams
- b. non-uniform coatings
- c. tears
- d. discoloration/degradation
- e. malfunctioning closures

[3] Hold up to light and check for pinholes.

[4] Flex material:
- a. observe for cracks
- b. other signs of shelf deterioration

[5] If the material has been used previously, inspect inside and out for signs of chemical penetration/degradation
- a. discoloration
- b. swelling
- c. stiffness

[6] During the work task:
- a. evidence of discoloration/degradation
- b. closure failure
- c. tears
- d. punctures
- e. seam discontinuities

RESPIRATORY PROTECTION

General Guidelines

[1] All personnel required to use respirators will select and use the respirators based upon guidelines established by OSHA, NIOSH, and the RES Respiratory Protection Program.

[2] All individuals required to wear respirators will have received a documented pre-issue qualitative fit test for the MSA full-face.

[3] Each individual will be responsible for conducting a positive/negative fit check each time the respirator is donned.

[4] Each individual shall be responsible for cleaning his/her own respirator at least once daily and is permitted to leave the work area to wash his/her own respirator as needed.

[5] Cartridges or filters shall be changed after each daily use or whenever an increase in breathing resistance/odor is detected, or if they become wet. All changes will be made in uncontaminated areas.

[6] No RES employee shall wear a respirator until he/she has been examined by a physician and determined to be physically able to wear respiratory protection. This examination shall be documented at the site.

[7] All personnel must be fit tested every six months.

Air Purifying Respirator Inspection and Checkout

[1] Visually inspect the entire unit for any obvious damages, defects, or deteriorated rubber.

[2] Make sure the face piece harness is not damaged.

[3] Inspect lens for damage and proper seal in face piece.

[4] Exhalation Valve
Pull off plastic cover and check valve for debris, tears, or deformities in the neoprene valve.

[5] Inhalation Valve
Screw off cartridges/canister and visually inspect neoprene valves for tears. Make sure than inhalation valves and cartridge receptacle gaskets are in place.

[6] Insure that the speaking diaphragm retainer ring is hand tight.

[7] Make sure than you have the correct cartridge.

[8] Don and perform positive and negative pressure check.

Storage of Air Purifying Respirators

[1] OSHA requires that respirators be stored to protect against:

* Dust
* Sunlight
* Heat
* Extreme Cold
* Excessive Moisture
* Damaging Chemicals
* Mechanical Damage

[2] Respirators must be stored in a clean area which is not likely to be contaminated by the work in progress.

[3] Respirators should not be hung from their headbands for prolonged periods of time.

SCBA Inspection and Checkout

[1] Monthly Inspection

a. check cylinder label for current hydrostatic test date
b. inspect cylinder for large dent or gouges
c. inspect cylinder gauge for damage
d. complete routine inspection
e. fill out inspection documentation card

[2] Routine Inspection

a. Pre-Operational
* high-pressure hose connector is tight on cylinder fitting
* by-pass valve is closed
* mainline valve is closed
* regulator outlet is not covered or obstructed

b. Backpack and Harness Assembly
* inspect backpack/harness straps for wear, damage, secure
* check wear and function of belts
* check backplate and cylinder holder for damage

c. Cylinder and High Pressure Hose Assembly
* check cylinder to insure firmly attached to backplate
* open cylinder valve; listen or feel for leakage around packing and hose connection
* check high pressure hose for damage or leaks

d. Regulator
* cover regulator outlet with palm of hand
* open mainline valve
* remove hand from regulator outlet
* open by-pass valve slowly to assure proper function
* close by-pass valve
* open mainline valve
* note pressure reading on regulator gauge
* close cylinder valve while keeping hand over regulator outlet
* slowly remove hand from outlet and allow air to flow
* note pressure when low pressure warning alarm sounds; it should be 550-650 psi
* close mainline valve
* check regulator for leaks by blowing air into regulator for 5-10 seconds
* draw air from outlet for 5-10 seconds
* if a positive pressure or vacuum cannot be maintained, there is a leak.

e. Facepiece & Corrugated Breathing Hose

* inspect head harness and facepiece for damage, serrations, and deteriorated rubber
* inspect lens for damage and proper seal in facepiece
* inspect exhalation valve for damage and dirt buildup
* stretch breathing hose and carefully and inspect for holes and deterioration
* inspect connector for damage and presence of washer
* perform negative pressure test with facepiece donned

f. Storage

* refill cylinder to 2216 psi
* close cylinder valve
* tightly connect high pressure hose to cylinder
* bleed pressure from high pressure hose by opening mainline valve
* close by-pass valve
* close mainline valve
* fully extend all straps
* store facepiece in a clean plastic bag for protection

ATTACHMENT E
DRUG AND ALCOHOL PROCEDURES

ATTACHMENT F
ACCIDENT REPORTING/INVESTIGATIONS

EQM ACCIDENT REPORTING/INVESTIGATIONS

- All injuries or accidents must be reported to the Response Manager or Site Safety Officer immediately.
- The Response Manager will conduct an immediate investigation of the accident and document all results on the Supervisor's Accident Investigation Report and State Worker's Compensation Form.
- The Response Manager will assign a supervisory individual to accompany all injured personnel to the clinic and follow guidelines outlined in the RET Return to Work Program.
- Copies of all Supervisor's Accident Reports will be sent to the ERRS PM, ERRS DPM, and the ERRS Safety Manager (Team Subcontractor) and copies of accident reports will be sent to START Regional offices when dealing with START personnel.

ATTACHMENT G
OSHA GUIDANCE AND REGULATIONS

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 1
	DATE 9/17/93
	PAGE 1 OF --
SUBJECT	SUPERCEDES
Occupational Safety and Health Regulations	APPROVED

The March 6, 1989 revision of 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response" is reproduced here in its entirety.

ronmental Protection Agency, EPA/625/9-85/006; September 1985.

12. *Hazardous Waste Sites and Hazardous Substance Emergencies*, NIOSH Worker Bulletin, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; December 1982.

13. *Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide;* U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; October 1984.

14. *Fire Service Emergency Management Handbook*, Federal Emergency Management Agency, Washington, DC, January 1985.

15. *Emergency Response Guidebook*, U.S. Department of Transportation, Washington, DC, 1983.

[51 FR 45663, Dec. 19, 1986, as amended at 52 FR 16241, 16242, May 4, 1987]

EFFECTIVE DATE NOTE: At 54 FR 9317, Mar. 6, 1989, § 1910.120 was revised, effective March 6, 1990, for the convenience of the reader, the new text is set forth as follows:

§ 1910.120 Hazardous waste operations and emergency response.

(a) *Scope, application, and definitions*—(1) *Scope.* This section covers the following operations, unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards:

(i) Clean-up operations required by a governmental body, whether Federal, state, local or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority Site List (NPL), state priority site lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained);

(ii) Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 U.S.C. 6901 *et seq.*);

(iii) Voluntary clean-up operations at sites recognized by Federal, state, local or other governmental bodies as uncontrolled hazardous waste sites;

(iv) Operations involving hazardous wastes that are conducted at treatment, storage, and disposal (TSD) facilities regulated by 40 CFR Parts 264 and 265 pursuant to RCRA; or by agencies under agreement with U.S.E.P.A. to implement RCRA regulations; and

(v) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.

(2) *Application.* (i) All requirements of Part 1910 and Part 1926 of Title 29 of the Code of Federal Regulations apply pursuant to their terms to hazardous waste and emergency response operations whether covered by this section or not. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1910.5(c)(1).

(ii) Hazardous substance clean-up operations within the scope of paragraphs (a)(1)(i) through (a)(1)(iii) of this section must comply with all paragraphs of this section except paragraphs (p) and (q).

(iii) Operations within the scope of paragraph (a)(1)(iv) of this section must comply only with the requirements of paragraph (p) of this section.

Exceptions: For large quantity generators of hazardous waste who store those wastes less than 90 days and for small quantity generators of hazardous wastes, who have emergency response teams that respond to releases of, or substantial threats of releases of, hazardous substances, for their RCRA workplaces only paragraph (p)(8) of this section is applicable. Such generators of hazardous wastes who do not have emergency response teams that respond to releases of, or substantial threats of releases of, hazardous substances are exempt from the requirements of this section.

(iv) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances which are not covered by paragraphs (a)(1)(i) through (a)(1)(iv) of this section must only comply with the requirements of paragraph (q) of this section.

(3) *Definitions*—*"Buddy system"* means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

"Clean-up operation" means an operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleaned-up, or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

"Decontamination" means the removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health affects.

"Emergency response" or *"responding to emergencies"* means a response effort by

employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

"Facility" means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any water-borne vessel.

(3) *"Hazardous materials response (HAZMAT) team"* means an organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

"Hazardous substance" means any substance designated or listed under paragraphs (A) through (D) of this definition, exposure to which results or may result in adverse affects on the health or safety of employees:

(A) Any substance defined under section 101(14) of CERCLA;

(B) Any biological agent and other disease-causing agent as defined in section 101(33) of CERCLA;

(C) Any substance listed by the U.S. Department of Transportation as hazardous materials under 49 CFR 172.101 and appendices; and

(D) Hazardous waste as herein defined.

"Hazardous waste" means—

(A) A waste or combination of wastes as defined in 40 CFR 261.3, or

(B) Those substances defined as hazardous wastes in 49 CFR 171.8.

"Hazardous waste operation" means any operation conducted within the scope of this standard.

"Hazardous waste site" or "Site" means any facility or location within the scope of this standard at which hazardous waste operations take place.

"Health hazard" means a chemical, mixture of chemicals or a pathogen 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, heptaotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. It also includes stress due to temperature extremes. Further definition of the terms used above can be found in Appendix A to 29 CFR 1910.1200.

"IDLH" or *"Immediately dangerous to life or health"* means an atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

"Oxygen deficiency" means that concentration of oxygen by volume below which atmosphere supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

"Permissible exposure limit" means the exposure, inhalation or dermal permissible exposure limit specified in 29 CFR Part 1910, Subparts G and Z.

"Published exposure level" means the exposure limits published in "NIOSH Recommendations for Occupational Health Standards" dated 1986 incorporated by reference, or if none is specified, the exposure limits published in the standards specified by the American Conference of Governmental Industrial Hygienists in their publication "Threshold Limit Values and Biological Exposure Indices for 1987-88" dated 1987 incorporated by reference.

"Post emergency response" means that portion of an emergency response performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If post emergency response is performed by an employer's own employees who were part of the initial emergency response, it is considered to be part of the initial response and not post emergency response. However, if a group of an employer's own employees, separate from the group providing initial response,

performs the clean-up operation, then the separate group of employees would be considered to be performing post-emergency response and subject to paragraph (g)(11) of this section.

"Qualified person" means a person with specific training, knowledge and experience in the area for which the person has the responsibility and the authority to control.

"Site safety and health supervisor (or official)" means the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

"Small quantity generator" means a generator of hazardous wastes who in any calendar month generates no more than 1,000 kilograms (2,205 pounds) of hazardous waste in that month.

"Uncontrolled hazardous waste site" means an area where an accumulation of hazardous waste creates a threat to the health and safety of individuals or the environment or both. Some sites are found on public lands, such as those created by former municipal, county or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property, often belonging to generators or former generators of hazardous waste. Examples of such sites include, but are not limited to, surface impoundments, landfills, dumps, and tank or drum farms. Normal operations at TSD sites are not covered by this definition.

(b) *Safety and health program.*

NOTE TO (b): Safety and health programs developed and implemented to meet other Federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this paragraph. An additional or separate safety and health program is not required by this paragraph.

(1) *General.* (i) Employers shall develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards, and provide for emergency response for hazardous waste operations.

(ii) The written safety and health program shall incorporate the following:

(A) An organizational structure;

(B) A comprehensive workplan;

(C) A site-specific safety and health plan which need not repeat the employer's standard operating procedures required in paragraph (b)(1)(ii)(F) of this section;

(D) The safety and health training program;

(E) The medical surveillance program;

(F) The employer's standard operating procedures for safety and health; and

(G) Any necessary interface between general program and site specific activities.

(iii) *Site excavation.* Site excavations created during initial site preparation or during hazardous waste operations shall be shored or sloped as appropriate to prevent accidental collapse in accordance with Subpart P of 29 CFR Part 1926.

(iv) *Contractors and sub-contractors.* An employer who retains contractor or sub-contractor services for work in hazardous waste operations shall inform those contractors, sub-contractors, or their representatives of the site emergency response procedures and any potential fire, explosion, health, safety or other hazards of the hazardous waste operation that have been identified by the employer, including those identified in the employer's information program.

(v) *Program availability.* The written safety and health program shall be made available to any contractor or subcontractor or their representative who will be involved with the hazardous waste operation; to employees; to employee designated representatives; to OSHA personnel, and to personnel of other Federal, state, or local agencies with regulatory authority over the site.

(2) *Organizational structure part of the site program.*—(i) The organizational structure part of the program shall establish the specific chain of command and specify the overall responsibilities of supervisors and employees. It shall include, at a minimum, the following elements:

(A) A general supervisor who has the responsibility and authority to direct all hazardous waste operations.

(B) A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

(C) All other personnel needed for hazardous waste site operations and emergency response and their general functions and responsibilities.

(D) The lines of authority, responsibility, and communication.

(ii) The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.

(3) *Comprehensive workplan part of the site program.* The comprehensive workplan part of the program shall address the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives.

(i) The comprehensive workplan shall address anticipated clean-up activities as well as normal operating procedures which need not repeat the employer's procedures available elsewhere.

(ii) The comprehensive workplan shall define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.

(iii) The comprehensive workplan shall establish personnel requirements for implementing the plan.

(iv) The comprehensive workplan shall provide for the implementation of the training required in paragraph (e) of this section.

(v) The comprehensive workplan shall provide for the implementation of the required informational programs required in paragraph (l) of this section.

(vi) The comprehensive workplan shall provide for the implementation of the medical surveillance program described in paragraph (f) of this section.

(4) *Site-specific safety and health plan part of the program.*—(i) *General.* The site safety and health plan, which must be kept on site, shall address the safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection.

(ii) *Elements.* The site safety and health plan, as a minimum, shall address the following:

(A) A safety and health risk or hazard analysis for each site task and operation found in the workplan.

(B) Employee training assignments to assure compliance with paragraph (e) of this section.

(C) Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in paragraph (g)(5) of this section.

(D) Medical surveillance requirements in accordance with the program in paragraph (f) of this section.

(E) Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

(F) Site control measures in accordance with the site control program required in paragraph (d) of this section.

(G) Decontamination procedures in accordance with paragraph (k) of this section.

(H) An emergency response plan meeting the requirements of paragraph (l) of this section for safe and effective responses to emergencies, including the necessary PPE and other equipment.

(I) Confined space entry procedures.

(J) A spill containment program meeting the requirements of paragraph (j) of this section.

(iii) *Pre-entry briefing.* The site specific safety and health plan shall provide for pre-entry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data obtained from site characterization and analysis work required in paragraph (c) of this section shall be used to prepare and update the site safety and health plan.

(iv) *Effectiveness of site safety and health plan.* Inspections shall be conducted by the site safety and health supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health, acting on behalf of the employer as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected by the employer.

(c) *Site characterization and analysis.*—(1) *General.* Hazardous waste sites shall be evaluated in accordance with this paragraph to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

(2) *Preliminary evaluation.* A preliminary evaluation of a site's characteristics shall be performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods prior to site entry. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics shall be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

(3) *Hazard identification.* All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH), or other conditions that may cause death or serious harm, shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to, confined space entry, potentially explosive or flammable situations, visible vapor clouds, or areas where biological indicators such as dead animals or vegetation are located.

(4) *Required information.* The following information to the extent available shall be obtained by the employer prior to allowing employees to enter a site:

(i) Location and approximate size of the site.

(ii) Description of the response activity and/or the job task to be performed.

(iii) Duration of the planned employee activity.

(iv) Site topography and accessibility by air and roads.

(v) Safety and health hazards expected at the site.

(vi) Pathways for hazardous substance dispersion.

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(vii) Present status and capabilities of emergency response teams that would provide assistance to hazardous waste clean-up site employees at the time of an emergency.

(viii) Hazardous substances and health hazards involved or expected at the site, and their chemical and physical properties.

(5) *Personal protective equipment.* Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with the following requirements:

(i) Based upon the results of the preliminary site evaluation, an ensemble of PPE shall be selected and used during initial site entry which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards, and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate personal protective equipment.

(ii) If positive-pressure self-contained breathing apparatus is not used as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least five minute's duration shall be carried by employees during initial site entry.

(iii) If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site, an ensemble providing protection equivalent to Level B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions. (See Appendix B for a description of Level B hazards and the recommendations for Level B protective equipment.)

(iv) Once the hazards of the site have been identified, the appropriate PPE shall be selected and used in accordance with paragraph (g) of this section.

(6) *Monitoring.* The following monitoring shall be conducted during initial site entry when the site evaluation produces information that shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient reasonably to eliminate these possible conditions:

(i) Monitoring with direct reading instruments for hazardous levels of ionizing radiation.

(ii) Monitoring the air with appropriate direct reading test equipment (i.e., combustible gas meters, detector tubes) for IDLH and other conditions that may cause death or serious harm (combustible or explosive atmospheres, oxygen deficiency, toxic substances).

(iii) Visually observing for signs of actual or potential IDLH or other dangerous conditions.

(iv) An ongoing air monitoring program in accordance with paragraph (h) of this section shall be implemented after site characterization has determined the site is safe for the start-up of operations.

(7) *Risk identification.* Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified. In situations covered by the Hazard Communication Standard, 29 CFR 1910.1200, training required by that standard need not be duplicated.

NOTE TO (c)(7).—Risks to consider include, but are not limited to:

(a) Exposures exceeding the permissible exposure limits and published exposure levels.

(b) IDLH concentrations.

(c) Potential skin absorption and irritation sources.

(d) Potential eye irritation sources.

(e) Explosion sensitivity and flammability ranges.

(f) Oxygen deficiency.

(8) *Employee notification.* Any information concerning the chemical, physical, and toxicologic properties of each substance known or expected to be present on site that is available to the employer and relevant to the duties an employee is expected to perform shall be made available to the affected employees prior to the commencement of their work activities. The employer may utilize information developed for the hazard communication standard for this purpose.

(d) *Site control*—(1) *General.* Appropriate site control procedures shall be implemented to control employee exposure to hazardous substances before clean-up work begins.

(2) *Site control program.* A site control program for protecting employees which is part of the employer's site safety and health program required in paragraph (b) of this section shall be developed during the planning stages of a hazardous waste clean-up operation and modified as necessary as new information becomes available.

(3) *Elements of the site control program.* The site control program shall, as a minimum, include: A site map; site work zones; the use of a "buddy system"; site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and, identification of the nearest medical assistance. Where these requirements are covered elsewhere they need not be repeated.

(e) *Training*—(1) *General.* (i) All employees working on site (such as but not limited to equipment operators, general laborers and others) exposed to hazardous substances, health hazards, or safety hazards and their supervisors and management responsible for the site shall receive training meeting the requirements of this paragraph before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards, and they shall receive review training as specified in this paragraph.

(ii) Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

(2) *Elements to be covered.* The training shall thoroughly cover the following:

(i) Names of personnel and alternates responsible for site safety and health;

(ii) Safety, health and other hazards present on the site;

(iii) Use of personal protective equipment;

(iv) Work practices by which the employee can minimize risks from hazards;

(v) Safe use of engineering controls and equipment on the site;

(vi) Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards; and

(vii) The contents of paragraphs (G) through (J) of the site safety and health plan set forth in paragraph (b)(4)(ii) of this section.

(3) *Initial training.* (i) General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.

(ii) Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geo-physical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iii) Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iv) Workers with 24 hours of training who are covered by paragraphs (a)(3)(ii) and (a)(3)(iii) of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two days of training necessary to total the training specified in paragraph (e)(3)(i).

(4) *Management and supervisor training.* On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive 40 hours initial training, and three days of supervised field experience (the training may be reduced to 24 hours and one day if the only area of their responsibility is employees covered by paragraphs (e)(3)(ii) and (e)(3)(iii)) and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

(5) *Qualifications for trainers.* Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter.

(6) *Training certification.* Employees and supervisors that have received and successfully completed the training and field experience specified in paragraphs (e)(1) through (e)(4) of this section shall be certified by their instructor or the head instructor and trained supervisor as having successfully completed the necessary training. A written certificate shall be given to each person so certified. Any person who has not been so certified or who does not meet the requirements of paragraph (e)(9) of this section shall be prohibited from engaging in hazardous waste operations.

(7) *Emergency response.* Employees who are engaged in responding to hazardous emergency situations at hazardous waste clean-up sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

(8) *Refresher training.* Employees specified in paragraph (e)(1) of this section, and

managers and supervisors specified in paragraph (e)(4) of this section, shall receive eight hours of refresher training annually on the items specified in paragraph (e)(2) and/or (e)(4) of this section, any critique of incidents that have occurred in the past year that can serve as training examples of related work, and other relevant topics.

(9) *Equivalent training.* Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in paragraphs (e)(1) through (e)(4) of this section shall not be required to provide the initial training requirements of those paragraphs to such employees. However, certified employees new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience.

(f) *Medical surveillance.*(1) *General.* Employers engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section and not covered by (a)(2)(iii) exceptions and employers of employees specified in paragraph (q)(9) shall institute a medical surveillance program in accordance with this paragraph.

(2) *Employees covered.* The medical surveillance program shall be instituted by the employer for the following employees:

(i) All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;

(ii) All employees who wear a respirator for 30 days or more a year or as required by § 1910.134;

(iii) All employees who are injured due to overexposure from an emergency incident involving hazardous substances or health hazards; or

(iv) Members of HAZMAT teams.

(3) *Frequency of medical examinations and consultations.* Medical examinations and consultations shall be made available by the employer to each employee covered under paragraph (f)(2) of this section on the following schedules:

(i) For employees covered under paragraphs (f)(2)(i), (f)(2)(ii), and (f)(2)(iv):

(A) Prior to assignment;

(B) At least once every twelve months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;

(C) At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months;

(D) As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;

(E) At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

(ii) For employees covered under paragraph (f)(2)(iii) and for all employees including those of employers covered by paragraph (a)(1)(v) who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used:

(A) As soon as possible following the emergency incident or development of signs or symptoms;

(B) At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

(4) *Content of medical examinations and consultations.* (i) Medical examinations required by paragraph (f)(3) of this section shall include a medical and work history (or updated history if one is in the employee's file) with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.

(ii) The content of medical examinations or consultations made available to employees pursuant to paragraph (f) shall be determined by the attending physician. The guidelines in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (See Appendix D, Reference #10) should be consulted.

(5) *Examination by a physician and costs.* All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(6) *Information provided to the physician.* The employer shall provide one copy of this standard and its appendices to the attending physician, and in addition the following for each employee:

(i) A description of the employee's duties as they relate to the employee's exposures.

(ii) The employee's exposure levels or anticipated exposure levels.

(iii) A description of any personal protective equipment used or to be used.

(iv) Information from previous medical examinations of the employee which is not readily available to the examining physician.

(v) Information required by § 1910.134.

(7) *Physician's written opinion.* (i) The employer shall obtain and furnish the employee with a copy of a written opinion from the attending physician containing the following:

(A) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

(B) The physician's recommended limitations upon the employee's assigned work.

(C) The results of the medical examination and tests if requested by the employee.

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposures.

(8) *Recordkeeping.* (i) An accurate record of the medical surveillance required by paragraph (f) of this section shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1910.20.

(ii) The record required in paragraph (f)(8)(i) of this section shall include at least the following information:

(A) The name and social security number of the employee;

(B) Physician's written opinions, recommended limitations, and results of examinations and tests;

(C) Any employee medical complaints related to exposure to hazardous substances;

(D) A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

(g) *Engineering controls, work practices, and personal protective equipment for employee protection.* Engineering controls, work practices, personal protective equipment, or a combination of these shall be implemented in accordance with this paragraph to protect employees from exposure to hazardous substances and safety and health hazards.

(1) *Engineering controls, work practices and PPE for substances regulated in Subparts G and Z.* (i) Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits for substances regulated by 29 CFR Part 1910, to the extent required by Subpart Z, except to the extent that such controls and practices are not feasible.

NOTE TO (g)(1)(i): Engineering controls which may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices which may be feasible are removing all non-essential employees from potential exposure during opening of drums, wetting down dusty operations and locating employees upwind of possible hazards.

(ii) Whenever engineering controls and work practices are not feasible, PPE shall be used to reduce and maintain employee exposures to or below the permissible exposure limits or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

(iii) The employer shall not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

(iv) The provisions of 29 CFR, Subpart G, shall be followed.

(2) *Engineering controls, work practices, and PPE for substances not regulated in Subparts G and Z.* An appropriate combination of engineering controls, work practices and personal protective equipment shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Z. The employer may use the published literature and MSDS as a guide in making the employer's determination as to what level of protection the employer believes is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

(3) *Personal protective equipment selection.* (i) Personal protective equipment (PPE) shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

(ii) Personal protective equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

(iii) Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply, shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(iv) Totally-encapsulating chemical protective suits (protection equivalent to Level A protection as recommended in Appendix B) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(v) The level of protection provided by PPE selection shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See Appendix B for guidance on selecting PPE ensembles.)

NOTE TO (G)(3): The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

(vi) Personal protective equipment shall be selected and used to meet the requirements of 29 CFR Part 1910, Subpart I, and additional requirements specified in this section.

(4) *Totally-encapsulating chemical protective suits.* (i) Totally-encapsulating suits shall protect employees from the particular hazards which are identified during site characterization and analysis.

(ii) Totally-encapsulating suits shall be capable of maintaining positive air pressure. (See Appendix A for a test method which may be used to evaluate this requirement.)

(iii) Totally-encapsulating suits shall be capable of preventing inward test gas leakage of more than 0.5 percent. (See Appendix A for a test method which may be used to evaluate this requirement.)

(5) *Personal protective equipment (PPE) program.* A written personal protective equipment program, which is part of the employer's safety and health program required in paragraph (b) of this section or required in paragraph (p)(1) of this section and which is also a part of the site-specific safety and health plan shall be established. The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

(i) PPE selection based upon site hazards,

(ii) PPE use and limitations of the equipment,

(iii) Work mission duration,

(iv) PPE maintenance and storage,

(v) PPE decontamination and disposal,

(vi) PPE training and proper fitting,

(vii) PPE donning and doffing procedures,

(viii) PPE inspection procedures prior to, during, and after use,

(ix) Evaluation of the effectiveness of the PPE program, and

(x) Limitations during temperature extremes, heat stress, and other appropriate medical considerations.

(h) *Monitoring*—(1) *General.* (i) Monitoring shall be performed in accordance with this paragraph where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits or published exposure levels for hazardous substances.

(ii) Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.

(2) *Initial entry.* Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits or other dangerous condition such as the presence of flammable atmospheres or oxygen-deficient environments.

(3) *Periodic monitoring.* Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

(i) When work begins on a different portion of the site.

(ii) When contaminants other than those previously identified are being handled.

(iii) When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).

(iv) When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

(4) *Monitoring of high-risk employees.* After the actual clean-up phase of any hazardous waste operation commences; for example, when soil, surface water or containers are moved or disturbed; the employer shall monitor those employees likely to have the highest exposures to hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently enough to characterize employee exposures. If the employees likely to have the highest exposure are over permissible exposure limits or published exposure limits, then monitoring shall continue to determine all employees likely to be above those limits. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated above.

NOTE TO (H): It is not required to monitor employees engaged in site characterization operations covered by paragraph (c) of this section.

(i) *Informational programs.* Employers shall develop and implement a program, which is part of the employer's safety and health program required in paragraph (b) of this section, to inform employees, contractors, and subcontractors (or their representative) actually engaged in hazardous waste operations of the nature, level and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors and subcontractors working outside of the operations part of a site are not covered by this standard.

(j) *Handling drums and containers*—(1) *General.* (i) Hazardous substances and contaminated soils, liquids, and other residues shall be handled, transported, labeled, and disposed of in accordance with this paragraph.

(ii) Drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

(iii) When practical, drums and containers shall be inspected and their integrity shall be assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions (i.e., buried beneath the earth, stacked behind other drums, stacked several tiers high in a pile, etc.) shall be moved to an accessible location and inspected prior to further handling.

(iv) Unlabelled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

(v) Site operations shall be organized to minimize the amount of drum or container movement.

(vi) Prior to movement of drums or containers, all employees exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.

(vii) U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent shall be kept available and used in areas where spills, leaks, or ruptures may occur.

(viii) Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in paragraph (b) of this section, shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

(ix) Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using a device classified for the material being transferred.

(x) A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of buried drums or containers.

(xi) Soil or covering material shall be removed with caution to prevent drum or container rupture.

(xii) Fire extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L, shall be on hand and ready for use to control incipient fires.

(2) *Opening drums and containers.* The following procedures shall be followed in areas where drums or containers are being opened:

(i) Where an airline respirator system is used, connections to the source of air supply shall be protected from contamination and the entire system shall be protected from physical damage.

(ii) Employees not actually involved in opening drums or containers shall be kept a safe distance from the drums or containers being opened.

(iii) If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation shall be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.

(iv) Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the explosion-resistant barrier.

(v) When there is a reasonable possibility of flammable atmospheres being present, material handling equipment and hand tools shall be of the type to prevent sources of ignition.

(vi) Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure can not be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

(vii) Employees shall not stand upon or work from drums or containers.

(3) *Material handling equipment.* Material handling equipment used to transfer drums and containers shall be selected, positioned and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

(4) *Radioactive wastes.* Drums and containers containing radioactive wastes shall not be handled until such time as their hazard to employees is properly assessed.

(5) *Shock sensitive wastes.* As a minimum, the following special precautions shall be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

(i) All non-essential employees shall be evacuated from the area of transfer.

(ii) Material handling equipment shall be provided with explosive containment devices or protective shields to protect equipment operators from exploding containers.

(iii) An employee alarm system capable of being perceived above surrounding light and noise conditions shall be used to signal the commencement and completion of explosive waste handling activities.

(iv) Continuous communications (i.e., portable radios, hand signals, telephones, as appropriate) shall be maintained between the employee-in-charge of the immediate handling area and both the site safety and health supervisor and the command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock sensitive materials to explode shall not be used.

(v) Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

(vi) Drums and containers containing packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials until they have been characterized.

CAUTION: Shipping of shock sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Employers and their shippers should refer to 49 CFR 173.21 and 173.50.

(6) *Laboratory waste packs.* In addition to the requirements of paragraph (j)(5) of this section, the following precautions shall be taken, as a minimum, in handling laboratory waste packs (lab packs):

(i) Lab packs shall be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes.

(ii) If crystalline material is noted on any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.

(7) *Sampling of drum and container contents.* Sampling of containers and drums shall be done in accordance with a sampling procedure which is part of the site safety and health plan developed for and available to employees and others at the specific worksite.

(8) *Shipping and transport.* (i) Drums and containers shall be identified and classified prior to packaging for shipment.

(ii) Drum or container staging areas shall be kept to the minimum number necessary to identify and classify materials safely and prepare them for transport.

(iii) Staging areas shall be provided with adequate access and egress routes.

(iv) Bulking of hazardous wastes shall be permitted only after a thorough characterization of the materials has been completed.

(9) *Tank and vault procedures.* (i) Tanks and vaults containing hazardous substances shall be handled in a manner similar to that for drums and containers, taking into consideration the size of the tank or vault.

(ii) Appropriate tank or vault entry procedures as described in the employer's safety and health plan shall be followed whenever employees must enter a tank or vault.

(k) *Decontamination*—(1) *General.* Procedures for all phases of decontamination shall be developed and implemented in accordance with this paragraph.

(2) *Decontamination procedures.* (i) A decontamination procedure shall be developed, communicated to employees and implemented before any employees or equipment may enter areas on site where potential for exposure to hazardous substances exists.

(ii) Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

(iii) All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

(iv) Decontamination procedures shall be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

(3) *Location.* Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

(4) *Equipment and solvents.* All equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

(5) *Personal protective clothing and equipment.* (i) Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

(ii) Employees whose non-impermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

(6) *Unauthorized employees.* Unauthorized employees shall not remove protective clothing or equipment from change rooms.

(7) *Commercial laundries or cleaning establishments.* Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures to hazardous substances.

(8) *Showers and change rooms.* Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they shall be provided and meet the requirements of 29 CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing shall be provided and used.

(l) *Emergency response by employees at uncontrolled hazardous waste sites*—(1) *Emergency response plan.* (i) An emergency response plan shall be developed and implemented by all employers within the scope of this section to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.

(ii) Employers who will evacuate their employees from the workplace when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan complying with section 1910.38(a) of this part.

(2) *Elements of an emergency response plan.* The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following:

(i) Pre-emergency planning.

(ii) Personnel roles, lines of authority, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination procedures which are not covered by the site safety and health plan.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(3) *Procedures for handling emergency incidents.* (i) In addition to the elements for the emergency response plan required in paragraph (l)(2) of this section, the following elements shall be included for emergency response plans:

(A) Site topography, layout, and prevailing weather conditions.

(B) Procedures for reporting incidents to local, state, and federal governmental agencies.

(ii) The emergency response plan shall be a separate section of the Site Safety and Health Plan.

(iii) The emergency response plan shall be compatible and integrated with the disaster fire and/or emergency response plans of local, state, and federal agencies.

(iv) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(v) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(vi) An employee alarm system shall be installed in accordance with 29 CFR 1910.16 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to spec communication; and to begin emergenc procedures.

(vii) Based upon the information availabl at time of the emergency, the employe shall evaluate the incident and the site r sponse capabilities and proceed with the ap propriate steps to implement the site eme gency response plan.

(m) *Illumination.* Areas accessible to employees shall be lighted to not less than the minimum illumination intensities listed in the following Table H-120.1 while any work is in progress:

TABLE H-120.1—MINIMUM ILLUMINATION INTENSITIES IN FOOT-CANDLES

Foot-candles	Area or operations
5	General site areas.
3	Excavation and waste areas, accessway active storage areas, loading platform refueling, and field maintenance areas.
5	Indoors: Warehouses, corridors, hallway and exitways.

TABLE H-120.1—MINIMUM ILLUMINATION INTENSITIES IN FOOT-CANDLES—Continued

Foot-candles	Area or operations
5	Tunnels, shafts, and general underground work areas. (Exception: Minimum of 10 foot-candles is required at tunnel and shaft heading during drilling mucking, and scaling. Mine Safety and Health Administration approved cap lights shall be acceptable for use in the tunnel heading.)
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.)
30	First aid stations, infirmaries, and offices.

(n) *Sanitation at temporary workplaces.*—(1) *Potable water.* (i) An adequate supply of potable water shall be provided on the site.

(ii) Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

(iii) Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

(iv) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

(2) *Nonpotable water.* (i) Outlets for nonpotable water, such as water for firefighting purposes, shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(ii) There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

(3) *Toilet facilities.* (i) Toilets shall be provided for employees according to the following Table H-120.2.

TABLE H-120.2—TOILET FACILITIES

Number of employees	Minimum number of facilities
20 or fewer	One.
More than 20, fewer than 200.	One toilet seat and one urinal per 40 employees.
More than 200	One toilet seat and one urinal per 50 employees.

(ii) Under temporary field conditions, provisions shall be made to assure that at least one toilet facility is available.

(iii) Hazardous waste sites not provided with a sanitary sewer shall be provided with the following toilet facilities unless prohibited by local codes:

(A) Chemical toilets;
(B) Recirculating toilets;
(C) Combustion toilets; or
(D) Flush toilets.

(iv) The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

(v) Doors entering toilet facilities shall be provided with entrance locks controlled from inside the facility.

(4) *Food handling.* All food service facilities and operations for employees shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

(5) *Temporary sleeping quarters.* When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

(6) *Washing facilities.* The employer shall provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be in near proximity to the worksite; in areas where exposures are below permissible exposure limits and published exposure levels and which are under the controls of the employer; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

(7) *Showers and change rooms.* When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require six months or greater time to complete, the employer shall provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations.

(i) Showers shall be provided and shall meet the requirements of 29 CFR 1910.141(d)(3).

(ii) Change rooms shall be provided and shall meet the requirements of 29 CFR 1910.141(e). Change rooms shall consist of two separate change areas separated by the shower area required in paragraph (n)(7)(i) of this section. One change area, with an exit leading off the worksite, shall provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to the worksite, shall provide employees with an area where they can put on, remove and store work clothing and personal protective equipment.

(iii) Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels.

(iv) Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

(o) *New technology programs.* (1) The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(2) New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminates while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations shall be made available to OSHA upon request.

(p) *Certain Operations Conducted Under the Resource Conservation and Recovery Act of 1976 (RCRA).* Employers conducting operations at treatment, storage, and disposal (TSD) facilities specified in paragraph (a)(1)(iv) of this section not exempted by paragraph (a)(2)(iii) of this section shall provide and implement the programs specified in this paragraph.

(1) *Safety and health program.* The employer shall develop and implement a written safety and health program for employees involved in hazardous waste operations that shall be available for inspection by employees, their representatives and OSHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection, to provide for emergency response meeting the requirements of paragraph (p)(8) of this section and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and uses of new technologies.

(2) *Hazard communication program.* The employer shall implement a hazard communication program meeting the requirements of 29 CFR 1910.1200 as part of the employer's safety and program.

NOTE TO 1910.120.—The exemption for hazardous waste provided in § 1910.1200 is applicable to this section.

(3) *Medical surveillance program.* The employer shall develop and implement a medical surveillance program meeting the requirements of paragraph (f) of this section.

(4) *Decontamination program.* The employer shall develop and implement a decontamination procedure meeting the requirements of paragraph (k) of this section.

(5) *New technology program.* The employer shall develop and implement procedures meeting the requirements of paragraph (o) of this section for introducing new and innovative equipment into the workplace.

(6) *Material handling program.* Where employees will be handling drums or containers, the employer shall develop and implement procedures meeting the requirements of paragraphs (j)(1) (ii) through (viii) and (xi) of this section, as well as (j)(3) and (j)(8) of this section prior to starting such work.

(7) *Training program*—(i) *New employees.* The employer shall develop and implement a training program, which is part of the employer's safety and health program, for employees involved with hazardous waste operations to enable employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees. The initial training shall be for 24 hours and refresher training shall be for eight hours annually. Employees who have received the initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

(ii) *Current employees.* Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training requirements of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive eight hours of refresher training annually.

(iii) *Trainers.* Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.

(8) *Emergency response program*—(i) *Emergency response plan.* An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan. The emergency response plan shall be a written portion of the employers safety and health program required in para-

graph (p)(1) of this section. Employers who will evacuate their employees from the worksite location when an emergency occurs and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of paragraph (p)(8) if they provide an emergency action plan complying with § 1910.38(a) of this part.

(ii) *Elements of an emergency response plan.* The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

(A) Pre-emergency planning and coordination with outside parties.

(B) Personnel roles, lines of authority, and communication.

(C) Emergency recognition and prevention.

(D) Safe distances and places of refuge.

(E) Site security and control.

(F) Evacuation routes and procedures.

(G) Decontamination procedures.

(H) Emergency medical treatment and first aid.

(I) Emergency alerting and response procedures.

(J) Critique of response and follow-up.

(K) PPE and emergency equipment.

(iii) *Training.* (A) Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn and procedures for handling emergency incidents.

Exception #1: An employer need not train all employees to the degree specified if the employer divides the work force in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt control activities for which they are not trained.

Exception #2: An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully-trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside fully-trained emergency response team for assistance.

(B) Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control equipment; in the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate response to over exposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from over exposures.

(C) The employer shall certify that each covered employee has attended and successfully completed the training required in paragraph (p)(8)(iii) of this section, or shall certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training shall be recorded and maintained by the employer.

(iv) *Procedures for handling emergency incidents.* (A) In addition to the elements for the emergency response plan required in paragraph (p)(8)(ii) of this section, the following elements shall be included for emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:

(*1*) Site topography, layout, and prevailing weather conditions.

(*2*) Procedures for reporting incidents to local, state, and federal governmental agencies.

(B) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(C) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(D) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(E) An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(F) Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(q) *Emergency response to hazardous substance releases.* This paragraph covers employers whose employees are engaged in emergency response no matter where it occurs except that it does not cover employees engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section. Those emergency response organizations who have developed and implemented programs equivalent to this paragraph for handling releases of hazardous substances pursuant to section 303 of the Superfund Amendments and Reauthorization Act of 1986 (Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11003) shall be deemed to have met the requirements of this paragraph.

(1) *Emergency response plan.* An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to the commencement of emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives and OSHA personnel. Employers who will evacuate their employees from the workplace when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan in accordance with § 1910.38(a) of this part.

(2) *Elements of an emergency response plan.* The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following to the extent that they are not addressed elsewhere:

(i) Pre-emergency planning and coordination with outside parties.

(ii) Personnel roles, lines of authority, training, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(xii) Emergency response organizations may use the local emergency response plan or the state emergency response plan or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are being properly addressed by the SARA Title III plans may be substituted into their emergency plan or otherwise kept together for the employer and employee's use.

(3) *Procedures for handling emergency response.* (i) The senior emergency response official responding to an emergency shall become the individual in charge of a site-specific Incident Command System (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS assisted by the senior official present for each employer.

NOTE TO (q)(3)(i).—The "senior official" at an emergency response is the most senior official on the site who has the responsibility for controlling the operations at the site. Initially it is the senior officer on the first-due piece of responding emergency apparatus to arrive on the incident scene. As more senior officers arrive (i.e., battalion chief, fire chief, state law enforcement official, site coordinator, etc.) the position is passed up the line of authority which has been previously established.

(ii) The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.

(iii) Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations, and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet, at a minimum, the criteria contained in 29 CFR 1910.156(e) when worn while performing fire fighting operations beyond the incipient stage for any incident or site.

(iv) Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear positive pressure self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.

(v) The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site, in those areas of potential or actual exposure to incident or site hazards, to those who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of two or more.

(vi) Back-up personnel shall stand by with equipment ready to provide assistance or rescue. Advance first aid support personnel,

as a minimum, shall also stand by with medical equipment and transportation capability.

(vii) The individual in charge of the ICS shall designate a safety official, who is knowledgable in the operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.

(viii) When activities are judged by the safety official to be an IDLH condition and/or to involve an imminent danger condition, the safety official shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at an emergency scene.

(ix) After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

(x) When deemed necessary for meeting the tasks at hand, approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.

(4) *Skilled support personnel.* Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer's regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel.

(5) *Specialist employees.* Employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances, and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge, shall receive training or demonstrate competency in the area of their specialization annually.

(6) *Training.* Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in emergency response, shall be given training in accordance with the following paragraphs:

(i) *First responder awareness level.* First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

(A) An understanding of what hazardous materials are, and the risks associated with them in an incident.

(B) An understanding of the potential outcomes associated with an emergency created when hazardous materials are present.

(C) The ability to recognize the presence of hazardous materials in an emergency.

(D) The ability to identify the hazardous materials, if possible.

(E) An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(F) The ability to realize the need for additional resources, and to make appropriate notifications to the communication center.

(ii) *First responder operations level.* First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(A) Knowledge of the basic hazard and risk assessment techniques.

(B) Know how to select and use proper personal protective equipment provided to the first responder operational level.

(C) An understanding of basic hazardous materials terms.

(D) Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.

(E) Know how to implement basic decontamination procedures.

(F) An understanding of the relevant standard operating procedures and termination procedures.

(iii) *Hazardous materials technician.* Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the employer's emergency response plan.

(B) Know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment.

(C) Be able to function within an assigned role in the Incident Command System.

(D) Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(E) Understand hazard and risk assessment techniques.

(F) Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.

(G) Understand and implement decontamination procedures.

(H) Understand termination procedures.

(I) Understand basic chemical and toxicological terminology and behavior.

(iv) *Hazardous materials specialist.* Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician, however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with Federal, state, local and other government authorities in regards to site activities. Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the local emergency response plan.

(B) Understand classification, identification and verification of known and unknown materials by using advanced survey instruments and equipment.

(C) Know of the state emergency response plan.

(D) Be able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

(E) Understand in-depth hazard and risk techniques.

(F) Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

(G) Be able to determine and implement decontamination procedures.

(H) Have the ability to develop a site safety and control plan.

(I) Understand chemical, radiological and toxicological terminology and behavior.

(v) *On scene incident commander.* Incident commanders, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know and be able to implement the employer's incident command system.

(B) Know how to implement the employer's emergency response plan.

(C) Know and understand the hazards and risks associated with employees working in chemical protective clothing.

(D) Know how to implement the local emergency response plan.

(E) Know of the state emergency response plan and of the Federal Regional Response Team.

(F) Know and understand the importance of decontamination procedures.

(7) *Trainers.* Trainers who teach any of the above training subjects shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the U.S. Fire Academy, or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach.

(8) *Refresher training.* (i) Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training of sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

(ii) A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

(9) *Medical surveillance and consultation.* (i) Members of an organized and designated HAZMAT team and hazardous materials specialists shall receive a baseline physical examination and be provided with medical surveillance as required in paragraph (f) of this section.

(ii) Any emergency response employees who exhibits signs or symptoms which may have resulted from exposure to hazardous substances during the course of an emergency incident, either immediately or subsequently, shall be provided with medical consultation as required in paragraph (f)(3)(ii) of this section.

(10) *Chemical protective clothing.* Chemical protective clothing and equipment to be used by organized and designated HAZMAT team members, or to be used by hazardous materials specialists, shall meet the requirements of paragraphs (g) (3) through (5) of this section.

(11) *Post-emergency response operations.* Upon completion of the emergency response, if it is determined that it is necessary to remove hazardous substances, health hazards, and materials contaminated with them (such as contaminated soil or other elements of the natural environment) from the site of the incident, the employer conducting the clean-up shall comply with one of the following:

(i) Meet all of the requirements of paragraphs (b) through (o) of this section; or

(ii) Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training requirements of the following: 29 CFR 1910.38(a); 1910.134; 1910.1200, and other appropriate safety and health training made necessary by the tasks that they are expected to be performed such as personal protective equipment and decontamination procedures. All equipment to be used in the performance of the clean-up work shall be in serviceable condition and shall have been inspected prior to use.

APPENDICES TO § 1910.120—HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE

NOTE: The following appendices serve as non-mandatory guidelines to assist employees and employers in complying with the appropriate requirements of this section. However paragraph 1910.120(g) makes mandatory in certain circumstances the use of Level A and Level B PPE protection.

APPENDIX A TO § 1910.120—PERSONAL PROTECTIVE EQUIPMENT TEST METHODS

This appendix sets forth the non-mandatory examples of tests which may be used to evaluate compliance with § 1910.120 (g)(4) (ii) and (iii). Other tests and other challenge agents may be used to evaluate compliance.

A. Totally-encapsulating chemical protective suit pressure test

1.0—Scope

1.1 This practice measures the ability of a gas tight totally-encapsulating chemical protective suit material, seams, and closures to maintain a fixed positive pressure. The results of this practice allow the gas tight integrity of a totally-encapsulating chemical protective suit to be evaluated.

1.2 Resistance of the suit materials to permeation, penetration, and degradation by specific hazardous substances is not determined by this test method.

2.0—Definition of terms

2.1 *"Totally-encapsulated chemical protective suit (TECP suit)"* means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves and boots.

2.2 *"Protective clothing material"* means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 *"Gas tight"* means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

3.0—Summary of test method

3.1 The TECP suit is visually inspected and modified for the test. The test apparatus is attached to the suit to permit inflation to the pre-test suit expansion pressure for removal of suit wrinkles and creases. The pressure is lowered to the test pressure and monitored for three minutes. If the pressure drop is excessive, the TECP suit fails the test and is removed from service. The test is repeated after leak location and repair.

4.0—Required Supplies

4.1 Source of compressed air.

4.2 Test apparatus for suit testing, including a pressure measurement device with a sensitivity of at least ¼ inch water gauge.

4.3 Vent valve closure plugs or sealing tape.

4.4 Soapy water solution and soft brush.

4.5 Stop watch or appropriate timing device.

5.0—Safety Precautions

5.1 Care shall be taken to provide the correct pressure safety devices required for the source of compressed air used.

6.0—Test Procedure

6.1 Prior to each test, the tester shall perform a visual inspection of the suit. Check the suit for seam integrity by visually examining the seams and gently pulling on the seams. Ensure that all air supply lines, fittings, visor, zippers, and valves are secure and show no signs of deterioration.

6.1.1 Seal off the vent valves along with any other normal inlet or exhaust points (such as umbilical air line fittings or face piece opening) with tape or other appropriate means (caps, plugs, fixture, etc.). Care should be exercised in the sealing process not to damage any of the suit components.

6.1.2 Close all closure assemblies.

6.1.3 Prepare the suit for inflation by providing an improvised connection point on the suit for connecting an airline. Attach the pressure test apparatus to the suit to permit suit inflation from a compressed air source equipped with a pressure indicating regulator. The leak tightness of the pressure test apparatus should be tested before and after each test by closing off the end of the tubing attached to the suit and assuring a pressure of three inches water gauge for three minutes can be maintained. If a component is removed for the test, that component shall be replaced and a second test conducted with another component removed to permit a complete test of the ensemble.

6.1.4 The pre-test expansion pressure (A) and the suit test pressure (B) shall be supplied by the suit manufacturer, but in no case shall they be less than: (A)=three inches water gauge; and (B)=two inches water gauge. The ending suit pressure (C) shall be no less than 80 percent of the test pressure (B); i.e., the pressure drop shall not exceed 20 percent of the test pressure (B).

6.1.5 Inflate the suit until the pressure inside is equal to pressure (A), the pre-test expansion suit pressure. Allow at least one minute to fill out the wrinkles in the suit. Release sufficient air to reduce the suit pressure to pressure (B), the suit test pressure. Begin timing. At the end of three minutes, record the suit pressure as pressure (C), the ending suit pressure. The difference between the suit test pressure and the ending suit test pressure (B-C) shall be defined as the suit pressure drop.

6.1.6 If the suit pressure drop is more than 20 percent of the suit test pressure (B) during the three-minute test period, the suit fails the test and shall be removed from service.

7.0—Retest Procedure

7.1 If the suit fails the test check for leaks by inflating the suit to pressure (A) and brushing or wiping the entire suit (including seams, closures, lens gaskets, glove-to-sleeve joints, etc.) with a mild soap and water solution. Observe the suit for the formation of soap bubbles, which is an indication of a leak. Repair all identified leaks.

7.2 Retest the TECP suit as outlined in Test procedure 6.0.

8.0—Report

8.1 Each TECP suit tested by this practice shall have the following information recorded:

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique fit features, e.g., special breathing apparatus.

8.1.2 The actual values for test pressures (A), (B), and (C) shall be recorded along with the specific observation times. If the ending pressure (C) is less than 80 percent of the test pressure (B), the suit shall be identified as failing the test. When possible, the specific leak location shall be identified in the test records. Retest pressure data shall be recorded as an additional test.

8.1.3 The source of the test apparatus used shall be identified and the sensitivity of the pressure gauge shall be recorded.

8.1.4 Records shall be kept for each pressure test even if repairs are being made at the test location.

CAUTION

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

B. Totally-encapsulating chemical protective suit qualitative leak test

1.0—Scope

1.1 This practice semi-qualitatively tests gas tight totally-encapsulating chemical protective suit integrity by detecting inward leakage of ammonia vapor. Since no modifications are made to the suit to carry out this test, the results from this practice provide a realistic test for the integrity of the entire suit.

1.2 Resistance of the suit materials to permeation, penetration, and degradation is not determined by this test method. ASTM test methods are available to test suit materials for these characteristics and the tests are usually conducted by the manufacturers of the suits.

2.0—Definition of terms

2.1 *"Totally-encapsulated chemical protective suit (TECP suit)* means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves, and boots.

2.2 *"Protective clothing material"* means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 *"Gas tight"* means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

2.4 *"Intrusion Coefficient"* means a number expressing the level of protection provided by a gas tight totally-encapsulating chemical protective suit. The intrusion coefficient is calculated by dividing the test room challenge agent concentration by the concentration of challenge agent found inside the suit. The accuracy of the intrusion coefficient is dependent on the challenge agent monitoring methods. The larger the intrusion coefficient the greater the protection provided by the TECP suit.

3.0—Summary of recommended practice

3.1 The volume of concentrated aqueous ammonia solution (ammonia hydroxide NH_4OH) required to generate the test atmosphere is determined using the directions outlined in 6.1. The suit is donned by a person wearing the appropriate respiratory equipment (either a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator) and worn inside the enclosed test room. The concentrated aqueous ammonia solution is taken by the suited individual into the test room and poured into an open plastic pan. A two-minute evaporation period is observed before the test room concentration is measured, using a high range ammonia length of stain detector tube. When the ammonia vapor reaches a concentration of between 1000 and 1200 ppm, the suited individual starts a standardized exercise protocol to stress and flex the suit. After this protocol is completed, the test room concentration is measured again. The suited individual exits the test room and his stand-by person measures the ammonia concentration inside the suit using a low range ammonia length of stain detector tube or other more sensitive ammonia detector. A stand-by person is required to observe the test individual during the test procedure; aid the person in donning and doffing the TECP suit; and monitor the suit interior. The intrusion coefficient of the suit can be calculated by dividing the average test area concentration by the interior suit concentration. A colorimetric ammonia indicator strip of bromophenol blue or equivalent is placed on the inside of the suit face piece lens so that the suited individual is able to detect a color change and know if the suit has a significant leak. If a color change is observed the individual shall leave the test room immediately.

4.0—Required supplies

4.1 A supply of concentrated aqueous (58 percent ammonium hydroxide by weight).

4.2 A supply of bromophenol/blue indicating paper or equivalent, sensitive to 5-10 ppm ammonia or greater over a two-minute period of exposure. [pH 3.0 (yellow) to pH 4.6 (blue)]

4.3 A supply of high range (0.5-10 volume percent) and low range (5-700 ppm) detector tubes for ammonia and the corresponding sampling pump. More sensitive ammonia detectors can be substituted for the low range detector tubes to improve the sensitivity of this practice.

4.4 A shallow plastic pan (PVC) at least 12":14":1" and a half pint plastic container (PVC) with tightly closing lid.

4.5 A graduated cylinder or other volumetric measuring device of at least 50 milliliters in volume with an accuracy of at least ± 1 milliliters.

5.0—Safety precautions

5.1 Concentrated aqueous ammonium hydroxide, NH_4OH, is a corrosive volatile liquid requiring eye, skin, and respiratory protection. The person conducting the test shall review the MSDS for aqueous ammonia.

5.2 Since the established permissible exposure limit for ammonia is 50 ppm, only persons wearing a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator shall be in the chamber. Normally only the person wearing the totally-encapsulating suit will be inside the chamber. A stand-by person shall have a positive pressure self-contained breathing apparatus, or a positive pressure supplied air respirator available to enter the test area should the suited individual need assistance.

5.3 A method to monitor the suited individual must be used during this test. Visual contact is the simplest but other methods using communication devices are acceptable.

5.4 The test room shall be large enough to allow the exercise protocol to be carried out and then to be ventilated to allow for easy exhaust of the ammonia test atmosphere after the test(s) are completed.

5.5 Individuals shall be medically screened for the use of respiratory protection and checked for allergies to ammonia before participating in this test procedure.

6.0—Test procedure

6.1.1 Measure the test area to the nearest foot and calculate its volume in cubic feet. Multiply the test area volume by 0.2 milliliters of concentrated aqueous ammonia solution per cubic foot of test area volume to determine the approximate volume of concentrated aqueous ammonia required to generate 1000 ppm in the test area.

6.1.2 Measure this volume from the supply of concentrated aqueous ammonia and place it into a closed plastic container.

6.1.3 Place the container, several high range ammonia detector tubes, and the pump in the clean test pan and locate it near the test area entry door so that the suited individual has easy access to these supplies.

6.2.1 In a non-contaminated atmosphere, open a pre-sealed ammonia indicator strip and fasten one end of the strip to the inside of the suit face shield lens where it can be seen by the wearer. Moisten the indicator strip with distilled water. Care shall be taken not to contaminate the detector part of the indicator paper by touching it. A small piece of masking tape or equivalent should be used to attach the indicator strip to the interior of the suit face shield.

6.2.2 If problems are encountered with this method of attachment, the indicator strip can be attached to the outside of the respirator face piece lens being used during the test.

6.3 Don the respiratory protective device normally used with the suit, and then don the TECP suit to be tested. Check to be sure all openings which are intended to be sealed (zippers, gloves, etc.) are completely sealed. DO NOT, however, plug off any venting valves.

6.4 Step into the enclosed test room such as a closet, bathroom, or test booth, equipped with an exhaust fan. No air should be exhausted from the chamber during the test because this will dilute the ammonia challenge concentrations.

6.5 Open the container with the premeasured volume of concentrated aqueous ammonia within the enclosed test room, and pour the liquid into the empty plastic test pan. Wait two minutes to allow for adequate volatilization of the concentrated aqueous ammonia. A small mixing fan can be used near the evaporation pan to increase the evaporation rate of the ammonia solution.

6.6 After two minutes a determination of the ammonia concentration within the chamber should be made using the high range colorimetric detector tube. A concentration of 1000 ppm ammonia or greater shall be generated before the exercises are started.

6.7 To test the integrity of the suit the following four minute exercise protocol should be followed:

6.7.1 Raising the arms above the head with at least 15 raising motions completed in one minute.

6.7.2 Walking in place for one minute with at least 15 raising motions of each leg in a one-minute period.

6.7.3 Touching the toes with a least 10 complete motions of the arms from above the head to touching of the toes in a one-minute period.

6.7.4 Knee bends with at least 10 complete standing and squatting motions in a one-minute period.

6.8 If at any time during the test the colorimetric indicating paper should change colors, the test should be stopped and section 6.10 and 6.12 initiated (See ¶4.2).

6.9 After completion of the test exercise, the test area concentration should be measured again using the high range colorimetric detector tube.

6.10 Exit the test area.

6.11 The opening created by the suit zipper or other appropriate suit penetration should be used to determine the ammonia concentration in the suit with the low range length of stain detector tube or other ammonia monitor. The internal TECP suit air should be sampled far enough from the enclosed test area to prevent a false ammonia reading.

6.12 After completion of the measurement of the suit interior ammonia concentration the test is concluded and the suit is doffed and the respirator removed.

6.13 The ventilating fan for the test room should be turned on and allowed to run for enough time to remove the ammonia gas. The fan shall be vented to the outside of the building.

6.14 Any detectable ammonia in the suit interior (five ppm ammonia (NH_3) or more for the length of stain detector tube) indicates that the suit has failed the test. When other ammonia detectors are used a lower level of detection is possible, and it should be specified as the pass/fail criteria.

6.15 By following this test method, an intrusion coefficient of approximately 200 or more can be measured with the suit in a completely operational condition. If the intrusion coefficient is 200 or more, then the suit is suitable for emergency response and field use.

7.0—Retest procedures

7.1 If the suit fails this test, check for leaks by following the pressure test in test A above.

7.2 Retest the TECP suit as outlined in the test procedure 6.0.

8.0—Report

8.1 Each gas tight totally-encapsulating chemical protective suit tested by this prac-

tice shall have the following information recorded.

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique suit features; e.g., special breathing apparatus.

8.1.2 General description of test room used for test.

8.1.3 Brand name and purchase date of ammonia detector strips and color change data.

8.1.4 Brand name, sampling range, and expiration date of the length of stain ammonia detector tubes. The brand name and model of the sampling pump should also be recorded. If another type of ammonia detector is used, it should be identified along with its minimum detection limit for ammonia.

8.1.5 Actual test results shall list the two test area concentrations, their average, the interior suit concentration, and the calculated intrusion coefficient. Retest data shall be recorded as an additional test.

8.2 The evaluation of the data shall be specified as "suit passed" or "suit failed," and the date of the test. Any detectable ammonia (five ppm or greater for the length of stain detector tube) in the suit interior indicates the suit has failed this test. When other ammonia detectors are used, a lower level of detection is possible and it should be specified as the pass fail criteria.

CAUTION

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

APPENDIX B TO § 1910.120—GENERAL DESCRIPTION AND DISCUSSION OF THE LEVELS OF PROTECTION AND PROTECTIVE GEAR

This appendix sets forth information about personal protective equipment (PPE) protection levels which may be used to assist employers in complying with the PPE requirements of this section.

As required by the standard, PPE must be selected which will protect employees from the specific hazards which they are likely to encounter during their work on-site.

Selection of the appropriate PPE is a complex process which should take into consideration a variety of factors. Key factors involved in this process are identification of the hazards, or suspected hazards; their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE *materials* (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases the breakthrough time of the protective material should exceed the work durations, or the exposure after breakthrough may not pose a hazardous level.

Other factors in this selection process to be considered are matching the PPE to the employee's work requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks. The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits or equipment.

The more that is known about the hazards at the site, the easier the job of PPE selection becomes. As more information about the hazards and conditions at the site becomes available, the site supervisor can make decisions to up-grade or down-grade the level of PPE protection to match the tasks at hand.

The following are guidelines which an employer can use to begin the selection of the appropriate PPE. As noted above, the site information may suggest the use of combinations of PPE selected from the different protection levels (i.e., A, B, C, or D) as being more suitable to the hazards of the work. It should be cautioned that the listing below does not fully address the performance of the specific PPE material in relation to the specific hazards at the job site, and that PPE selection, evaluation and re-selection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

Part A. Personal protective equipment is divided into four categories based on the degree of protection afforded. (See Part B of this appendix for further explanation of Levels A, B, C, and D hazards.)

I. *Level A*—To be selected when the greatest level of skin, respiratory, and eye protection is required.

The following constitute Level A equipment; it may be used as appropriate;

1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).

2. Totally-encapsulating chemical-protective suit.
3. Coveralls.[1]
4. Long underwear.[1]
5. Gloves, outer, chemical-resistant.
6. Gloves, inner, chemical-resistant.
7. Boots, chemical-resistant, steel toe and shank.
8. Hard hat (under suit).[1]
9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

II. *Level B*—The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.

The following constitute Level B equipment; it may be used as appropriate.

1. Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).
2. Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls.[1]
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots, outer, chemical-resistant steel toe and shank.
7. Boot-covers, outer, chemical-resistant (disposable).[1]
8. Hard hat.[1]
9. [Reserved
10. Face shield.[1]

III. *Level C*—The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met.

The following constitute Level C equipment; it may be used as appropriate.

1. Full-face or half-mask, air purifying respirators (NIOSH approved).
2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Coveralls.[1]
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots (outer), chemical-resistant steel toe and shank.[1]
7. Boot-covers, outer, chemical-resistant (disposable)[1].
8. Hard hat.[1]
9. Escape mask.[1]
10. Face shield.[1]

IV. *Level D*—A work uniform affording minimal protection, used for nuisance contamination only.

The following constitute Level D equipment; it may be used as appropriate:

1. Coveralls.
2. Gloves.[1]
3. Boots/shoes, chemical-resistant steel toe and shank.
4. Boots, outer, chemical-resistant (disposable).[1]
5. Safety glasses or chemical splash goggles*.
6. Hard hat.[1]
7. Escape mask.[1]
8. Face shield.[1]

Part B. The types of hazards for which levels A, B, C, and D protection are appropriate are described below:

I. *Level A*—Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the skin;

2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or

3. Operations are being conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.

II. *Level B*—Level B protection should be used when:

1. The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection;

2. The atmosphere contains less than 19.5 percent oxygen; or

3. The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

NOTE: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

III. *Level C*—Level C protection should be used when:

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin;

2. The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and

[1] Optional, as applicable.

[1] Optional, as applicable.

3. All criteria for the use of air-purifying respirators are met.

IV. *Level D*—Level D protection should be used when:

1. The atmosphere contains no known hazard; and

2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

NOTE: As stated before, combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

As an aid in selecting suitable chemical protective clothing, it should be noted that the National Fire Protection Association is developing standards on chemical protective clothing. These standards are currently undergoing public review prior to adoption, including:

NFPA 1991—Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies (EPA Level A Protective Clothing)

NFPA 1991—Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies (EPA Level B Protective Clothing)

NFPA 1993—Standard on Liquid Splash-Protective Suits for Non-emergency, Nonflammable Hazardous Chemical Situations (EPA Level B Protective Clothing)

These standards would apply documentation and performance requirements to the manufacture of chemical protective suits. Chemical protective suits meeting these requirements would be labelled as compliant with the appropriate standard. When these standards are adopted by the National Fire Protection Association, it is recommended that chemical protective suits which meet these standards be used.

APPENDIX C TO § 1910.120—COMPLIANCE GUIDELINES

1. *Occupational Safety and Health Program.* Each hazardous waste site clean-up effort will require an occupational safety and health program headed by the site coordinator or the employer's representative. The purpose of the program will be the protection of employees at the site and will be an extension of the employer's overall safety and health program. The program will need to be developed before work begins on the site and implemented as work proceeds as stated in paragraph (b). The program is to facilitate coordination and communication of safety and health issues among personnel responsible for the various activities which will take place at the site. It will provide the overall means for planning and implementing the needed safety and health training and job orientation of employees who will be working at the site. The program will provide the means for identifying and controlling worksite hazards and the means for monitoring program effectiveness. The program will need to cover the responsibilities and authority of the site coordinator or the employer's manager on the site for the safety and health of employees at the site, and the relationships with contractors or support services as to what each employer's safety and health responsibilities are for their employees on the site. Each contractor on the site needs to have its own safety and health program so structured that it will smoothly interface with the program of the site coordinator or principal contractor.

Also those employers involved with treating, storing or disposal of hazardous waste as covered in paragraph (p) must have implemented a safety and health program for their employees. This program is to include the hazard communication program required in paragraph (p)(1) and the training required in paragraphs (p)(7) and (p)(8) as parts of the employers comprehensive overall safety and health program. This program is to be in writing.

Each site or workplace safety and health program will need to include the following: (1) Policy statements of the line of authority and accountability for implementing the program, the objectives of the program and the role of the site safety and health supervisor or manager and staff; (2) means or methods for the development of procedures for identifying and controlling workplace hazards at the site; (3) means or methods for the development and communication to employees of the various plans, work rules, standard operating procedures and practices that pertain to individual employees and supervisors; (4) means for the training of supervisors and employees to develop the needed skills and knowledge to perform their work in a safe and healthful manner; (5) means to anticipate and prepare for emergency situations; and (6) means for obtaining information feedback to aid in evaluating the program and for improving the effectiveness of the program. The management and employees should be trying continually to improve the effectiveness of the program thereby enhancing the protection being afforded those working on the site.

Accidents on the site or workplace should be investigated to provide information on how such occurrences can be avoided in the future. When injuries or illnesses occur on the site or workplace, they will need to be investigated to determine what needs to be done to prevent this incident from occurring again. Such information will need to be used as feedback on the effectiveness of the program and the information turned into positive steps to prevent any reoccurrence. Receipt of employee suggestions or complaints relating to safety and health issues involved with site or workplace activities is also a feedback mechanism that can be used effectively to improve the program and may serve in part as an evaluative tool(s).

For the development and implementation of the program to be the most effective, professional safety and health personnel should be used. Certified Safety Professionals, Board Certified Industrial Hygienists or Registered Professional Safety Engineers are good examples of professional stature for safety and health managers who will administer the employer's program.

2. *Training.* The training programs for employees subject to the requirements of paragraph (e) of this standard should address: the safety and health hazards employees should expect to find on hazardous waste clean-up sites; what control measures or techniques are effective for those hazards; what monitoring procedures are effective in characterizing exposure levels; what makes an effective employer's safety and health program; what a site safety and health plan should include; hands on training with personal protective equipment and clothing they may be expected to use; the contents of the OSHA standard relevant to the employee's duties and function; and, employee's responsibilities under OSHA and other regulations. Supervisors will need training in their responsibilities under the safety and health program and its subject areas such as the spill containment program, the personal protective equipment program, the medical surveillance program, the emergency response plan and other areas.

The training programs for employees subject to the requirements of paragraph (p) of this standard should address: the employers safety and health program elements impacting employees; the hazard communication program; the medical surveillance program; the hazards and the controls for such hazards that employees need to know for their job duties and functions. All require annual refresher training.

The training programs for employees covered by the requirements of paragraph (q) of this standard should address those competencies required for the various levels of response such as: the hazards associated with hazardous substances; hazard identification and awareness; notification of appropriate persons; the need for and use of personal protective equipment including respirators; the decontamination procedures to be used; preplanning activities for hazardous substance incidents including the emergency reponse plan; company standard operating procedures for hazardous substance emergency responses; the use of the incident command system and other subjects. Hands-on training should be stressed whenever possible. Critiques done after an incident which include an evaluation of what worked and what did not and how could the incident be better handled the next time may be counted as training time.

For hazardous materials specialists (usually members of hazardous materials teams), the training should address the care, use and/or testing of chemical protective clothing including totally encapsulating suits, the medical surveillance program, the standard operating procedures for the hazardous materials team including the use of plugging and patching equipment and other subject areas.

Officers and leaders who may be expected to be in charge at an incident should be fully knowledgeable of their company's incident command system. They should know where and how to obtain additional assistance and be familiar with the local district's emergency response plan and the state emergency response plan.

Specialist employees such as technical experts, medical experts or environmental experts that work with hazardous materials in their regular jobs, who may be sent to the incident scene by the shipper, manufacturer or governmental agency to advise and assist the person in charge of the incident should have training on an annual basis. Their training should include the care and use of personal protective equipment including respirators; knowledge of the incident command system and how they are to relate to it; and those areas needed to keep them current in their respective field as it relates to safety and health involving specific hazardous substances.

Those skilled support personnel, such as employees who work for public works departments or equipment operators who operate bulldozers, sand trucks, backhoes, etc., who may be called to the incident scene to provide emergency support assistance, should have at least a safety and health briefing before entering the area of potential or actual exposure. These skilled support personnel, who have not been a part of the emergency response plan and do not meet the training requirements, should be made aware of the hazards they face and should be provided all necessary protective clothing and equipment required for their tasks.

3. *Decontamination.* Decontamination procedures should be tailored to the specific hazards of the site, and may vary in complexity and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method may not work for all substances. Evaluation of

ATTACHMENT H
CONFINED SPACE

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 2 DATE 9/17/93 PAGE 1 OF 8
SUBJECT Confined Space	SUPERCEDES APPROVED

PERMIT-REQUIRED CONFINED SPACE PROGRAM

This program establishes confined space procedures for the employees of Environmental Quality Management, Inc. (EQ). The program is intended to control and protect employees from confined space hazards and to regulate employee entry into confined spaces. Only personnel trained and knowledgeable of the requirements of this Permit-required Confined Space Program (Permit Space Program) will be authorized to participate in confined space entries or provide onsite support to authorized entry personnel.

This Permit Space Program has been developed for compliance with OSHA Standard 29 CFR 1910.146, *Permit-required Confined Spaces*. It contains specific procedures to:

1) Identify confined spaces at a project location;
2) Evaluate the hazardous characteristics of the confined space;
3) Prepare for entry; and
4) Allow EQ employees to enter and work in the space.

CONFINED SPACE DETERMINATIONS

A *confined space* is a space or work area large enough for personnel to enter but having limited means of entry or egress. It is not designed or intended for continuous human occupancy.

The project manager or other EQ employee designated as the *entry supervisor* will determine if the workplace is a *permit-required confined space* (permit space), i.e., a confined space having one or more of the following actual or potential hazardous characteristics:

- Contains a hazardous atmosphere;
- Contains a material that has the potential for engulfing an entrant;

- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

- Contains any other recognized serious safety or health hazard.

The nature of project tasks will be considered, and if it is determined that work can be completed without having to enter the permit space, barricades will be set up to prevent entry by EQ personnel, subcontractors, or other individuals.

When entry into the space is intended, the entry supervisor will evaluate the hazards of the confined space and determine if an *entry permit* needs to be issued before *authorized entrants* will be allowed to enter and work within the space. If subcontractors will enter the space with EQ personnel, the entry supervisor will make them aware of the nature of the permit space and the existence of this Permit Space Program and will coordinate operations.

No permit is required when the confined space 1) does not have permit space hazards or potentials (*non-permit confined space*), or 2) mechanical ventilation alone can eliminate all hazards prior to and during entry. Specific requirements for entries into confined spaces meeting criterion (2) are included in the Permit Procedures subsection.

HAZARD EVALUATION

Entrapment/Engulfment

The entry supervisor will discuss the history and use of the confined space with the client or other persons having knowledge of the space. The potential for entrapment or engulfment will be considered, and the need to isolate the space by lockout and tagout procedures will be evaluated.

For sewer entries, it may not be possible to achieve complete engulfment protection through isolation. In this case, the entry supervisor will notify and, when possible, coordinate entries with industries and municipalities that may otherwise inadvertently create an unannounced engulfment hazard by discharging into the sewer system. Current weather forecasts will be considered in evaluating the potential for sudden discharge of stormwater runoff to the system during entries. When precipitation is imminent, radio broadcasts by the National Weather Service will be monitored.

Hazardous Atmospheres

Prior to entry operations, the entry supervisor will monitor for hazardous atmospheres to assess the space for acceptable entry conditions. Instrumentation will be approved

as inherently safe for use in Class I, Division 1, atmospheres and include audio alarms preset to sound when readings vary beyond the ranges of predetermined acceptable entry conditions for the parameters being monitored. The devices will be operated, calibrated, and maintained by personnel trained in accordance with manufacturer's instructions. A current log of calibration and maintenance will be kept at the job site or the EQ corporate office.

Measurements within the space will be compared to predetermined background (ambient) conditions. Readings will be made remotely when practicable and will be taken at the entrance to the space and at varying locations and depths within the space as appropriate to the nature of the anticipated atmospheric hazards and the configuration of the space. Sewers typically will be monitored at 1- to 2-foot intervals beginning at the manhole and continuing across the depth of the space. The following atmospheric conditions will be assessed, as described, in the order presented:

- *Oxygen concentration* will be determined using an oxygen meter or a combination monitoring device that includes this function. Readings between 19.5 and 23.5 percent are considered acceptable for entry.

- *Explosive atmospheres* will be measured using a device capable of assessing the concentrations relative to the lower explosive limit (LEL). Readings at or above 10 percent of the LEL are regarded as prohibited conditions. Detectable concentration <10 percent of the LEL are considered acceptable for permitted entry.

- *Toxic atmospheres* will be assessed using gross survey meters such as a photoionization detector (PID) or a flame ionization detector (FID). Acceptable entry conditions will be determined relative to the Permissible Exposure Limit (PEL) or other available exposure guideline for known chemical and physical airborne contaminants. For sewer entry, compound-specific monitors ("monotox units," compounds-specific functions of multimeters, or colorimetric indicator tubes) for carbon monoxide, hydrogen sulfide, or other known contaminants will be included in the evaluation of toxic atmospheres.

Based upon the results of the hazard assessment of the confined space, the entry supervisor will determine if the confined space presents no hazards and can be classified as a non-permit confined space, the atmospheric hazards can be managed with mechanical ventilation alone, or the hazards cannot be eliminated prior to entry. In the latter case, a permit must be issued and all its conditions must be met before entry will be authorized.

Communication

Authorized entrants must be able to communicate directly with the attendant outside the space. Visual and verbal communication is preferred. As needed, inherently safe radios may be used to enable the attendant to monitor entrant activities and notify them to exit in the event of an emergency. When possible, the attendant will maintain visual contact with at least one other person outside the permit space who may be called for assistance in the event of an emergency.

Barricades

The entrance to the space will be marked and access limited to prevent unauthorized entries into the space. Barricade tape, traffic cones, or construction fencing will be used to keep client and subcontractor personnel or other individuals from injury or posing external risk to authorized entrants.

Posting

Permit spaces shall be identified with a posted sign which reads, "DANGER - PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER."

The authorized permit shall be issued and posted at the work site. The permit shall be removed at the completion of the job or the end of the shift, whichever comes first. The date and time of cancellation shall be recorded on the original permit. The form will be filed by the entry supervisor at the job site and, at the conclusion of the project, kept in the corporate office files.

Fire Extinguisher/First Aid Kit

An emergency station will be set up outside the entrance to provide a fire extinguisher, first aid kit, and other job-specific supplies that the attendant can make available to the entrants on an as-needed basis.

Emergency Plan

An emergency plan must be established and reviewed by project personnel prior to entry. The plan will detail the nature of potential emergency situations that may arise and identify emergency response personnel, equipment, services, and procedures.

Pre-Entry Briefing

The entry supervisor will hold a briefing prior to authorizing entry for all personnel involved in entry or support. The meeting will cover the contents and conditions of the permit, including planned operations, safety considerations, and emergency preparedness.

PREPARATION FOR ENTRY

The entry supervisor will determine specific *acceptable entry conditions* prior to allowing entry operations to begin. As necessary, measures will be taken, then conditions verified, before issuance of an entry permit. At a minimum, the following conditions will be satisfied:

Isolation

All forms of known or potential energy input to the permit space will be assessed. To the extent practicable, water, product or waste, electrical, and other lines will be disconnected, blanked, locked out, or tagged out. These procedures will be conducted with interaction from the client and local utility companies in accordance with OSHA Standard 29 CFR 1910.147 *The Control of Hazardous Energy (Lockout/Tagout).*

Space Ventilation

Natural ventilation shall be provided for the permit space prior to initial entry and for the duration of the permit. Prior to sewer or other confined space entry, manhole covers or lids will be removed from all available ports accessing the space, including the point of ingress, at least 1/2 hour prior to planned entry operations. Positive pressure or forced mechanical ventilation may be required to achieve 100 percent outside air. Atmospheres in the space will be retested to verify ventilation effectiveness.

Where air-moving equipment is used to provide ventilation, chemicals shall be removed from the vicinity to prevent their introduction into the permit space. The source of intake air will be monitored. Vehicles shall not be left running near permit space work or near air-moving equipment being used for permit space ventilation.

During entry operations, output air from mechanical ventilation shall be directed on the authorized entrants whenever practicable.

Lighting

Lighting requirements will be determined based upon the configuration of the confined space and the nature of entry operations. Flashlights and temporary light fixtures will be inventoried and used to provide entrants sufficient illumination for a safe workplace and visible exit pathways. Hand-held lights and other illumination utilized in confined space shall be equipped with guards to prevent contact with the bulk and must be explosion-proof. For use in sewer entries, flashlights must also be water-tight.

Safety Equipment

Personal Protective Equipment (PPE)

Selection and use of PPE will be based upon the understanding of risk associated with the confined space and its measured and estimated hazards. Assigned PPE will be inventoried to assure adequate quantities are available and inspected for integrity and proper function.

Only MSHA/NIOSH-approved positive-pressure self-contained breathing apparatus (SCBA) or airline respirators equipped with a 5-minute emergency air supply (egress bottle) shall be used in hazardous atmospheres or in any permit space with conditions determined to be, or which could potentially be, immediately dangerous to life and health (IDLH). Air-purifying respirators (APR) may be used when actual and potential conditions in the permit space can be determined or anticipated to satisfy APR selection criteria as specified in OSHA's *Respiratory Protection* Standard, 29 CFR 1910.134.

Confined Space Equipment

At a minimum, a lifeline must be attached to the entrant before he/she is allowed to enter a permit space. Provisions must be made (e.g., tripod and pulley assembly provided) so the attendant can initiate a rescue from outside the space if problems occur. It is recommended that a safety harness and wristlets be added if an overhead entry is made.

Hand tools used in confined spaces shall be in good repair, explosion-proof, and selected according to intended use. Where possible, pneumatic power tools are to be used.

Compressed gas cylinders (except cylinders used for SCBAs) shall not be taken into confined spaces. Gas hoses shall be removed from the space and the supply turned off at the cylinder valve when personnel exit from the confined space.

A ladder is required in all confined spaces deeper than the employee's shoulders or 4 feet, whichever is less. The ladder shall be secured and not removed until all employees have exited the space.

If a trench is 4 feet or deeper, it is considered a confined space, and these procedures must be followed. Sloping or benching may be substituted for a ladder. Additionally, the provisions of the OSHA Standard 29 CFR 1926.650 on excavation must be followed regarding soil types, trench shields, sloping, water removal, shoring, benching, etc.

Rescue and Emergency Services

The attendant will be prepared to use the entrant's rescue equipment without entering the space. The attendant will not enter the space to attempt a rescue without first being relieved by another trained attendant. If an offsite rescue service is to be used, the attendant must be prepared to summon the service as directed in the emergency plan. A nearby or mobile telephone must be identified that offers access for this need.

Rescue and emergency service personnel must be properly equipped with appropriate PPE. They must have received specific training on proper confined spaces rescue procedures and performed a simulated rescue during their training. The rescue team must practice a rescue at least every 12 months in which a mannequin or person is actually rescued from a confined space. One member of the rescue team must hold a current certificate in basic first aid and CPR.

If an outside rescue team is used, they will be apprised of all known hazards before a rescue attempt is made.

Contractor Notification

The entry supervisor will notify any subcontractors involved in entry operations of the conditions of the entry permit and summarize existing information regarding the specific hazards of the confined space. If entries are planned with subcontractor personnel, the entry supervisor will coordinate activities within the space during the project.

PERMIT PROCEDURES

Entry Without Permit/Attendant

All confined spaces will be considered to be permit spaces unless the results of the entry supervisor's hazard evaluation and pre-entry preparations indicate the absence of real or potential hazards or that ventilation alone can effectively mitigate all space hazards. If atmospheric hazards are the sole risk and retesting demonstrates that they have been eliminated after 30 minutes of forced air ventilation, entry may be allowed without permit issuance or the use of an attendant. The permit form or other means of clear documentation will be used as a checklist to record that these conditions are true. Pre-entry requirements to assure acceptable conditions with regard to confined space hazards described previously must be satisfied and documented.

The entry supervisor will periodically retest the atmosphere in the permit space to verify that the hazards do not recur during entry operations.

Permitted Entry

The entry supervisor must evaluate workplace hazards and verify the fulfillment of pre-entry preparations before authorizing entry into the permit space. The permit is valid for up to one 8-hour shift and authorized entry only to those EQ personnel identified on the permit who have also met the confined space entry training and pre-entry briefing requirements.

During entry operations, the attendant will keep a current listing of authorized entrants working within the permit space.

Should planned entry operations be interrupted or should a confined space hazard develop or recur, all entrants must promptly exit the permit space. The entry supervisor must reassess and, if appropriate, issue a new entry permit before authorizing the resumption of entry operations.

At the completion of entry operations, the entry supervisor will terminate the permit and file it in project records at the job site or the EQ corporate office.

PERMIT-REQUIRED CONFINED SPACE ENTRY PERMIT

Date Valid:_____ From:_____ am/pm To:_____am/pm Permit No:_____
Confined Space Description:_____
_____
Purpose of Entry:_____
_____
Hazards:_____
Authorized Entrants:_____
Attendant:_____ Fire Watch (Hot Work):_____

PRE-ENTRY ATMOSPHERIC TESTING

		Reading	Time	Intervals
1. Test for oxygen content:		_____ $\%O_2$	_____	_____
2. Test for flammable concentration:		_____ %LEL	_____	_____
3. Test for toxic concentration:	a.	_____ ppm of (PEL=)	_____	_____
	b.	_____ ppm of (PEL=)	_____	_____

ACCEPTABLE ENTRY CONDITIONS

_____Lock & Tag
_____Lighting
_____Barricades
_____Posting
_____Pre-Entry Briefing

_____Ventilation
_____Communications
_____Fire Extinguisher
_____Emergency Plan
_____Other*

ISOLATION/LOCKOUT

_____Water
_____Electrical
_____Mechanical
_____Hydraulic
_____Other*

*Specify:_____

SAFETY EQUIPMENT

Respirators

____ SCBA
____ Airline/Egress
____ Egress Only
____ APR
____ Other*

Clothing

____ Hard Hat
____ Safety Shoes
____ Safety Glasses
____ Goggles
____ Ear Plugs
____ Overalls*
____ Chem. Suit*
____ Gloves*
____ Overboots
____ Other*

Other

____ Life Line & Harness
____ Tripod & Pulley
____ Wristlets

*Specify:_____

RESCUE & EMERGENCY SERVICES

Type of Emergency/Rescue Team required: Onsite_____ Offsite_____ Phone:_____

CONTRACTOR NOTIFICATION: Permit Conditions_____ Potential Hazards_____

PERMIT AUTHORIZATION

I certify that I have inspected the work area for safety and reviewed all safety precautions recorded on this permit.
Entry Supervisor:_____ Signature:_____ Date:_____

ATTACHMENT I

DRUM HANDLING, SAMPLING, OPENING DRUMS AND OVERPACKS, AND DRUM STAGING AND OVERPACKING

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 3 DATE 9/17/93 PAGE 1 OF 35
SUBJECT Drum Handling	SUPERCEDES APPROVED

DRUM HANDLING

1. PURPOSE

1.1 To provide general reference information for use in planning for and implementing sampling programs involving the moving and/or opening of closed containers on uncontrolled hazardous substance sites.

1.2 To provide guidelines for primary and secondary staging.

1.3 To provide guidelines for opening containers.

1.4 To provide guidelines for sampling material in containers.

1.5 To discuss organization, protective clothing, worker protection and other safety procedures.

2. SCOPE

2.1 This guideline is applicable to opening and sampling of closed containers (120 gallon or less) on uncontrolled hazardous substance sites. Bulk tanks such as railroad tank cars, large above- and below-ground tanks (with a capacity of more than 120 gallons), and tank trailers are not considered in this procedure.

3. REQUIREMENTS

3.1 Strict adherence to safety precautions cannot be overemphasized when handling and sampling drums.

3.2 Hazards encountered when sampling drums include:

- Fires
- Explosions
- Vapor generation
- Worker exposure to the waste

3.3 Scenarios involving drums encountered in the field may include drums that are:

- Unmarked
- Mislabeled
- Bulging
- Buried
- Deteriorated
- Leaking

Consequently, such drums may require handling to accommodate sampling. Because the condition of the drum and its contents dictate how drums are handled and sampled, no single procedure can be written to cover all possibilities.

3.4 This procedure lists general guidelines that should be used when developing an onsite drum handling/sampling procedure. The procedure developed should be based on all available information and revised as more information becomes available. When implementing the procedure, common sense and good judgement are important.

3.5 Consult OSHA regulations (29 CFR Sections 1910 and 1926) for established general requirements and standards for storing, containing, and handling chemicals and containers, and for maintaining equipment used for handling materials.

3.6 Consult EPA regulations (49 CFR 265) for requirements pertaining to the types of containers, maintenance of containers and containment structures, and design and maintenance of storage areas.

4. REFERENCES

4.1 Cassis, Jo, et al., 1985. Guidance Document for Cleanup of Surface Tank and Drum Sites. Prepared for Office of Emergency and Remedial Response, USEPA, Washington, D.C. under Contract No. 68-01-6930.

4.2 Hazardous Waste Operations and Emergency Response, December 1988. IT Corporation, Knoxville, TN.

4.3 Martin, F.M., Lippit, J.M., Prothero, T.G., 1987. Hazardous Waste Handbook for Health and Safety, Butterworth Publishers, p. 167-177.

4.4 NIOSH, OSHA, USCG, & USEPA, October 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.

4.5 USEPA, 1986. Drum Handling Practices at Hazardous Waste Sites, EPA/600/2-86/013.

5. DEFINITIONS

5.1 Air Reactive Wastes - Some chemicals, such as white phosphorus or barium oxide, react with oxygen in the air, while others, such as sodium cesium or various metal hydrides, react with the moisture or water vapor in the air. Many of these compounds are explosive when they come in contact with air or water.

5.2 Container - Defined as any drum, bottle, can, bag, etc., with a capacity of 120 gallons (450 liters) or less.

5.3 Dosimeter - A portable, transistorized survey meter that can be used for radiation monitoring purposes and/or contamination measurements. "Dosimeter" is the brand name of the type of radiological survey meter in common use.

5.4 Exotic Metal Drums - (i.e., aluminum, nickel, stainless steel, or other unusual metals). Very expensive drums that usually contain an extremely dangerous material.

5.5 Glass Thief - A glass tube 4 feet long and 3/4 inches in diameter, used for taking samples from drums. The tube is usually broken and disposed of in the drum following sampling.

5.6 LEL - (Lower explosive limit) An air monitoring device which tests the surrounding air for sufficient oxygen content for life support and/or the presence of combustible gases or vapors which may pose a potential flammability hazard. The lower explosive limit is defined as the minimum concentration of a particular combustible gas in the air which can be ignited. The upper explosive limit is defined as the maximum concentration that can be ignited.

5.7 Laboratory Packs - Such drums are commonly used for disposal of expired chemicals and process samples from laboratories, hospitals and similar institutions. Bottles in the laboratory pack may contain incompatible materials and may not be packed in absorbent material. They may contain radioisotopes, shock sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals. Laboratory packs are the primary ignition source for fires at most hazardous waste sites.

5.8 Monitox - A portable warning device used for detecting specific toxic gases found in the surrounding air (i.e., H_2S, HCl, Cl, HCN and $COCl_2$).

5.9 PID - (photoionization detector) A portable air-monitoring instrument used to detect organic vapors. The PID does not distinguish between different types of vapors or tell if more than one vapor is present.

5.10 Polyethylene or PVC-lined Drums - Often contains strong acids or bases. If the lining is punctured, the substance usually corrodes the steel, resulting in a significant leak or spill.

5.11 Shock Sensitives - A chemical which may undergo a very rapid chemical transformation, with the simultaneous production of large quantities of heat and gases, if introduced to shock (i.e., friction). Some shock sensitive chemicals are any substance containing the prefix Picr-.

5.12 Single-Walled Drums Used as a Pressure Vessel - These drums have fittings for both product filling and placement of an inert gas, such as nitrogen. Such drums may contain reactive, flammable, or explosive substances.

5.13 Vapor Control - The use of an LEL, PID, Monitox, or any other air monitoring device to assure the quality of air meets all safety requirements.

6. RESPONSIBILITIES

6.1 Manager, Technical Field Services

The manager of field technical services will:

- Act as project coordinator for field technical personnel
- Reviews and updates procedures in the sampling and field analytical manuals

6.2 Project Chemist

The project chemist will:

- Manage the mobile laboratory or shift so the data generated meets the required levels of certification
- Implement sample acquisition numbering system

6.3 Chemists

The chemists will:

- Carry out compatibility tests
- Carry out approved analytical procedures
- Fill our COC forms and sample analysis tracking forms

6.4 Sample Technicians

The sampling technicians will be responsible for:

- Carrying out all drum sampling in accordance to approved procedures and methodologies as defined in the Sampling and Analysis Plan
- Generate trip blanks, equipment blanks, and acquire replicate samples as defined in the Sampling and Analysis Plan
- Record all field data in Log Books and complete Drum Inventory logs
- Reporting unusual conditions encountered to supervision.

7. PROCEDURE

7.1 Introduction

The guidance presented is based on field experience in working with containers on uncontrolled hazardous substance sites and on information contained in USEPA and other government agency publications. It will be evident that in many cases hard and fast rules cannot be given, and professional judgement is required because uncontrolled variables are involved. For example, no one can be absolutely certain of any assessment of the potential contents of a container. Labels cannot be absolutely trusted; only educated guesses can be made by a thorough review of all available background data, such as potential sources of the wastes. The following topics will be covered in the paragraphs to follow:

- Risks
- Site Preparation and Survey
- Handling, Primary Staging and Numbering
- Radiological Survey
- Drum Opening
- Second Radiological Survey

- Problem Containers
- Sampling
- Resealing and Secondary Staging
- Sample Control
- Blended Wastes
- Safety

Figure 1 demonstrates a flow chart for drum handling on a typical hazardous waste project.

During many drum projects, several phases will be in progress simultaneously. Air monitoring, dust control, and organic vapor control operations should be in progress throughout the course of the project.

7.2 Risks

Three basic risks are involved in moving and opening closed containers:

- Exposure of personnel to toxic materials
- Fire
- Explosion

7.2.1 Exposure of personnel to toxic materials

The first risk can be reasonably eliminated through the use of proper skin and respiratory protection equipment. The use of level B protection with splash guard (i.e., Tyvek and Saran suits with face shield) acceptably reduces the risk of a worker being injured by toxic vapors, mists, or splashes.

7.2.2 Fire

In the same way, standard fire prevention procedures can be used to reduce the fire hazard through the use of detector instruments and proper equipment. These include the use of non sparking tools and intrinsically safe radios, pumps, and other equipments as well as the staging of fire fighting equipment and the elimination of any other possible ignition sources. Piles of sand and lime (for neutralization and suffocation) will be on hand at the site in case of a fire.

7.2.3 Explosion

The explosive risk however, is not as easily handled, and thus is the primary consideration in any container-opening operation.

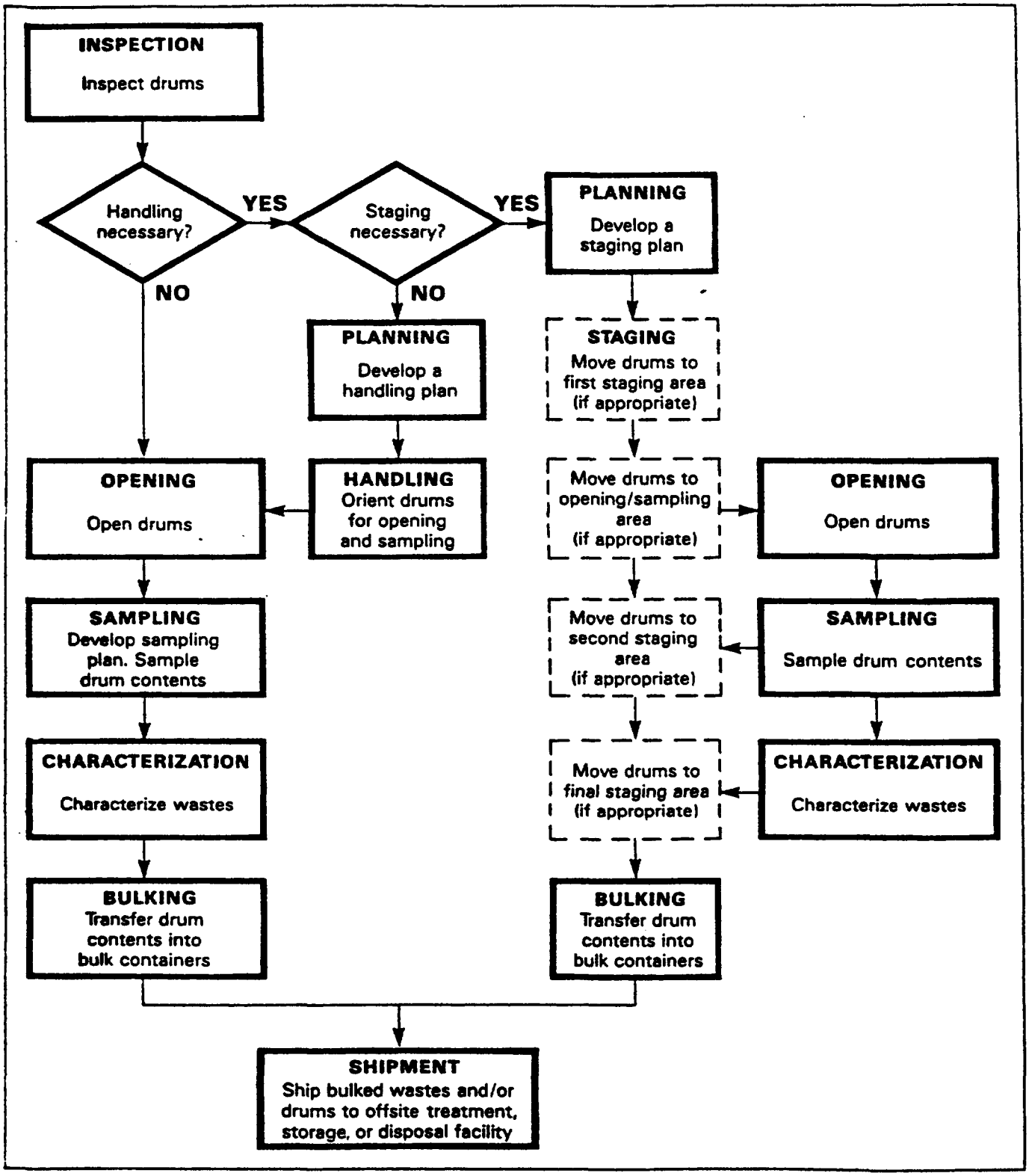

Figure 1. Flow Chart for Drum Handling. (Dashed boxes indicate optional steps.) Number of staging areas necessary is site specific.

Even if no solid evidence of the presence of explosives is found during the preliminary data collection, one can never be certain that explosives have not been disposed of at the site. In order to provide the same reasonable level of protection against this risk as against toxic exposure and fire, a very cautious approach, such as the one recommended in this guideline, should be used (see section 7.9.3, Drum Containing Explosive or Shock Sensitive Waste).

7.3 Site Preparation and Survey

Proper site preparation involves, among other things, construction of primary and secondary staging areas. Proper staging areas reduce the amount of cleanup required because of inevitable spills and leaking drums.

Preliminary surveys at project sites for organic vapors, explosivity, and radiation should be completed for all drum projects. This survey will aid in identifying site specific hazard and development of work zones. In addition, materials (such as drums) which require special handling can be identified.

7.4 Handling, Primary Staging and Numbering of Drums

Personnel involved in handling and transporting containerized waste will work in teams containing no fewer than two people. Visual contact will be maintained between member of the working team at all times. All team members will be able to communicate between themselves and with the Site Health and Safety Officer by intrinsically safe two-way radio at all times on the work site.

7.4.1 Checklist

Prior to physically handling a drum or other container, the following preliminary classifications checklist must be reviewed and each response noted in a field notebook:

1. Is the drum radioactive?

2. Does the drum exhibit leakage or deterioration, i.e., is it unsound?

3. Does the drum exhibit apparent internal pressure?

4. Is the drum empty?

5. Does the drum contain markings which would indicate that the contents are potentially explosive?

The results of the preliminary classification checklist dictate which specific procedures will be followed in handling, opening, and sampling the drum.

7.4.2 Handling

The handling, movements and transport of drums and other containers should be by use of mechanical equipment only; no drums should be handled manually. Remote drum handling equipment may consist of a grappler equipped backhoe or front-end loaders. Drum transportation should be with front-end loaders or fork lifts with modified carrying platforms. Portions of equipment that contact drums or canisters should be constructed of non-ferrous metals or contact portions should be coated or lined to preclude spark generation. Handling and transport equipment must be equipped with full frontal an side splash and explosion shields. Class ABC fire extinguishers will be fitted to the body of each piece of equipment.

7.4.2.1 Minimize Handling

When possible, drums or other containers to be sampled should be opened and sampled in place to minimize handling. However, when drums are stacked or are close together, they may have to be moved to prevent sympathetic detonation of, or chemical reaction with, other drums around the one being opened. The main criterion is distance to other drums--a reasonable distance should be maintained to keep the drum to be opened segregated from the others.

7.4.2.2 Handling Special Drums

Drums or containers exhibiting the following characteristics require special treatment in handling and sampling:

- Drums containing Biohazards
- Leaking or deteriorated drums
- Bulging drums
- Drums containing explosive or shock sensitive waste

- Drums containing radioactive waste
- Laboratory packs (in drums)
- Gas cylinders (in drums)

7.4.3 Primary Staging of Drums

There are three important aspects of primary staging:

- Staging configuration
- Numbering
- Overpacking leakers

7.4.3.1 Staging Configuration

A staging configuration must allow the samplers reasonable access to each drum for inspection, sampling and overpacking, if necessary, while economizing on space. Drums are staged in rows, two wide, and isle space between rows. According to the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, "In all staging areas, stage the drums two wide in two rows, per area, and space these rows 7 to 8 feet apart to enable movement of the drum handling equipment".

7.4.3.2 Numbering

Accurate numbering is critical. Mistakes in numbering, such as missing numbers or double numbering are minimized by numbering after primary staging. (It is highly recommended that drums are not numbered prior to staging.) To avoid problems, empty containers (not removed from the staging area prior to sampling) should be numbered and recorded on drum inventory logs as empty. Note: Drum numbering should be strictly numerical.

If the drums are numbered in the staging area as they are staged, the marking on the drums and whether or not they are empty may be recorded in a log book. Drum log sheets may then be partially filled out in advance. This will make the sampling more efficient.

7.4.3.3 Overpacking Leakers

Personnel in the staging area should watch for leaking drums. These must be overpacked promptly, and the spill should be cleaned up.

7.4.4 Containers Located Inside Buildings

Containers that are inside warehouses, basements, or other buildings must be moved outside before they can be opened. Adequate ventilation is critical for container-opening operations.

7.5 Radiological Survey

The personnel conducting radiological surveys will have a basic knowledge of the radiological survey meter used and of radiation types.

7.5.1 Types of Radiation

There are three types of radiation which might be encountered in the field:

1. Alpha (α), which is stopped by clothing or a sheet of paper. While alpha radiation is the least penetrating type, it can be very dangerous if alpha-emitting radionuclides are ingested, inhaled, or enter the body through a puncture wound.

2. Beta (β), which is stopped by the steel wall of a drum.

3. Gamma (γ) or X-ray, which is only stopped by lead shielding, thick concrete, or steel.

7.5.2 Type of Radiation Probes

The type of radiation detected depends on the probe being used. Three types of probes and their detection capabilities are:

1. The metal-bodies probe with side window, and a sliding cover for that window, detects beta and gamma radiation. When the window is closed, beta radiation is shut out, and only gamma radiation is detected.

2. The probe with the end window detects alpha, beta, and gamma radiation.

3. The "pancake" probe detects alpha, beta and gamma radiation.

7.5.3 Survey Meters

Survey meters measure radiation in units of millirems per hour (mr/hr). The dose that one is exposed to is calculated by multiplying the hours of exposure by the average measured level of exposure, by the use of a personal dosimeter, or a film badge.

7.5.4 Background Level for Gamma Radiation

The background level for gamma radiation is between 0.008 and 0.02 mr/hr. Occasionally, the needle will briefly jump above this level, but it should not stay there.

7.5.5 Radiation Areas Defined

The Nuclear Regulatory Commission defines a radiation area to be one in which there are 5 mr/hr or greater or an area where one can accumulate 100 mr of exposure in 5 days of normal work in the area. A high-radiation area has radiation at greater than 100 mr/hr.

When abnormally high readings are obtained, ranging from 0.2 to 2.0 mr/hr, one must first ascertain that this is not caused by a malfunction in the unit. If the readings are not caused by a malfunction one should follow the guidelines in Table 1 below.

TABLE 1. DOSIMETER READINGS

Reading	Action
< or = 2 mrem/hr	Radiation above background levels (0.001-0.02 mrem/hr) signifies the possible presence of radiation sources. Continue investigation with caution.
> 2 mrem/hr	Potential radiation hazard. Contact Site Health and Safety Officer and Site Supervisor immediately.

7.6 Drum Opening

7.6.1 Opening Area

The drum opening area should be physically separated from the drum removal and drum staging operations. There should be adequate distance between the drum opening and the removal

and staging operations to prevent a chain reaction or fire during the drum opening procedure.

7.6.2 Caterpillar 215 Grappler

Drum opening is normally accomplished with a Caterpillar 215 grappler using a brass-tipped punch. A remote drum punching unit may also be used in smaller drum projects. At all times the staging area should be clear of personnel on the ground during punching operations. Extreme caution should always be taken when drum punching/opening is being performed. **AT NO TIME SHOULD DRUMS BE PUNCHED MANUALLY!**

7.6.3 Opening by Hand

On smaller jobs, drum opening is sometimes done by hand using a nonsparking bung (or plug) wrench. This must be done carefully and should be preceded by careful screening for shock-sensitive materials and drums obviously under pressure. Before any drums are opened by hand, the Health and Safety Department or a chemist on site must be consulted. The "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" should also be consulted.

7.6.4 Opening Other Types of Containers

The following guidelines are offered for other types of containers:

1. Ring-closed, open-top drums - Loosen the ring and then remove it remotely by means of a rope. If it is necessary to cut the ring, do so near the bolt or clamp/lever so that there will be a place to attach the rope.

2. Glass car boys or jugs with lapped/ground-glass stopper or plastic cap - Slowly release any retaining wire and vent any pressure. Remove the stopper or cap by hand only.

3. Fiberpacks or corrugated cardboard containers - Release the locking ring and remove the ring and lid by hand.

4. Plastic or polyethylene car boys and plastic-lined drums (when necessary) - Use a non sparking aluminum, brass, or beryllium bung wrench of the proper size. Do not use a

bung wrench or any distended drums of this type; remote methods will be applied.

5. Plastic Kraft paper, burlap, or cloth bags - Use a trowel or sampling trier. The bags should be resealed or placed in an overpack.

7.7 Secondary Radiological Survey

After the drums are open, another radiological survey should be conducted. This is necessary because the drum tops block out all forms of radiation except the gamma radiation.

7.8 Problem Containers

Special handling techniques are required for containers which may expose personnel to particularly hazardous conditions. These techniques are described in general below (information derived from Reference 4.1), although site-specific conditions may require the development of specialized methods. The following are considered to problem containers:

- Drum Containing Biohazards
- Leaking or Deteriorated Drums
- Bulging Drums
- Drums Containing Explosive or Shock Sensitive Waste
- Drums Containing Radioactive Waste
- Packaged Laboratory Wastes (Laboratory Packs)
- Air Reactive Wastes (in drums)
- Gas Cylinders (in drums)

7.8.1 Drums Containing Biohazards

A biohazard is defined by the Biohazards Committee of the American Industrial Hygiene Association (AIHA), is "an agent that is biological in nature, capable of self-reproduction, and has the capacity to produce deleterious effects upon other biological organisms, particularly humans." Biological agents or substances which could be biohazardous substances, are but not limited to the following:

- Infectious or parasitic agents

- Non-infection microorganisms (such as fungi, yeasts, and algae)

- Plants and plant products

- Animals and animal products which can cause occupational disease

Recognition is the key to avoiding disease contaminated biological waste. Be aware that this may take the form of cultured animal cells, infected clinical specimens (tissues, fluids, etc.), or tissues from experimental animals (including animal dander). Open drums should be examined for evidence of biological material such as:

- Gauze
- Hypodermic syringes
- Petri dishes
- Cultures
- Blood
- Animal tissues
- Waste from orthopedic casts (may be gray, crumbly solids resembling a type of insulation).

Biological waste that has been prepared for incineration or for autoclaving may be packaged in red plastic bags or may be contained in plastic bags that are marked with the universal biohazard symbol (one ring with three interlocking "C"-shaped rings on top). Biohazards such as research bacterial cultures may be sent through the mail if they are packaged in a mailing tube. It is conceivable that either type of packaging could be found on a hazardous waste project.

If a biohazard or possible biohazard is identified, seal the drum and immediately notify the Senior Technical Personnel, Site Safety Officer, and Site Supervisor.

7.8.2 Leaking or Deteriorated Drums

1. The contents of drums that exhibit leakage or apparent deterioration such that movement will cause rupture (determined by the HSO) must immediately be transferred to a repack drum. Equipment, including transfer pumps used in the repack operation must be of explosive proof construction.

2. Leaking drums containing sludges or semi-solids, drums that are structurally sound but which are open and contain

liquid or solid waste, and drums which are deteriorated but can be moved without rupture must be immediately placed in overpack containers.

7.8.3 Bulging Drums

1. Drums which potentially may be under internal pressure, as evidenced by bulging, must be sampled in place. Extreme care shall be exercised when working with and adjacent to potentially pressurized drums.

2. Should movement of a pressurized drum be unavoidable, handle only by a grappler unit constructed for explosive containment. The bulging drum should be moved only as far as necessary to allow seating on firm ground or it should be carefully overpacked.

3. Openings into pressurized drums shall be plugged and the bung holes fitted with pressure venting caps set a 5 psi release.

7.8.4 Drums Containing Explosive or Shock Sensitive Waste

1. If drums containing wastes that have been identified by sampling, or are suspected by visual examination to be explosive in nature are found, the Project Manager and the HSO must be notified immediately, before the drums are handled in any way.

2. If the Project Manager and the HSO approve handling of these drums, they shall be handled with extreme caution. Initial handling shall be by a grappler unit constructed for explosive containment. Drums shall be palletized prior to transport to a high hazard interim storage and disposal area.

3. If at any time during remedial activities, an explosive, pursuant to provisions of Title 18, U.S. Code, Chapter 40 (Importation, Manufacturer, Distribution, and Storage of Explosive Materials, 1975 Explosive List) is identified, it should be secured and the appropriate state and federal agencies notified.

4. Identification of an explosive substance during the course of a remedial action is dually based on the experience of the

on-site personnel. Potentially explosive material usually may be identified by their physical Characteristics - texture, color density, etc., as well as the way they are packaged or labeled. Most explosives are solids. In some cases they are packaged in water-tight containers to exclude water while in other cases they are packaged wet to preclude explosion.

5. Prior to handling or transporting drums containing explosive wastes, personnel working in the area shall be removed to a safe distance (as determined by the HSO). Continuous contact with the communication base shall be maintained until handling or transporting operations are complete. An audible siren signal system, similar to that employed in conventional blasting Operations, shall be used to signify the commencement and completion of explosive waste handling or transporting activities.

7.8.5 Drums Containing Radioactive Waste

7.8.5.1 Handling and Transporting Drums Containing Radioactive Waste

Drums containing radioactive wastes shall not be handled until radiation levels have been determined by an initial field survey which is recorded in a field notebook. The survey shall include background levels, direct gamma readings and laboratory analysis of drum surface wipe samples.

Depending on the level of radiation encountered, handling and transport may require special shielding devices to protect personnel. Following handling and transport, equipment used shall be surveyed by the HSO and decontaminated to background levels prior to recommending work. Surveys shall also be made of the ground surface in the vicinity of original drum storage to identify potential soil contamination by spilled or leaked radioactive waste. Prior to recommending work in the area, radioactive soil areas shall be isolated to prevent tracking of radioactive contaminants about the site, and workers who entered the area should have their gloves and boots surveyed for radiation.

7.8.5.2 Opening Drums Containing Radioactive Waste

After the containers are opened, another radiological survey will be conducted. This is necessary because the drum tops block out all forms of radiation except gamma radiation.

7.8.6 Packaged Laboratory Wastes (Laboratory Packs)

If drums known or suspected of containing discarded laboratory chemicals, reagents or other potentially dangerous materials in small volume, or individual containers are found, the Project Manager is to be notified immediately, before the drums or containers are moved or opened.

Lab pack drums are easily identified by the presence of vermiculite or other packaging material. If a drum contains such material, there is a good possibility that the drum is a lab pack drum. Further investigation may reveal that the drum also contains smaller containers inside such as:

- Sample jars
- Metal shipping containers
- Specially sealed packages
- Sealed 5 gallon buckets

If the Project Manager and the HSO approve the handling of these containers, they shall be handled with extreme caution. Until otherwise categorized, they shall be considered explosive or shock-sensitive wastes. Initial handling shall be by a grappler unit constructed for explosive containment. Drums shall be palletized and overpacked if required prior to transport to the Laboratory Pack staging area for sorting, identification, repacking and/or stabilization.

Prior to handling or transporting Laboratory Packs from the existing drum area, personnel working in the immediate area shall be removed to a safe distance. Continuous contact with the communication base shall be removed to a safe distance. Continuous contact with the communication base shall be maintained until handling or transporting operations are complete. An audible siren signal system, similar to that employed in conventional blasting operations will be used to signify the commencement and cessation of Laboratory pack handling or transporting activities.

7.8.7 Air Reactive Wastes

1. If the presence of air reactive substance is verified or even suspected, the material should be immediately segregated and transported to a separate high hazard interim storage and disposal area.

2. Air reactive wastes may be discovered during opening or sampling operations. Air reactive substances normally require special packaging. They may be stored under water or some other liquid to minimize air contact. They may also be found in sealed ampoules, corrugated drums, stainless steel canisters, or specially lined drums.

7.8.8 Gas Cylinders

1. Gas cylinders, when encountered, should be stored and disposed of on a special case basis depending on the integrity of the cylinders and type of substance they are expected to contain.

7.9 Sampling

7.9.1 Required Equipment

- 1 12-column book
- 2 record books
- 1 utility knife
- 1 brass bung wrench
- 1 brass hammer with cutting edge
- 1 brass chisel
- 1 brass screwdriver
- 1 stainless-steel trowel
- 2 pair Wizard cut-proof glove liners
- 2 1/2 inch drive with 15/16 socket
- 2 polyethylene squirt bottles
- Level B protective equipment
- 1 photoionization detector with thin window "pancake probe"
- 1 geiger counter
- 1 H_2S monitox with gas generator
- 1 HCN monitox with gas generator
- 1 brass-tipped drum punch (optional)

7.9.2 Expendables per Hundred Drums

- 120 drum log sheets
- 120 8 oz. jars with Teflon liners
- 100 tongue depressors
- 120 11-mm dip tubes
- 400 pari sample gloves
- 5 mean streaks
- 2 rolls paper towels
- 2 trash bags
- 10 chain-of-custody forms
- 1 quart hexane
- 1 quart acetone

7.9.3 Sampling Procedures

All drums and mechanical equipment should be grounded prior to the commencement of sampling. If the bung or container lid can be removed, sample contained liquids using a glass thief, which shall then be broken and discarded within the barrel. A barrel that has a badly rusted bung, or that cannot be sampled as above, shall be safety entered with a hydraulic penetrating device operated remotely (see Section 7.6). All openings shall be plugged expect during sampling operation.

The steps to be followed in sampling are as follows:

1. Record any markings, special drum conditions, and type of opening in the field notebook, on the sample log sheet, and later, on the Chain-of-Custody form. Locate the general area on a sketch of the site.

2. Stencil an identifying number on the drums and record in logbook. Consult the sampling plan for identifications.

3. Make certain that the drum/container is set on a firm base, preferably in a fully upright position.

4. Open the drum/container as described in Section 7.6.

5. Insert glass tubing almost to the bottom of the drum or until a solid layer is encountered. About one foot of tubing should extend above the drum.

6. Allow the waste in the drum to reach its natural level in the tube. Cap the top of the sampling tube with a tapered

stopper, ensuring liquid does not come into contact with stopper.

7. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container. Release the stopper and allow the glass thief to drain completely into the sample container.

8. Deliver 100 to 250 ml of the sample to a clean, wide-mouth, 500-ml (1-pt) glass sample jar. If the sample is not free flowing and is taken through a bung opening, repeated sampling may be necessary.

9. Place the used sampling tube, along with paper towels or waste rags used to wipe up any spills, into an empty metal barrel for subsequent disposal. If glass tubing has been used, it may be broken and left inside the drum being samples.

10. Clamp the sample container tightly and place prelabeled and tagged sample container in a carrier.

11. Replace the bung or lids or place plastic over the drum/container.

12. Measure the sample for radioactivity and record results in a field notebook.

13. Fill out Chain-of-Custody Record and carefully pack samples. The finished package will be padlocked or custody-sealed for shipment to the laboratory. The preferred procedure includes the use of a custody seal across filament tape that is wrapped around the package at least twice. The custody seal (paper, plastic, or metal) is folded over and stuck to itself so that the only access to the samples is by cutting the filament tape or breaking the seal to unwrap the tape. The seal is signed before the package is shipped.

14. Complete the appropriate traffic report. Drum samples are always considered to be high-hazard samples.

7.9.3.1 Sampling Solids and Semisolids

Solids in drums are sampled by scooping the material up with the jar or with a tongue depressor. Often the material must first be broken up with a brass hammer or brass hammer and chisel, or a piece must be cut off with a razor knife. It is sometimes necessary to sample the material with the use of a trier. This sampling device is often not used however, due to the substantial increase in time necessary to obtain the samples. Tongue depressors must be disposed after each use. Nonexpendable sampling tools must be decontaminated between drums.

7.9.3.2 Sampling Liquids

Liquids in a container will be sampled using 4-foot sections of glass tubing or pipette. The pipette is slowly lowered into the drum. When the bottom of the drum is reached, the sampler places his thumb over the end of the pipette and pulls it up. Any liquid or sludge layering in the container should now be apparent as the tube is brought up. The contents of the tube are then released into an 8-ounce sample bottle. The process is repeated until a sufficient sample has been collected.

7.9.3.3 Sampling Solids Underneath Liquids

Sludges or solids underneath a liquid may be sampled by forcing the pipette into it. If the sludge does not run out into the jar, shaking the pipette or tapping it against the side of the bottle may loosen the sample. If this fails, one may break the pipette and put the pieces which have the solid in them in the bottle.

When pipettes are used for sampling, samplers should wear Wizard gloves (steel, mesh, gloves designed to prevent cuts which could be caused by the pipettes).

7.9.4 Post Sampling Procedures

After the sample has been taken, the outside of the bottle will be wiped off and labeled with the drum number. The drum number will also be written on the lid of the bottle. All sampling data and observations will be recorded on the drum inspection log.

After a group of drums have been sampled, the samples will be collected. The sampling trash, sample gloves, paper towels, etc., will be collected and bagged for disposal. The sampling pipettes will be collected and packaged for disposal.

7.9.4.1 Drum Inventory Log

The field data gathered during the drum sampling activities will be recorded on a Drum Inventory Log along with the following sampling information:

- Drum Number - Numbers only; at least 3 digits in length (001).
- Project Number -
- Page of - If the drum log is accompanied by Material Safety Data Sheets (MSDS) or other information, then the total number of pages is required. Mostly, will be page 1 of 1.
- Project Location - Generally the client company's name and/or street address of the facility/site.
- Project Contact - The EQ employee responsible for overseeing the sampling operation. This person should be the individual to whom questions are to be directed or verbal results given for review (i.e., project chemists, or site supervisor).
- Phone - Site phone or number of the supporting EQ office.
- Logger - Name of individual responsible for filling in the sampling portion of the Drum Inventory Log.
- Sampler - Name of individual(s) responsible for obtaining the sample.
- Weather - Weather conditions during sampling (e.g., temperature and/or precipitation).
- Date - Date when sample is collected.
- Time - Time when sample is collected.

- Drum Type - Place an "x" in the box or boxes which best describes the drum type and materials of construction.

- Lid Type - An "x" should appear in the box that describes the type of closure on the container.

- Drum Condition - Place an "x" in the box indicating the integrity of the drum. "Meets DOT specifications" means the drum can be shipped according to Department of Transportation (DOT) regulations.

- Drum Size - Place an "x" in the box indicating the volume of drum when full. If the drum is overpacked, the inner drum volume should be indicated, not the size of the overpack.

- Drum Contents - Place an "x" in the box indicating the volume of waste contained in the drum.

- Overpacked - An "x" should appear in the "yes" box if the container was overpacked, along with an "x" in the box which states the type of overpacked utilized.

- Layers - This designates the layer as top, middle, or bottom for a multi-layered sample. If only one layer exists, complete only the line associated with the top layer, "T".

- Physical State - Place an "x" in the box indicating the actual physical state of each layer.

- Color - The standard color description for each layer of the sample should be written in. The only acceptable color descriptions are:

blue (blu)	white (wht)	black (blk)
red (red)	cream (crm)	orange (org)
pink (pnk)	yellow (ylw)	gray (gry)
colorless (cls)	amber (amb)	purple (prp)
green (grn)	brown (brn)	green-blue (gbl)
tan (tan)		

- Clarity - An "x" should appear in the box indicating the clarity of each layer of the sample.

- Layer Thickness - Record the thickness of each layer in inches, an estimate of how deep the layer is.

- pH - Record pH measurement in standard units (SU); 0 to 14.

- PID - Record the results for vapor analysis by photoionization detector (PID). The PID scale reads in ppm (0 to 2,000).

- Dosimeter - The results of the field radiation survey is recorded in this space. The dosimeter's scale units are in millirems per hour (mr/hr or mrem/hr).

- Other - This space is for additional analysis which may take place. The information should include the equipment used, the parameter being measured, and its concentration. Example: Drager tube - HCN - 5 ppm.

- DOT Haz - Hazard category from placards or stencils on drum. Example: Corrosive Liquid.

- UN/NA - Space for any UN or NA numbers which are stenciled or written on the drum. These numbers are always prefixed either UN or NA.

- MFG Name - Name, address, and telephone number of the company producing or distributing the chemical/product. If the space provided is inadequate, indicate that the information continues on the back of the log, and do so.

- Chemical Name - Any chemical compound, key ingredient, trade name, and/or chemical name of the contents on the label or stenciled on the drum. Indicate whether the information was printed on a label or stenciled or handwritten on the drum. If the space provided is inadequate, indicate that the information continues on the back of the log, and do so.

- Additional Information - This space is for additional information or comments for which no specific space is designated. It can include unusual comments or

problems such as the contents are too hard to sample, drum color, or that colored crystals have formed on the drum. If the space provided is inadequate, indicate that the information continues on the back of the log, and do so.

7.9.5 Sample Preservation and Packaging Procedures for Drummed Waste Samples

1. No preservatives shall be used.

2. Place sample in a zip lock plastic bag.

3. Place each bagged container in a 1-gallon covered can containing absorbent packing material. Place lid on can.

4. Mark the sample identification number on the outside of the can.

5. Arrange for the appropriate transportation mode consistent with the type of hazardous waste involved.

7.9.6 Decontamination Procedures

All sampling equipment used in obtaining samples from containers will be either dedicated (disposable) or pre-cleaned or decontaminated by the following procedures:

- Thoroughly scrub with a brush using a soap (Alconox) and water solution to remove large particles.

- Thoroughly rinse the soap solution of the equipment with tap water.

- Rinse the equipment with deionized water.

- Solvent clean the equipment with pesticide grade isopropanol.

- Solvent clean the equipment with pesticide grade hexane.

- Air dry the equipment before use.

7.9.7 Sampling for Enforcement

When considering sampling for enforcement, priority will be given in the following order:

1. Those marked with known hazardous materials (trade name, chemical name, empirical formula) or hazardous labeling.

2. Those isolated by themselves or material contained in an exotic metal container (e.g., aluminum, nickel, monel stainless steel).

3. Unmarked drum piles or stacks. These should be sampled randomly among the various distinguishable drum lots.

7.9.8 Sampling for Site Characterization

When sampling for site characterization purposes, a concerted effort should be made to distinguish drum lots and to get a good drum count among the lots. Sampling should occur in the following order:

1. A drum that appears to be characteristics and in the center of all the major drum lots.

2. Drums in as many of the smaller lots as practical.

Also, if practical, duplicate samples should be taken on major drum lots at either end of a lot to see if the wastes appear to be characteristic all the way through.

7.9.9 Sampling at Abandoned Waste Sites

On most abandoned waste sites, there usually, through not always is some organization or pattern to the way the material was placed on the site. The pattern is occasionally as detailed as finding the flammable solvents in one area, acids in another, cyanide in another, recoverable metals in a fourth, and so on. Some disposal facilities stencil control numbers on drums to indicate specific lots. Often, if the site was poorly run, the only indication that a group of drums is related will be their color, size, or type.

7.9.10 General Information

Typically, waste is shipped to sites in 55-gallon drums on trucks. About 60 to 80 drums are delivered from a given load, depending on the weight of the load. During the initial site inspection, one should look for distinguishing features in an attempt to define the different lots of drums on the site. Often the trade name, chemical name, or empirical formula will be written on the drum. Another distinguishing feature would be drums of exotic metal such as aluminum, nickel, Monel, stainless steel, etc. A manufacturing facility will use a specified DOT coded drum, a strange drum size, or a drum with an unusual configuration or adaption for a particular process line (center of drum head fill bung, double-sided fill/vent bungs, etc.).

At almost every site that has been receiving waste, there is an isolated group of containers. Approach these with care and try to determine why they are segregated.

In any lot of drums there is sometimes encountered an unusual or out-of-place container. This oddball container will not fit the pattern, color, size, etc., of those around it (e.g., it may be the only distended drum among undistended drums or a lined drum among unlined drums).

On a site where many different types of containers are present, they should be sampled in the following order, based on what they can be expected to contain and in increasing order of hazard.

1. Paper, plastic, cloth, and burlap bags.

2. Glass carboys and jugs (except chemical reagent or laboratory-packed bottles).

3. Fiberboard drums.

4. Plastic and polyethylene carboys and containers.

5. Plastic-lined steel drums.

6. Steel drums

7. Exotic metal drums

8. Odd containers (distended, isolated, etc.)

The DOT designation, which is usually found on the bottom of a drum, can be useful in determining the material of the drum.

7.10 Resealing and Secondary Staging

All containers opened for sampling need to be resealed to prevent the escape of vapors and possible reactions from rainwater, air and so on. The resealing methods will depend on the opening methods used and include the following:

1. Replacing the bung, screw cap, etc.

2. Replacing the lid and retaining ring.

3. Placing the drum in an overpack (larger drum) when it cannot be resealed by any other method.

4. If a hole is drilled, use of a special rubber of plastic plug. A drum bonnet should be used to ensure that rainwater does not seep around the plug.

It is important to note that these resealing methods are for the purpose of preventing leakage from the container while it is in storage on the site. If the container is to be moved off the site, DOT regulations regarding transportation of drums must be complied with. These will generally require more rigorous sealing procedures.

Once the drum is sampled and resealed, it should be left where it cannot react with any other containers on the site. For a small number of drums, the storage areas may be the staging and opening area. In any event, the sampled drums should be placed in an area away from other groups of containers on the site. The reason is that slowly progressing chemical reactions can start when a container is opened and the contents exposed to air or the disturbance caused by handling the drum. Such a reaction could take hours or even days to occur. Another reason for the segregation and identification of drums for recovery is for use as evidence.

7.11 Sample Control

A designated person on site is responsible for the identification, preservation, packaging, handling, shipping, and storage of samples obtained from the site. All samples must be readily identifiable and retain to the extent possible that in situ characteristics to be determined through testing. All samples collected from containers to be analyzed for

compatibilities will be validated through the preparation of a drum log. At the conclusion of the daily sampling operations for containerized waste, it is the responsibility of the Technical Services Representative to review each sample with its respective drum log to assure the documentation is completed and accurate. His signature verifying the sample has been checked must appear in the appropriate space prior to sending samples to the laboratory. In addition, these samples will be validated through the following steps:

- Sample Containers--Samples taken from containers to be analyzed for compatibilities will be placed into a clean 8-ounce glass bottle and secured with a Teflon-lined lid.

- Sample Number--Each sample will be labeled and uniquely identified in accordance with the numbering system used for this job.

- Sample Label--Each sample label will be legibly completed and affixed to the sample container. The label will include the name of the sampler, date and time of collection, placed on collection, unique sample ID number, analysis required, preservatives added, and type of sample (grab or composite).

- Field Log--All sample collection data and field observations for each sample will be recorded on a drum inventory log (see Section 7.9.4.1).

- Chain-of-Custody Procedures--All samples taken on this site will be verified through chain-of-custody procedures. The procedures followed will be in accordance with USEPA procedures.

- Sample Preservation--Samples taken from containers to be analyzed for compatibility will not be preserved.

- Sample Shipment--Samples taken from containers to be analyzed for compatibilities will be packaged in their original shipping container or the sample bottles and transported to the mobile laboratory on site where they will be placed in a sample refrigerator.

7.1.2 Waste Blending

A waste blending test is used to determine if the drums included in a wastestream are truly compatible. Whether the wastes are to be blended on site or to be sent in drums to a disposal facility, a waste blending test must be performed for waste profile purposes. Waste blending is most often performed by the on site Chemist. However, situations arise when the Sample Technologist is asked to determine which compatibility groups can be blended.

7.12.1 Disposal of Blended Waste

Samples of blended waste to be sent off site for laboratory analysis for disposal parameters will be shipped by the following procedures:

- The lids of the sample jars will be sealed with tape.
- The sample container will be placed inside two 4-mil plastic, protective bags.
- The sealed sample will be placed in a metal paint can.
- The samples will be placed into a cooler and packed with blue ice to maintain their temperature at 4 degree Celsius.
- Bubble pack or other insulating packing material will be placed into empty space of the cooler.
- The cooler will be sealed, addressed, identified, and placarded as environmental samples.

7.1.3 Public Evacuation/Alert Consideration

7.13.1 General

The potential need for evacuation of the site and surrounding area must be considered. Several site-specific factors influence the need for, and the extent of, the evacuation or alerting of the nearby off-site public. These factors include the following:

1. Proximity of residences, shopping or other commercial or business areas, factories, highways, railroads, and airfields or other transportation routes that may have to be

evacuated. This information will be available from the background review and preliminary site inspections.

2. Proximity of other facilities that could be involved in, cause or propagate a fire, explosion, or toxic release on the site. This information will also be known from the background review and site inspection.

3. Presence of explosive, flammable, or volatile substances on the site. Some general indications of the types of hazards present may be provided by the background review and site inspection. The probability of encountering explosives (i.e., directly detonatable or shock-sensitive materials as opposed to explosive vapor-oxygen mixtures) will have been reduced by the screening procedures applied during earlier site evaluation. Preliminary assessment and site inspection may provide indications, or definite knowledge, that specific compounds presenting known flammability or toxicity hazards are in the containers. Of these known hazards, those having the greatest potential for atmospheric spread off the site should be used in estimating evacuation hazard distances as described below. For example, if several volatile toxic liquids, or toxic vapors, are present, those having the greatest toxic potential in air, as measured by a Threshold Limit Value (TLV) or classified as Immediately Dangerous to Life and Health (IDLH), should determine the hazard distance, since these have the potential for the greatest health impacts.

   Atmospheric drift of a toxic or flammable vapor cloud or plume can often extent to great distances from the site, and hence potentially threaten more people than ever an explosive hazard. Similarly, thermal-radiation hazards generated by even a large fire on the site generally reach to distances which are small compared to possible atmospheric drift distances of a vapor cloud.

4. Potential for an accident on the site which could result in an atmospheric release of flammable or toxic liquid or vapor. This possibility should be remote if only one drum is opened at a time and if that drum is segregated from the other drums.

   The most important parameter that needs to be established for any accident is the rate of liberation of flammable or

toxic vapor; unfortunately, this is often the most uncertain quantity.

5. Prevailing wind speed and direction and atmospheric stability affect very strongly the pattern of atmospheric spread of a gas cloud. If these can be quantitatively estimated at the time an actual accidental release occurs, this information should be used in calculating an estimated evacuation corridor as detailed below.

   However, because wind direction is subject to rapid and unpredictable variations, and because atmospheric drift of a concentrated cloud or plume is greatest under stable atmospheric conditions and low winds speeds, it is usually preferable to take a conservative approach. Thus, one should base a public hazard evacuation distance, in any direction from the site, on an assumed worst-case atmospheric condition, that is, a stable atmosphere and nominal low wind speed, say 5 mph.

7.13.2 Plausible Accident Scenario

A plausible but hypothetical scenario for an accident that may be expected to occur during closed-container opening operations would involve a release, from only the one 55-gallon drum being opened, of a volatile toxic liquid that rapidly vaporizes and forms and nonburing but continuous source of a toxic vapor plume. The rate of vapor generation and release can be calculated from the assumption that the upright drum is completely open at the top and a knowledge of the vapor pressure and some other readily available chemical properties of the chemical involved. For simplicity, the fact that a complex mixture of chemicals may actually be involved is neglected and the most toxic liquid or vapor is treated as if it were a pure component.

7.1.3.3 Estimating Hazard Evacuation Radius

Once the rate of atmospheric release of vapor is estimated for the accident scenario, outside assistance from any of several sources may be sought to estimate an atmospheric dispersion distance appropriate for the degree of flammability or toxicity hazard of the chemical involved. This estimate would then be used as a recommendation of an evacuation radius to be made to the responsible official

in charge at the site, who will actually determine the necessity and extent of public evacuation.

Outside assistance in estimating the hazard radius in an emergency situation may be obtained from EPA's Emergency Response Team (ERT), the U.S. Coast Guard's Hazard Assessment Computer System (HACS), or from other hazard analysts.

Two different situations may require the evacuation of the off-site public:

1. The emergency resulting from an actual occurrence of an accident involving atmospheric release during drum-opening operations.

2. Precautionary planning before the start of drum opening operations, in anticipation of an accident.

The above hypothetical scenario involving a single drum may be used in planning precautionary evacuations before the start of a dangerous drum-opening operation. On the other hand, in an actual accident, the release rate may be estimated if the number of drums releasing and the size of the opening in each such drum can be estimated by observation.

The decision to evacuate or alert the public off the site as a precautionary measure depends on the degree of hazard presented by the materials known to be present at the site. For the scenarios described above, a table of numerical hazard distances for several of the commonly encountered chemicals and those expected to be found at the site should be prepared before drum-opening commences.

These distances may then be used as numerical decision criteria for precautionary evacuation by comparing them to the known distances of populated areas from the site.

8. EQUIPMENT

8.1 Spill control kit
8.2 Drum over packs
8.3 Drum grappler
8.4 Drum opening equipment suitable for the respective type drums

8.5 Explosion meter
8.6 HNu portable organic vapor analyzer
8.7 Fire extinguisher, Class A, B, and C, 12 lb capacity
8.8 Alpha and beta radiation detectors
8.9 Personal protective equipment. This may include: Robar or Tingley boots, Tyvek protective suit with hood, acid jacket and pants, vinyl booties, vinyl sample gloves, nitrile outer gloves, hard hat with splash shield and SCBA units.
8.10 Plexiglass shield
8.11 Sheet plastic
8.12 Sampling equipment

8.12.1 Equipment needed for drum sampling are listed below

- 100 drum log sheets
- 100 8 oz jars with Teflon lined lids
- 50 tongue depressors
- 100 11mm dip tubs
- 300 pair sample gloves
- 10 mean streaks
- 4 rolls of paper towels
- 4 trash bags
- 20 chain-of-custody forms
- two 12-column books
- 4 record books
- 2 utility knifes
- 2 brass bung wrenches
- 1 brass hammer with cutting edge
- 1 brass chisel
- 1 brass screwdriver
- 50 stainless-steel triers
- 2 pair wizard liners
- 2 1/2-inch drive with 15/16-inch socket
- 2 polyethylene squirt bottles
- Level B protective equipment
- 1 photoionization detector
- 1 geiger counter
- 1 H_2S monitox with gas generator
- 1 HCN monitox with gas generator

ATTACHMENT J
DRUM SAMPLING

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 4 DATE 8/7/98 PAGE 1 OF 5
SUBJECT Hazards and SOPs Associated with Drum Excavation	SUPERCEDES APPROVED

HAZARDS

1. General hazards associated with heavy equipment operations.
2. Slip, trip, fall.
3. Physical contact from splashing of any residual material in buried drums.
4. Physical contact from flying metal pieces.
5. Engulfment by excavated materials.

SOPs

1. Wear hard hats, face shields, safety goggles, and steel toed work boots at all times.
2. All personnel not necessary for the operation of equipment should stay clear of drum crushing activities.
3. Equipment operators are to be constantly aware of all other personnel/ equipment in the area during operation.
4. If excavation is deeper than 5 feet, EQ Procedure No. 12, Excavation and Trenching (29CFR 1926.652) must be followed.
5. Section 11.1 of Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities NIOSH/OSHA/USCG/EPA October, 1985.

Buried Drums

- Prior to initiating subsurface excavation, use ground-penetrating systems to estimate the location and depth of the drums (see *Inspection* in this chapter).
- Remove soil with great caution to minimize the potential for drum rupture.
- Have a dry chemical fire extinguisher on hand to control small fires.

11. Handling Drums and Other Containers

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Introduction

Accidents may occur during handling of drums and other hazardous waste containers. Hazards include detonations, fires, explosions, vapor generation, and physical injury resulting from moving heavy containers by hand and working around stacked drums, heavy equipment, and deteriorated drums. While these hazards are always present, proper work practices—such as minimizing handling and using equipment and procedures that isolate workers from hazardous substances—can minimize the risks to site personnel.

This chapter defines practices and procedures for safe handling of drums and other hazardous waste containers. It is intended to aid the Project Team Leader in setting up a waste container handling program. In addition to reading this chapter, the Project Team Leader should also be aware of all pertinent regulations. OSHA regulations (29 CFR Parts 1910 and 1926) include general requirements and standards for storing, containing, and handling chemicals and containers, and for maintaining equipment used for handling materials. EPA regulations (40 CFR Part 265) stipulate requirements for types of containers, maintenance of containers and containment structures, and design and maintenance of storage areas. DOT regulations (49 CFR Parts 171 through 178) also stipulate requirements for containers and procedures for shipment of hazardous wastes.

Containers are handled during characterization and removal of their contents and during other operations. A flow chart showing one set of possible procedures for drum handling is given in Figure 11-1. Guidance for safely performing the procedures shown in Figure 11-1 is provided in the following sections of this chapter. The final section, *Special Case Problems*, describes the handling of tanks, vaults, vacuum trucks, elevated tanks, and compressed gas cylinders.

Inspection

The appropriate procedures for handling drums depend on the drum contents. Thus, prior to any handling, drums should be visually inspected to gain as much information as possible about their contents. The inspection crew should look for:

- Symbols, words, or other marks on the drum indicating that its contents are hazardous, e.g., radioactive, explosive, corrosive, toxic, flammable.
- Symbols, words, or other marks on a drum indicating that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume individual containers (see Table 11-1).
- Signs of deterioration such as corrosion, rust, and leaks.
- Signs that the drum is under pressure such as swelling and bulging.
- Drum type (see Table 11-1).
- Configuration of the drumhead (see Table 11-2).

Conditions in the immediate vicinity of the drums may provide information about drum contents and their associated hazards. Monitoring should be conducted around the drums using instruments such as a gamma radiation survey instrument, organic vapor monitors, and a combustible gas meter.

The results of this survey can be used to classify the drums into preliminary hazard categories, for example:

- Radioactive.
- Leaking/deteriorated.
- Bulging.
- Explosive/shock-sensitive.
- Contains small-volume individual containers of laboratory wastes or other dangerous materials.

As a precautionary measure, personnel should assume that unlabelled drums contain hazardous materials until their contents are characterized. Also, they should bear in mind that drums are frequently mislabelled—particularly drums that are reused. Thus, a drum's label may not accurately describe its contents.

If buried drums are suspected, ground-penetrating systems, such as electromagnetic wave, electrical resistivity, ground-penetrating radar, magnetometry, and metal detection, can be used to estimate the location and depth of the drums.

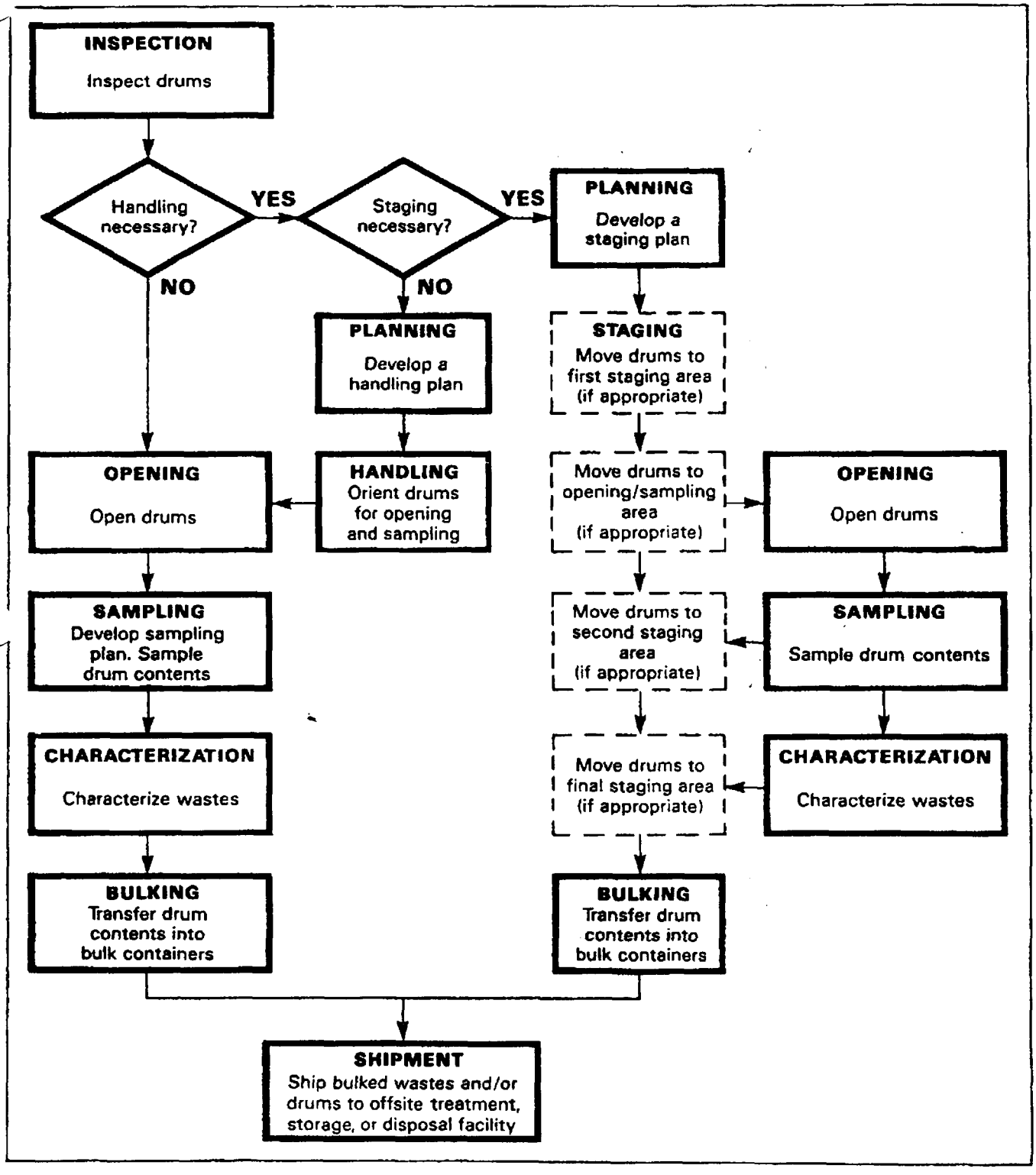

Figure 11-1. Flow Chart for Drum Handling. (Dashed boxes indicate optional steps. Number of staging areas necessary is site specific.)

Table 11-1. Special Drum Types and Their Associated Hazards

Polyethylene or PVC-Lined Drums	Often contain strong acids or bases. If the lining is punctured, the substance usually quickly corrodes the steel, resulting in a significant leak or spill.
Exotic Metal Drums (e.g., aluminum, nickel, stainless, steel, or other unusual metal)	Very expensive drums that usually contain an extremely dangerous material.
Single-Walled Drums Used as a Pressure Vessel	These drums have fittings for both product filling and placement of an inert gas, such as nitrogen. May contain reactive, flammable, or explosive substances.
Laboratory Packs	Used for disposal of expired chemicals and process samples from university laboratories, hospitals, and similar institutions. Individual containers within the lab pack are often not packed in absorbent material. They may contain incompatible materials, radioisotopes, shock-sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals. Laboratory packs can be an ignition source for fires at hazardous waste sites.

Table 11-2. Information Provided by Drumhead Configuration

CONFIGURATION	INFORMATION
Whole lid removable.	Designed to contain solid material.
Has a bung.	Designed to contain a liquid.
Contains a liner.	May contain a highly corrosive or otherwise hazardous material.

Planning

Since drum handling is fraught with danger, every step of the operation should be carefully planned, based on all the information available at the time. The results of the preliminary inspection can be used to determine (1) if any hazards are present and the appropriate response, and (2) which drums need to be moved in order to be opened and sampled. A preliminary plan should be developed which specifies the extent of handling necessary, the personnel selected for the job, and the most appropriate procedures based on the hazards associated with the probable drum contents as determined by visual inspection. This plan should be revised as new information is obtained during drum handling.

Handling

The purpose of handling is to (1) respond to any obvious problems that might impair worker safety, such as radioactivity, leakage, or the presence of explosive substances, (2) unstack and orient drums for sampling, and (3) if necessary, to organize drums into different areas on site to facilitate characterization and remedial action (see *Staging* in this chapter). Handling may or may not be necessary, depending on how the drums are positioned at a site.

Since accidents occur frequently during handling, particularly initial handling, drums should only be handled if necessary. Prior to handling, all personnel should be warned about the hazards of handling, and instructed to minimize handling as much as possible and to avoid unnecessary handling. In all phases of handling, personnel should be alert for new information about potential hazards. These hazards should be responded to before continuing with more routine handling operations. Overpack drums (larger drums in which leaking or damaged drums are placed for storage or shipment [see 49 CFR Part 173.3(c)]) and an adequate volume of absorbent should be kept near areas where minor spills may occur. Where major spills may occur, a containment berm adequate to contain the entire volume of liquid in the drums should be constructed before any handling takes place. If the drum contents spill, personnel trained in spill response should be used to isolate and contain the spill.

Several types of equipment can be used to move drums: (1) A drum grappler attached to a hydraulic excavator; (2) a small front-end loader, which can be either loaded manually or equipped with a bucket sling; (3) a rough terrain forklift; (4) a roller conveyor equipped with solid rollers; and (5) drum carts designed specifically for drum handling. Drums are also sometimes moved manually. The drum grappler is the preferred piece of equipment for drum handling. It keeps the operator removed from the drums so that there is less likelihood of injury if the drums detonate or rupture. If a drum is leaking, the operator can stop the leak by rotating the drum and immediately placing it into an overpack. In case of an explosion, grappler claws help protect the operator by partially deflecting the force of the explosion.

Backhoe with drum grappler.

The following procedures can be used to maximize worker safety during drum handling and movement:

- Train personnel in proper lifting and moving techniques to prevent back injuries.
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, and

ATTACHMENT K
OPENING DRUMS AND OVERPACKS

ATTACHMENT L
DRUM STAGING AND OVERPACKING

ATTACHMENT M
EMPTY DRUM CRUSHING

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 5 DATE 9/17/93 PAGE 1 OF 1 SUPERCEDES APPROVED
SUBJECT Hazards and SOPs Associated with Empty Drum Crushing	

HAZARDS

1. General hazards associated with heavy equipment operations.
2. Slip, trip, fall.
3. Physical contact from splashing of any residual material remaining in drums.
4. Physical contact from flying metal pieces.

SOPs

1. Wear hard hats, face shields, safety goggles, and steel toed work boots at all times.
2. All personnel not necessary for the operation of equipment should stay clear of drum crushing activities.
3. Equipment operators are to be constantly aware of all other personnel/ equipment in the area during operation.

ATTACHMENT N
SITE WALKTHROUGHS/ENTRY

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 7 DATE 9/17/93 PAGE 1 OF 2
SUBJECT Hazards and SOPs Associated with Site Walkthroughs	SUPERCEDES APPROVED

TASK SAFETY AND HEALTH RISK ANALYSIS

This Hazard Assessment identifies the general hazards associated with site operations. Every effort must be made to reduce or eliminate these hazards. Those which cannot be eliminated must be guarded against by use of engineering controls and/or personal protective equipment.

HAZARDS

1. Slip, trip, fall hazard from debris scattered throughout buildings, unstable stairways and drum/containers in buildings.
2. Slip, trip, fall hazards associated with general site operations.
3. Injury from unstable overhead and falling building materials/debris.
4. Gas release hazards due to the compressed gas cylinders.
5. Direct skin contact and/or inhalation of contaminants.
6. Biological hazards from uncultivated areas, such as vermin, bees, poison ivy, poison oak, and ticks.

SOPs

1. Be sure that all areas of entry have been provided with adequate lighting.
2. Be sure that all manholes/floor drains in buildings are covered and marked.
3. Be sure that stairways are structurally sound prior to work.

4. Be sure that all rooms are checked for loose or unstable overhead structures/debris prior to commencement of work activities.

5. Slip, trip, fall hazards can be minimized by keeping clean, organized work areas and being aware of unstable or loose footing areas.

6. Air monitoring to be conducted prior to walkthrough.

7. Wear proper level of protection when inside the hot zone area (see Section 4.5).

8. Be aware of and avoid potential biological hazards as stated above. Personnel check for ticks upon exiting hot zone area.

ATTACHMENT O
HOUSEKEEPING AND MATERIAL STORAGE

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 8 DATE 9/17/93 PAGE 1 OF 1
SUBJECT Housekeeping	SUPERCEDES APPROVED

HOUSEKEEPING

Housekeeping hazards produce congestion, disorder, dirt, waste, trash, and other obstacles and can lead to slips, trips, and fall potentials which can cause strains, sprains, broken bones, contusions, fractured ribs, and fatalities.

CONTROLS:

- Work areas shall be kept sufficiently clean and orderly so that work activities can proceed in an efficient and safe manner such that safety and quality are maintained. These areas will be adequately lighted, ventilated, protected, and accessible as appropriate for the work being performed. Machinery and equipment will be arranged and stored to permit safe, efficient work activities and to provide ease in cleaning. Tools and accessories will be safely stored in cabinets, racks, or other suitable devices out of traffic areas.

- Sufficient waste containers and receptacles will be provided in appropriate locations and will be emptied regularly. Work areas and floors will be maintained free of materials debris, obstructions, foreign materials, or slippery substances such as oil, water, and grease.

- Aisles, traffic areas, and exits will be maintained free of materials and debris. Combustible materials will be stored in approved containers and will be properly disposed of. Waste rags will be stored in metal containers. All flammable liquids will be stored in safety cans. Dangerous materials will be stored in areas outside of the work area.

- Personnel will be held accountable for keeping their work areas clear of housekeeping hazards.

ATTACHMENT P
HAZARDOUS WASTE STORAGE

STANDARD PROCEDURE	PROCEDURE NO. 9 DATE 9/17/93 PAGE 1 OF 5
SUBJECT Hazardous Waste Storage	SUPERCEDES APPROVED

HAZARDOUS WASTE STORAGE

Packaging, Labeling and Storage of Material

EQ ensures the utilization of the proper containers with the proper labeling by following the packaging and labeling requirements defined in the work plan. The present regulations for packaging of wastes are being revised. Currently either the Hazardous Materials Rule 181 specifications or the Performance Oriented Packaging method for packaging is acceptable and EQ can perform both methods. The proposed packaging method must be specified in the delivery order to ensure the proper packaging, labels, and placards are available for project initiation. The types of packaging required is specified in the "Hazardous Materials Table," 49 CFR 172.101, Column 8 in the HM 181 table and Column 5 in the present regulations.

Each regional transportation and disposal coordinator and on-site transportation and disposal coordinator is equipped with a copy of the hazardous materials table applicable to the delivery order. Each table also specified DOT shipping names, label requirements, special provisions, and limited quantities for aircraft and water vessels.

To ensure the containers are properly labeled prior to shipment, a Preshipment Certification Form (Figure 1) and a Drummed Waste Preshipment Checklist (Figure 2) is completed and certified by the on-site transportation and disposal coordinator prior to shipment. The "product code" is the alpha-numeric designation assigned by the receiving TSDF to track the shipment once it arrives at the facility. Proper labeling is important because a TSDF will not accept material improperly marked.

Proper Storage of Waste

Storage of waste on a non-permitted facility falls under the jurisdiction of the USEPA. State agencies also regulate environmental programs to at least the same extent as the USEPA. The USEPA regulations are the focus of this section, since state regulations vary widely and must be at least as stringent as federal regulations.

To determine the applicable storage regulations, EQ first determines the generator's status. The "accumulation time" factor determines if they are an exempt, small quantity generator; a small quantity generator; a generator storing for less than 90 days; or a generator requiring a storage permit. For all generators, the accumulation time begins when the first drop of known hazardous waste enters a drum. For material of unknown status, EQ performs chemical analysis per USEPA and/or state requirements. The accumulation time starts when the tests are complete and the analytical data show that the waste is hazardous. Once the drum/container is full, the status of the generator determines the length of time the drum/container may remain at this filling location.

To aid in complying with the regulations, EQ has developed a Weekly Inspection Form (see Figure ___) for use by the on-site transportation and disposal coordinator or another designee of the generator. The form is completed by the inspector and filed for verification that all storage requirements identified in the proposal or technical plans (WP, CSAP, and SSHP) were maintained and the containers were labeled correctly.

EQ PRESHIPMENT CERTIFICATION FORM

DATE: ___/___/___ TIME: ____:____ PROJECT #_____ TRACKING #: _____

Y/N/NA	INITIALS	
_____	_____	Vehicle is in good condition, DOT ID # on side
_____	_____	Drum preshipment check list completed
_____	_____	Load secured (tarp in place and good condition, drums stable, liner in place)
_____	_____	Placards legible and in place
_____	_____	Manifest completed properly
_____	_____	Transporter signed, printed name, and dated manifest
_____	_____	Generator signed, printed name, and dated manifest
_____	_____	Bottom copy given to generator
_____	_____	Land Disposal Restriction Notification attached to manifest
_____	_____	License number, vehicle number of vehicle recorded
_____	_____	Manifest Document # and State Document # recorded
_____	_____	Date and time of shipment logged

Comments:

_____

_____

_____

_____

Name of EQ Responsible Party: _____ Employee #: _____

Signature: _____

Figure 1. Preshipment Certification Form

DRUMMED WASTE PRESHIPMENT CHECK LIST

Y/N/NA	INITIALS	
_____	_____	Assigned manifest document number
_____	_____	Correct drum count
_____	_____	Estimated total volume/weight
_____	_____	Manifest document number is on haz-waste label
_____	_____	Hazardous waste label is on upper one-third side of drum.
_____	_____	Non-regulated waste label is on upper one-third side of drum.
_____	_____	_____ DOT label is next to waste label.
_____	_____	ORM-E Mark (in rectangle) or label is next to waste label.
_____	_____	Product code _____ is on top and side of drums.
_____	_____	Drum has no void space.
_____	_____	Drum contains no free liquids.
_____	_____	Drums are secured in truck
_____	_____	Drum numbers of all containers are recorded.

EQ Responsible Party: _____ Employee #: _____

Signature: _____

Figure 2. Drummed Waste Preshipment Check List

	WEEKLY INSPECTION FORM	Project Number: _____ Project Name: _____ T & D COORDINATOR: _____

This inspection is required by state and federal regulations (40 CFR, Part 265.174)

STAGING AREA ID: _____	# OF CONTAINERS: _____	DOCUMENT #: _____

THE DOCUMENT NUMBER IS SPECIFIC FOR THIS STAGING AREA. THE NUMBERS INDICATES THE NUMBER OF TIMES THE AREA HAS BEEN INSPECTED.

All containers have been visually inspected for:

1. Evidence of leaking: YES ☐ NO ☐
   ID of container(s) leaking: _____
   _____
   Corrective actions: _____
   _____
2. Evidence of deterioration: YES ☐ NO ☐
   ID of container(s) corroding: _____
   _____
   Corrective actions: _____
   _____
3. Bulging: YES ☐ NO ☐
   ID of container(s) bulging: _____
   _____
   Corrective actions: _____
   _____
4. Fuming: YES ☐ NO ☐
   ID of container(s) fuming: _____
   _____
   Corrective actions: _____
   _____
5. Labels properly placed, visible and legible: YES ☐ NO ☐
   Corrective actions: _____
   _____

The following operation were required to insure adequate aisle space clear of obstructions.

The range of accumulation dates in this area are _____/____/____ to _____/____/____
The following containers required restaging to ensure proper segregation.

YES	NO	
		No smoking and hazardous waste signs in place and clean?
		Spill control equipment in place?
		Communication devices working?

DATE TIME SIGNATURE

Note: Any deficiencies noted must be brought to the attention of the hazardous waste emergency coordinator on site for immediate action.

Figure 3. Weekly Inspection Form

ATTACHMENT Q
DEMOLITION

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 10 DATE 9/17/93 PAGE 1 OF 5
SUBJECT Demolition Safety	SUPERCEDES APPROVED

DEMOLITION SAFETY

1. PURPOSE

To outline hazards and controls associated with building demolition.

2. SCOPE

Demolition operations in which contaminated surfaces have either been decontaminated or removed prior to beginning demolition.

3. REFERENCES

A. Demolition Safety Manual; National Association of Demolition Contractors, 1981.

B. 29 CFR§1926 Subpart T - Demolition.

4. ATTACHMENT

Engineering Survey Form.

5. HAZARDS AND CONTROLS

	Hazards	Controls
A.	Unplanned collapse of any portion of the structure to be demolished or any adjacent structures.	Conduct an engineering survey by a competent and qualified person. Document in writing that the engineering survey has been performed (see attached form).

	Hazards	Controls
B.	Exposure or contact with any electric (overhead and underground), gas, water, steam, sewer, and other service lines.	Shut off, cap, or otherwise control outside the building before demolition work is started. Notify any utility company involved in advance. If it is necessary to maintain any utilities during demolition, temporarily relocate and protect the lines as necessary.
C.	Exposure to hazardous materials.	Eliminate the hazard before beginning demolition. If a portion of the structure is considered hazardous, isolate the contaminated area and protect against the spreading of contaminated material (dust, etc.).
D.	Fragmentation of glass.	Remove the hazard before beginning demolition.
E.	Falling debris.	When debris is dropped through holes in the structure without the use of chutes the area onto which the material is dropped shall be enclosed with barricades not less than 42 inches high and not less than 6 feet back from the projected edge of the opening above. Signs, warning of the hazard of falling materials, shall be posted. Removal of debris shall not be permitted in the lower area until debris handling ceases above. Except for preparatory work, such as cutting holes through which to drop material and the preparation of storage areas, the demolition of exterior walls and floor construction shall begin at the top and proceed downward. No material shall be dropped outside the exterior walls of the structure unless the area is effectively protected.
F.	Removal of walls.	Masonry walls, or other sections of masonry, shall not be permitted to fall upon the floors of the building in such

F. (continued)

masses as to exceed the safe carrying capacities of the floors. No wall section, which is more than one story in height, shall be permitted to stand alone without lateral bracing, unless such wall was originally designed and constructed to stand without such lateral support, and is in a condition safe enough to be self-supporting. All walls shall be left in a stable condition at the end of each shift. Employees shall not be permitted to work on the top of a wall when weather conditions constitute a hazard. In buildings of "skeleton-steel" construction, the steel framing may be left in place during the demolition of masonry. Where this is done, all steel beams, girders, and similar structural supports shall be cleared of all loose material as the masonry demolition progresses downward. Walkways or ladders shall be provided to enable employees to safely reach or leave any scaffold or wall. Walls, which serve as retaining walls to support earth, adjoining structures, or debris shall not be demolished until such material has been properly braced or adjoining structures have been properly underpinned. Mechanical equipment shall not be used on floors or working surfaces unless such floors or surfaces are of sufficient strength to support the imposed load. Floor openings shall have curbs or stop-logs to prevent equipment from running over the edge. Mechanical equipment used shall meet the requirements specified in 29CFR§1926 Subparts N and O.

G. Storage of waste materials.

The storage of waste material and debris on any floor shall not exceed the allowable floor loads. Storage space into which material is dumped shall be

G. (continued)

blocked off, except for openings necessary for the removal of material. Such openings shall be kept closed at all times when material is not being removed.

H. Removal of steel construction.

Cranes, derricks, and other hoisting equipment used shall meet the requirements specified in Subpart N of 29CFR§1926. Steel construction shall be dismantled column length by column length, and tier by tier (columns may be in two-story lengths). Any structural member being dismembered shall not be overstressed.

I. Mechanical demolition.

No workers hall be permitted in any area, which can be adversely affected by demolition operations, when balling or clamming is being performed. Only those workers necessary for the performance of the operations shall be permitted in this area at any other time. When pulling over walls or portions thereof, all steel members affected shall have been previously cut free. During demolition, continuing inspections by a competent person shall be made as the work progresses to detect hazards resulting from weakened or deteriorated floors, walls, or loosened material. No employee shall be permitted to work where such hazards exist until they are corrected by shoring, bracing, or other effective means.

SUGGESTED FORM FOR ENGINEERING SURVEY

DATE _____

TYPE OF STRUCTURE _____

LOCATION _____ BASEMENT _____

STORIES OR HEIGHT _____ SIZE OF STRUCTURE _____

LOCATE PARTY WALLS _____

ARE WALL TIES REQUIRED? _____ HOW MANY? ____ TYPE _____

STRUCTURAL HAZARDS _____

_____

IS SHORING OF WALLS OR FLOORS REQUIRED? _____

TYPE OF SHORING AND LOCATION _____

_____

PROTECTION FOR ADJACENT PROPERTIES _____

_____

PROTECTION FOR PUBLIC _____

_____

METHODS OF DEMOLITION _____

_____

UTILITIES _____

LOCATION OF POWER LINES _____

LOCATE ANY TANKS _____

TANKS' PREVIOUS USE _____

HAVE TANKS BEEN PURGED AND TESTED? _____ BY WHOM? _____

LOCATE PITS OR OPEN HOLES

SPECIAL HAZARDS AND REMEDIES _____

_____

SIGNED _____

ATTACHMENT R
WORKING AROUND HEAVY EQUIPMENT

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 11 DATE 9/17/93 PAGE 1 OF 7
SUBJECT Working Around Heavy Equipment and Machinery (Excavators/Loaders)	SUPERCEDES APPROVED

WORKING AROUND HEAVY EQUIPMENT AND MACHINERY

The hazards associated with the operation of heavy equipment are injury to personnel, equipment damage, and property damage. The potential for injury or damage to personnel and property is due to the size of the equipment, limited visibility or the driver, and the potential overhead hazards leading to crushing, tripping, falls, cuts, or punctures, and the high noise levels created by the equipment.

General

1) The work area shall be appropriately delineated to prevent non-essential personnel from wandering into the area.

2) Equipment operators shall maintain eye contact with ground personnel at all times, giving ground personnel the right of way.

3) Vehicles/equipment paths shall be marked as feasible to prevent personnel from crossing.

4) Equipment shall be outfitted with the appropriate safety features, back-up alarms, rollover protection, fire extinguishers, etc.

5) Loads shall be lowered and equipment de-energized and secured before any adjustments are made to load, repositioning, etc.

6) Personnel shall be cognizant of excavations, material/debris piles and other equipment in the work area. These areas shall be appropriately marked or protected to prevent falls.

Excavators/ Loaders

1) Only trained and qualified individuals shall operate heavy equipment/excavators.

2) All heavy equipment shall be inspected before mobilization, on-site, and daily prior to use; inspections shall be documented.

3) All heavy equipment shall be equipped with the appropriate safety devices (ROPS, fire extinguishers, seat belts, backup alarms, (etc.).

4) Vehicles shall maintain appropriate operating speeds and load capacities at all times.

5) A spotter shall be used for each piece of heavy equipment to assist the operator and nearby personnel in preventing injuries. The spotter shall carry an emergency signal/alarm at all times during work operations.

6) The area of excavation (or other operation) shall be appropriately marked to prevent non-essential personnel from wandering into the vehicle path (safe work buffer zone).

7) Ground personnel shall be given the right of way at all times. Safety vests, and/or reflective clothing shall be worn by those working in the immediate area. Eye contact shall be maintained between operators and laborers in the vicinity.

8) Radio contact shall be maintained between operators and the appropriate on-site personnel.

9) At the end of the day, equipment breathing air and safety equipment shall be checked, the cab shall be cleaned, refueling will occur, brakes will be set, and a daily report shall be completed by the equipment operator.

10) The area shall be visually inspected and all structural encumbrances shall be removed or protected prior to work.

11) Personnel shall enter and exit vehicles using handrails and steps that are provided.

Excavators/ Loaders (continued)

12) Work area shall be kept neat and in an orderly state of housekeeping.

13) All underground utilities shall be located prior to excavation; utility companies shall be contacted if necessary.

14) Excavator shall be prohibited from operating on severe inclines or questionable surfaces. Excavators operating near the edge of a quarry shall be supported with a swamp pad.

15) Employees shall be prohibited from standing or working in areas where they would be exposed to falling loads. Personnel shall stand away from vehicles during excavation or loading. Operators may remain within vehicle cabs during loading as outlined in 29 CFR 1926.601(b)(6) for adequate protection.

16) All personnel working around the excavators shall be trained in emergency shutdown of the equipment.

17) Stop logs/railroad ties shall be used to barricade a quarry rim to prevent equipment or personnel from coming too close to the edge. Barricade shall be established 5 feet from the edge of the excavation, and a warning sign shall be posted in this area to alert personnel of the dangers.

18) Areas within a quarry, which are directly beneath the excavation areas shall be barricaded to prevent personnel from standing below in areas with a potential hazard of falling objects/debris.

19) When lowering excavator(s) from the rim into a quarry, the load weight shall be checked to ensure lifting equipment has sufficient capacity.

20) Air monitoring for carbon monoxide, oxygen, etc. shall be performed by EQ within vehicle cabs throughout work operations.

21) Equipment operators shall wear appropriate PPE as outlined in the SWP, to protect personnel from exposure to potential chemical and radiological hazards.

Excavators/ Loaders (continued)

22) Personnel shall be prohibited from reaching into loading operations with arms or legs while in operation.

23) Any adjustments or repairs that need to be made to equipment (or loads) shall be made with the equipment disengaged and shut down. If there is a suspended load, the load shall be lowered to the ground (or securely braced) before any adjustments can be made to the equipment.

Cranes

1) All cranes must have proof of a thorough inspection within the last year by an appropriately qualified individual. Crane personnel platform (manbasket), and rigging equipment shall be inspected daily prior to use.

2) Load capacities shall be stenciled onto the equipment and observed during operations. The combined weight of the loaded personnel platform/manbasket and its rigging must not exceed 50 percent of the rated load capacity in all locations where the platform will be positioned.

3) All hooks, slings, and other fittings shall be the correct size for the work to be done and with sufficient capacity for the load to be lifted.

4) Manbasket will be load tested at 150 percent of rated capacity prior to daily use and whenever reattached to hoist line.

5) The manbasket shall be equipped with the appropriate safety features to prevent personnel from falling out (guardrails, grabrails, overhead protection if necessary, etc.).

6) The crane operator must always have full control over the movement of the personnel platform/manbasket. All vertical movement must use the power of the crane winch.

7) Employees shall be prohibited from standing or working beneath crane booms.

8) In the event of emergency repair work on hoisting equipment with a suspended load, the area below the load shall be barricaded and the load blocked or otherwise supported.

Cranes (continued)

9) Employees are prohibited from riding on loads, hooks, slings (etc.) suspended from hoisting equipment.

10) Inspection shall be made of all hooks, rings, pins, shackles, or other lifting attachments, and defective parts shall not be used. Wire ropes shall be free of kinks, sharp bends, or twists.

11) When the occupied personnel platform/manbasket is in a stationary position, all brakes and locking devices on the crane must be set.

12) All cranes used for personnel hoisting must have boom angle indicator that is visible to the operator, and shall be equipped with either an anti-two-blocking device that prevents contact with the load block or a two-block damage feature that deactivates the hoisting action before damage occurs.

13) No mobile crane will operate or make a heavy lift without its outriggers fully extended to assure maximum stabilization of the equipment.

14) Appropriate hand signals shall be predetermined and used during crane operations. Only one individual shall issue signals to the operator unless a relay system is necessary.

15) Tag lines shall be used at all times for controlling swinging loads.

16) The crane operator and rigger shall confirm that the load is properly secured and balanced before it is lifted.

17) Crane operations shall be stopped or restricted during bad weather or poor visibility.

Maintenance and Repairs

1) All equipment hazards identified shall be controlled.

2) Operators shall not wear loose clothing that might get tangled in the equipment or controls.

Maintenance and Repairs (continued)	3)	Appropriate machine/equipment guards shall be in place and intact at all times during operation. When guards require maintenance or replacement, equipment will be shut down and repaired, to be restarted only when guards are replaced and in good condition.
	4)	Heavy equipment shall be demobilized to a staging area and decontaminated as necessary before performing maintenance or repairs.
	5)	An equipment repair log shall be maintained and updated on a daily basis/whenever a repair or adjustment is made.
	6)	Pinching and cutting hazards shall be controlled by prohibiting personnel from reaching into running equipment and by wearing the appropriate PPE. All equipment repairs shall be made while equipment is shut down.
	7)	Appropriate PPE shall be used as outlined in the SWP to prevent contact with chemicals.
Refueling	1)	Equipment engine must be shut down and locked/tagged out before any refueling operations are conducted.
	2)	Appropriate ABC type fire extinguishers shall be available.
	3)	All ignition sources shall be eliminated.
	4)	Fuel shall be brought to the equipment using the designated vehicle. Appropriate vehicle safety precautions shall be followed.
	5)	Appropriate grounding/bonding shall be conducted before transferring fuel.
Decontamination and Removal	1)	Appropriate PPE shall be worn as outlined in the SWP (faceshields, etc.).
	2)	Only trained, authorized personnel shall operate high pressure washers.
	3)	The lance/nozzle must always be pointed at the work area, and not toward other personnel.
	4)	The operator shall maintain good footing during cleaning.

Decontamination and Removal (continued)

5) Non-operators shall maintain a safe distance (25 feet) from the operator during washing.

6) Washer operators shall alternate to avoid fatigue. Assistants shall also be used to help move and handle the equipment.

7) Washer equipment shall be cleaned/rinsed periodically to avoid build-up (around trigger, guard).

8) An assistant shall monitor the pressure during operations, and shall stand near the generator in case emergency shutdown is necessary.

9) All lances/nozzles shall be constructed of seamless stainless steel to avoid rusting.

10) Washers shall be operated at the designated pressure. Inspections shall be made for leaks and malfunctions; damaged or faulty equipment must be repaired or taken out of service immediately.

11) Personnel shall use proper lifting techniques such as keeping back straight, lifting with legs, limiting twisting, getting help in moving bulky/heavy loads, and using mechanical equipment to move material and equipment when appropriate.

12) Personnel shall work at a rational pace.

13) If decontamination is performed in the presence of electrical circuits, appropriate provisions shall be made to disconnect them or protect them from contact with water.

ATTACHMENT T
EXCAVATION

STANDARD PROCEDURE	PROCEDURE NO. 12
	DATE 10/27/93
	PAGE 1 OF 11
SUBJECT	SUPERCEDES
Excavation and Trenching	APPROVED

EXCAVATION AND TRENCHING

1.0 PURPOSE AND SUMMARY

This procedure presents the federal requirements for excavation safety. Excavation operations pose unique and serious hazards.

With very few exceptions, protective systems must be designed and installed to protect employees who enter excavations of 5 feet or more in depth. Accepted protective systems include: sloping, shoring and shielding.

The protective system must be designed by a registered professional engineer (civil), and plans must be available for inspections on-site.

In addition to these federal requirements, some states and localities may require notification of trenching/excavation operations prior to beginning work.

2.0 TABLE OF CONTENTS

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Trench/Excavation Notification Worksheet
Attachments:
1) Selection of Protective Systems for Excavations 20 Feet or Less in Depth
2) Sloping Options
3) Shoring or Shielding Options
4) 29 CFR 1926 Subpart P - Excavations
5) Excavation and Trenching Notification Log

3.0 DEFINITIONS

A. Accepted Engineering Requirements: Those requirements or practices which are compatible with standards required by a registered professional engineer.

B. Angle of Repose: The greatest angle above the horizontal plane at which a material will lie without sliding.

C. Benching: Means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

D. Competent Person (Federal OSHA, 29 CFR 1926.32(f): A person, such as a supervisor or engineer, who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees and who has the authority to take prompt corrective measures to eliminate them. Nomenclature for responsibilities equivalent to a competent person varies from state to state. For example, in California, the individual with excavation/trenching installation and supervision responsibilities is a "qualified person".

E. Confined Space: Enclosure having limited means for entry and exit, by reason of location, size, or numbers of openings; and unfavorable natural ventilation that could contain or produce dangerous air contaminants, flammable atmospheres, and/or oxygen deficiency.

F. Design Engineer: An individual, currently registered as a civil engineer in the applicable state, who, in all other respects, meets the requirements of a pertinent State OSHA Program, or Federal OSHA in terms of his or her ability to design shoring, sloping, benching, or alternate trench/excavation systems.

G. Excavation: Any man-made cut, cavity, trench, or depression in an earth surface, including its sides, walls, or faces, formed by earth removal.

H. Project Manager: An individual who is responsible to coordinate and direct the activities of both the Design Engineer and Project Supervisor. The Project Manager is responsible to assure that all pre-excavation requirements are met: site preparation, health and safety office notification, OSHA and internal project permitting, and employee training.

I. Project Supervisor: A person, such as a supervisor or engineer, who is familiar with the installation of shoring or sloping/benching systems and the attendant hazards of excavation or trenching operations. Project supervisors shall meet the particular requirements of State OSHA programs, or where applicable, the requirements of a Federal OSHA competent person. Project Supervisors shall assure that excavation/trenching work practices are properly followed.

J. Sheeting: Means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

K. Shield: Means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Shields may be pre-manufactured or job-built in accordance with 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields".

L. Shoring: Means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

M. Sloping: Means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

N. Spoil: The earth material that is removed in the formation of an excavation, or trench.

O. Support System: Means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

P. Tabulated Data: Means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

Q. Trench: An excavation made below the surface of the ground. In general, the depth is greater than the width at the bottom, but the width of a trench at the bottom is not greater than 15 feet.

4.0 EXCAVATION AND TRENCHING

4.1 Pre-Excavation Requirements

4.1.1 Underground Installations

Prior to opening an excavation, the estimated location of utility installations such as sewer, telephone, fuel, electric, water lines, or any underground installations that may reasonably be expected to be encountered during the excavation work shall be determined.

Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations.

When utility companies or owners cannot respond to a request within 24 hours - excluding weekends and holidays - (or longer if required by state or local law), or if the exact location of installations cannot be established, excavation may proceed with caution, provided detection equipment or other means to locate utility installations are used.

4.1.2 Surface Encumbrances

All surface encumbrances (trees, poles, boulders, etc.) that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

4.1.3 Training

Employees shall not be assigned, or permitted, to design, supervise, or work in or about excavations until they have completed formal classroom training to include:

- types of hazards associated with excavation operations,
- safe work practices and techniques,
- a review of applicable Federal, state and local regulations, and
- a review of this procedure.

Tailgate Safety Meetings detailing the specific hazards of the work to be performed and safety precautions and procedures specific for the job shall be conducted by the project supervisor at the beginning of each shift for each job. The meeting shall be documented on the Tailgate Safety Meeting Form.

Formal training shall be complemented with on-the-job training and instruction by management as part of standard employee supervision, and to the extent necessary to assure compliance with this procedure, and all other applicable health and safety practices.

4.1.4 Hazard Assessment

During the project planning stage, an assessment of potential hazards shall be made to include:

- the presence and quantity of hazardous substances in the area of the excavation;
- the toxicity and flammability of hazardous substances present, or to be introduced into, the area of the excavation;
- the potential for work meeting the definition of confined space work;
- the presence of nearby above-ground or overhead utility installations;
- the exposure of the general public to the excavation operations; and
- the potential for surface water runoff into the excavation.

At this time, the Project Notification Worksheet must be completed.

4.2 Excavation Work Practices

4.2.1 General

Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with 29 CFR 1926.652. the project supervisor shall ensure that the required protective system is installed and maintained per the design specifications.

No employee shall be permitted to enter the excavation unless they are specifically required to do so. Unauthorized persons shall not be allowed access.

4.2.2 Supervision

Work in an excavation shall at all times be supervised by an EQ project supervisor. This individual will remain outside of the excavation at all times, and will be responsible for identifying any unusual developments above ground which may warn of impending earth movement.

4.2.3 Access and Egress

Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design. Ramp design and construction shall comply with 29 CFR 1926.651(c).

A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 or more feet in depth so as to require no more than 25 feet of lateral travel for employees.

4.2.4 Protect Systems

Protective systems designed in accordance with 29 CFR 1926.652(b) or (c) shall be installed except when:

1) the excavation is made entirely in stable rock; or

2) the excavation is less than 5 feet in depth, and examination of the ground by a competent person provides no indication of a potential cave-in.

Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

4.2.5 Placement of Spoil

All spoil shall be placed at least 2 feet from the edge of the excavation. It is strongly recommended that spoil be placed 4 or more feet from the excavation edge so as not to cover surface indicators of subsidence (such as fissures or cracks). No method that disturbs the soil in place (such as driving stakes) shall be used to contain the spoil material.

4.2.6 Exposure to Falling Loads

No employees shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded provided the vehicles are equipped with protection as specified in 29 CFR 1926.601(b)(6).

4.2.7 Warning System for Mobile Equipment

When mobile equipment is operated adjacent to an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs.

4.2.8 Hazardous Atmospheres

Where an oxygen deficient (less than 20.5% 0_2) or hazardous atmosphere exists, or could reasonably be expected to exist, the excavation shall be tested before employees enter.

Adequate precautions shall be taken to prevent employee exposure to oxygen deficient or hazardous atmospheres. As appropriate, ventilation and/or respiratory protective devices shall be used.

Adequate precautions, including ventilation, shall be taken to prevent employee exposure to atmospheres containing a concentration of flammable gas in excess of 10 percent of the lower explosive limit (LEL) of the gas.

Testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

4.2.9 Water Accumulation Hazards

Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation.

If water is controlled or prevented from accumulating by the use of water removal equipment. The water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

If the excavation work interrupts the natural drainage of surface water (streams, run-off channels), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation.

Excavations subject to run-off from heavy rains shall be inspected by a competent person in compliance with Subsection 4.2.10 below.

4.2.10 Stability of Adjacent Structures

The stability of structures adjoining the excavation shall be supported to protect employees.

Excavation below the level of the base or footing of any foundation or retaining wall that could reasonably be expected to pose a hazard to employees shall not be permitted except when:

- a support system (underpinning) is provided to ensure the safety of employees and the stability of the structure; or
- the excavation is in stable rock; or
- a registered professional engineer has determined that the structure will be unaffected by the excavation; or
- a registered professional engineer has determined that such excavation will not pose a hazard to employees.

Sidewalks, pavements and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

4.2.11 Protection of Employees from Loose Rock or Soil

Employees shall be protected from loose rock or soil which could fall or roll from the excavation face. Such protection could be scaled to remove loose material, or the installation of barriers.

Employees shall be protected from spoil or other materials or equipment which could fall or roll into the excavation. Such materials shall be kept at least 2 feet from the excavation edge, and/or retaining devices shall be used to present materials or equipment from falling or rolling into excavations.

4.2.12 Inspections

A competent person shall make daily inspections of excavations, the adjacent areas and protective systems for evidence of conditions that could result in a cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.

The inspection shall be made prior to the start of work, and as needed throughout the shift. Inspections shall be made after each rainstorm or other hazard-increasing event.

Where the inspection finds evidence of any hazardous condition, exposed employees shall be removed from the hazardous area until necessary precautions have been taken.

4.2.13 Fall Protection

Where employees or equipment are permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.

Adequate barrier physical protection shall be provided at all remotely located excavations. All wells, pits, shafts, etc., shall be barricaded or covered. Temporary well, pits, shafts, etc., shall be backfilled as soon as possible.

4.3 Requirements for Protective Systems

4.3.1 Protection for Employees in Excavations

Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed and installed in compliance with 29 CFR 1926.652(b) or 29 CFR 1926.652(c), except when

- the excavation is made entirely in stable rock; or
- the excavation is less than 5 feet in depth and a competent person determines there is no danger of cave-in.

Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

5.0 EXCEPTION PROVISIONS

No exceptions to the requirements of this policy are permitted.

6.0 CROSS REFERENCES

29 CFR 1926 Subpart P - Excavations
§ 650; Scope, application and definitions
§ 651; General requirements
§ 652; Requirements for protective systems
Appendices A - F, mandatory

7.0 FORMS AND CHECKLISTS

Trench/Excavation Notification Worksheet. This form is mandatory. It is to be completed by the project manager and/or design engineer. After the form is completed, a copy is submitted to the responsible health and safety professional who will review it, and make any necessary state or local notifications.

Attachment 1, Selection of Protective Systems for Excavations 20 Feet or Less in Depth

Attachment 2, Sloping Options

Attachment 3, Shoring or Shielding Options

Attachment 4, Responsibility Matrix

Attachment 5, 29 CFR 1926 Subpart P - Excavations

TRENCH/EXCAVATION NOTIFICATION WORKSHEET

Project Number _____ Project Name _____

Customer's Name: _____

Specific Jobsite Location: _____

Nearest Major Cross Street: _____

City: _____ County: _____

Name and Title of Site Supervisor: _____

Starting Date: _____ Estimated Completion Date: _____

High Voltage Lines in Proximity: YES_____ NO_____ How Near_____

Depth Range (ft): ___ ___ Width Range(ft): ___ ___ Length(ft): _____
min max min max

Project Description: _____

_____

Anticipated Soil Condition: Hard Compact___ Unstable___ Running___

Ground Protection Method: Shoring_____ Sloping____
Trench Shield_____ Alternate_____

ALL METHODS MUST MEET ACCEPTED ENGINEERING REQUIREMENTS.
PLANS MUST BE KEPT ON-SITE.

Describe Chemical Hazards at Site: _____

_____

Subcontractor's Name: _____

Equipment to be Used: _____

Design Engineer: _____ Project Supervisor: _____

Phone: ( ) _____

==========

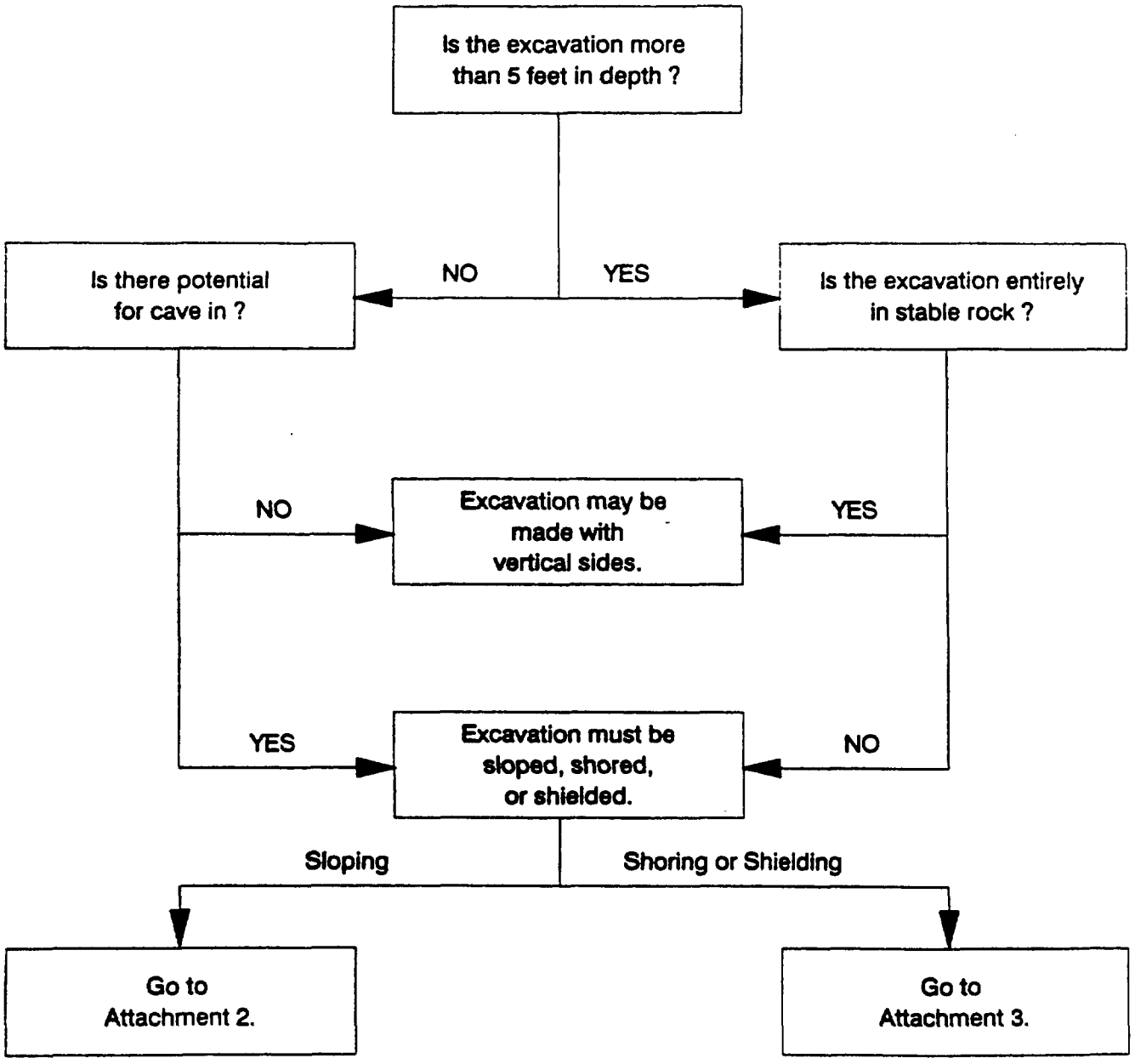
Health & Safety Use Only

EQ Permit Number: _____ Date Issued: _____ Expires: _____

Issued By: _____

ATTACHMENT 1.

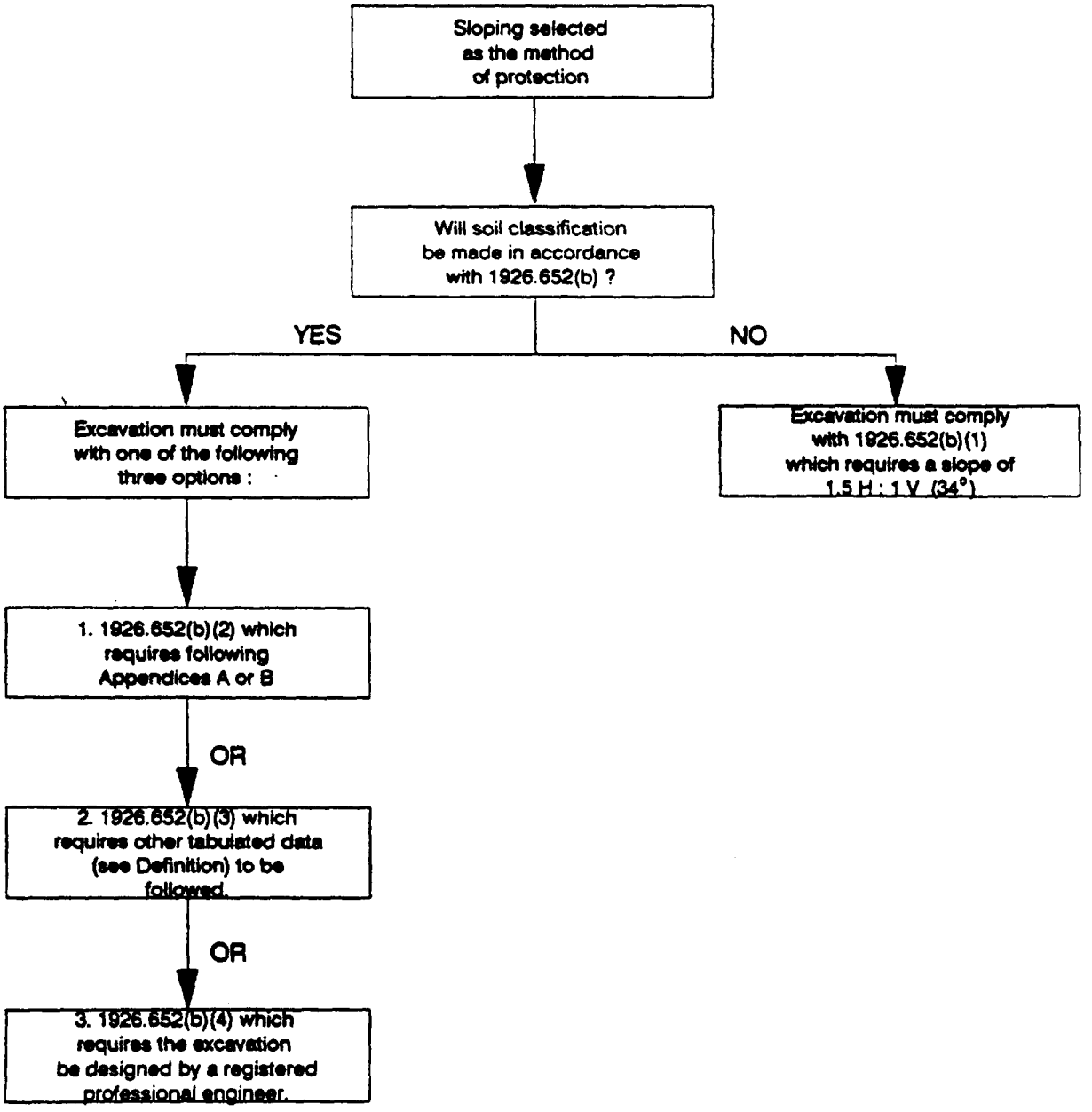
Selection of Protective Systems for Excavations 20 Feet or Less in Depth



For excavations greater than 20 feet in depth, design by a registered professional engineer in compliance with 1926.652(b) and (c) is required.

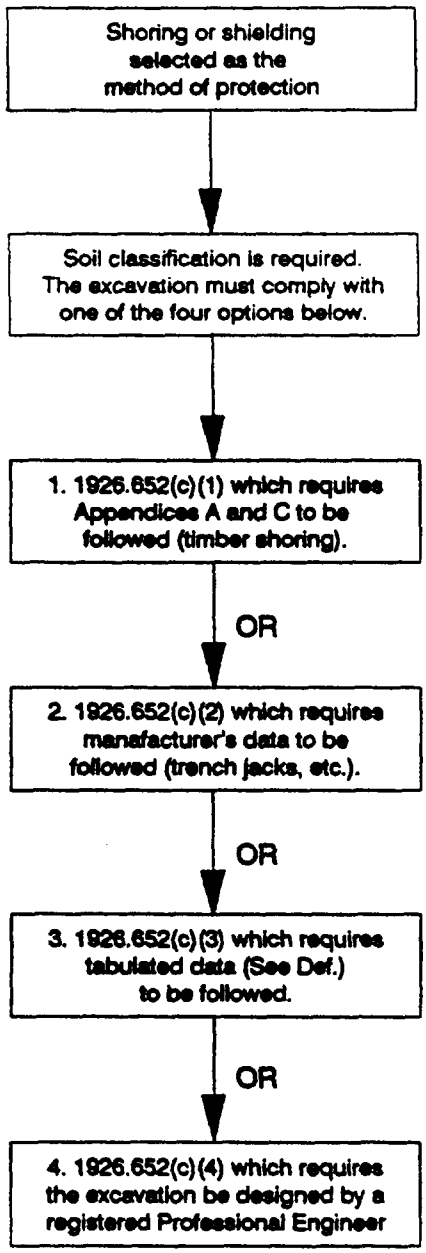
ATTACHMENT 2.

Sloping Options



ATTACHMENT 3.

Shoring or Shielding Options



PART 1926—[AMENDED]

Subpart M—[Amended]

1. By revising the authority citation for subpart M of part 1926 to read as follows:

Authority: Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12–71 (36 FR 8754), 8–76 (41 FR 25059), or 9–83 (48 FR 35736), as applicable, and 29 CFR part 1911.

2. By revising subpart P of part 1926 to read as follows:

Subpart P—Excavations

Sec.
1926.650 Scope, application, and definitions applicable to this subpart.
1926.651 General requirements.
1926.652 Requirements for protective systems.

Appendix A to Subpart P—Soil Classification

Appendix B to Subpart P—Sloping and Benching

Appendix C to Subpart P—Timber Shoring for Trenches

Appendix D to Subpart P—Aluminum Hydraulic Shoring for Trenches

Appendix E to Subpart P—Alternatives to Timber Shoring

Appendix F to Subpart P—Selection of Protective Systems

Subpart P—Excavations

Authority: Sec. 107, Contract Worker Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12–71 (36 FR 8754), 8–76 (41 FR 25059), or 9–83 (48 FR 35736), as applicable, and 29 CFR part 1911.

§ 1926.650 Scope, application, and definitions applicable to this subpart.

(a) *Scope and application.* This subpart applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

(b) *Definitions applicable to this subpart.*

Accepted engineering practices means those requirements which are compatible with standards of practice required by a registered professional engineer.

Aluminum Hydraulic Shoring means a pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (walers). Such system is designed, specifically to support the sidewalls of an excavation and prevent cave-ins.

Bell-bottom pier hole means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

Benching (Benching system) means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Competent person means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Cross braces mean the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

Excavation means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Faces or *sides* means the vertical or inclined earth surfaces formed as a result of excavation work.

Failure means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Hazardous atmosphere means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

Kickout means the accidental release or failure of a cross brace.

Protective system means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

Ramp means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

Registered Professional Engineer means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

Sheeting means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield (Shield system) means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with § 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

Shoring (Shoring system) means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sides. See "Faces."

Sloping (Sloping system) means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Stable rock means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Structural ramp means a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

Support system means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground

installation, or the sides of an excavation.

Tabulated data means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

Trench (Trench excavation) means a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

Trench box. See "Shield."

Trench shield. See "Shield."

Uprights means the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "sheeting."

Wales means horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

§ 1926.651 General requirements.

(a) *Surface encumbrances.* All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

(b) *Underground installations.* (1) The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

(2) Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

(3) When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means.

(4) While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

(c) *Access and egress*—(1) *Structural ramps.* (i) Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

(ii) Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.

(iii) Structural members used for ramps and runways shall be of uniform thickness.

(iv) Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

(v) Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

(2) *Means of egress from trench excavations.* A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

(d) *Exposure to vehicular traffic.* Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

(e) *Exposure to falling loads.* No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with § 1926.601(b)(6), to provide adequate protection for the operator during loading and unloading operations.

(f) *Warning system for mobile equipment.* When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

(g) *Hazardous atmospheres*—(1) *Testing and controls.* In addition to the requirements set forth in subparts D and E of this part (29 CFR 1926.50–1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

(i) Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

(ii) Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

(iii) Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

(iv) When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

(2) *Emergency rescue equipment.* (i) Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

(ii) Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a life-line securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually

attended at all times while the employee wearing the lifeline is in the excavation.

(h) *Protection from hazards associated with water accumulation.* (1) Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

(2) If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

(3) If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

(i) *Stability of adjacent structures.* (1) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

(2) Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

(i) A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

(ii) The excavation is in stable rock; or

(iii) A registered professional engineer has approved the determination that the structure is sufficently removed from the excavation so as to be unaffected by the excavation activity; or

(iv) A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

(3) Sidewalks, pavements, and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

(j) *Protection of employees from loose rock or soil.* (1) Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of scaling to remove loose material; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection.

(2) Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

(k) *Inspections.* (1) Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

(2) Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

(l) *Fall protection.* (1) Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.

(2) Adequate barrier physical protection shall be provided at all remotely located excavations. All wells, pits, shafts, etc., shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc., shall be backfilled.

§ 1926.652 Requirements for protective systems.

(a) *Protection of employees in excavations.* (1) Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:

(i) Excavations are made entirely in stable rock; or

(ii) Excavations are less than 5 feet (1.52m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

(2) Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

(b) *Design of sloping and benching systems.* The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (b)(1); or, in the alternative, paragraph (b)(2); or, in the alternative, paragraph (b)(3), or, in the alternative, paragraph (b)(4), as follows:

(1) *Option (1)—Allowable configurations and slopes.* (i) Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

(ii) Slopes specified in paragraph (b)(1)(i) of this section, shall be excavated to form configurations that are in accordance with the slopes shown for Type C soil in Appendix B to this subpart.

(2) *Option (2)—Determination of slopes and configurations using Appendices A and B.* Maximum allowable slopes, and allowable configurations for sloping and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendices A and B to this subpart.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of sloping or benching systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data shall be in written form and shall include all of the following:

(A) Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;

(B) Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) under paragraph (b) of this section shall be approved by a registered professional engineer.

(ii) Designs shall be in written form and shall include at least the following:

(A) The magnitude of the slopes that were determined to be safe for the particular project;

(B) The configurations that were determined to be safe for the particular project; and

(C) The identity of the registered professional engineer approving the design.

(iii) At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time the design need not be at the jobsite, but a copy shall be made available to the Secretary upon request.

(c) *Design of support systems, shield systems, and other protective systems.* Designs of support systems shield systems, and other protective systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (c)(1); or, in the alternative, paragraph (c)(2); or, in the alternative, paragraph (c)(3); or, in the alternative, paragraph (c)(4) as follows:

(1) *Option (1)—Designs using appendices A, C and D.* Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in appendices A and C to this subpart. Designs for aluminum hydraulic shoring shall be in accordance with paragraph (c)(2) of this section, but if manufacturer's tabulated data cannot be utilized, designs shall be in accordance with appendix D.

(2) *Option (2)—Designs Using Manufacturer's Tabulated Data.* (i) Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

(ii) Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall only be allowed after the manufacturer issues specific written approval.

(iii) Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations shall be in written form at the jobsite during construction of the protective system. After that time this data may be stored off the jobsite, but a copy shall be made available to the Secretary upon request.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of support systems, shield systems, or other protective systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data shall be in written form and include all of the following:

(A) Identification of the parameters that affect the selection of a protective system drawn from such data;

(B) Identification of the limits of use of the data;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, shall be approved by a registered professional engineer.

(ii) Designs shall be in written form and shall include the following:

(A) A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and

(B) The identity of the registered professional engineer approving the design.

(iii) At least one copy of the design shall be maintained at the jobsite during construction of the protective system. After that time, the design may be stored off the jobsite, but a copy of the design shall be made available to the Secretary upon request.

(d) *Materials and equipment.* (1) Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function.

(2) Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

(3) When material or equipment that is used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

(e) *Installation and removal of support*—(1) *General.* (i) Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other predictable failure.

(ii) Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

(iii) Individual members of support systems shall not be subjected to loads exceeding those which those members were designed to withstand.

(iv) Before temporary removal of individual members begins, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

(v) Removal shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

(vi) Backfilling shall progress together with the removal of support systems from excavations.

(2) *Additional requirements for support systems for trench excavations.* (i) Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

(ii) Installation of a support system shall be closely coordinated with the excavation of trenches.

(f) *Sloping and benching systems.* Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

(g) *Shield systems*—(1) *General.* (i) Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

(ii) Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(iii) Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

(iv) Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

(2) *Additional requirement for shield systems used in trench excavations.* Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

Appendix A to Subpart P

Soil Classification

(a) *Scope and application*—(1) *Scope.* This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

(2) *Application.* This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in § 1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic shoring is designed in accordance with appendix D. This Appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in § 1926.652(c), and the use of the data is predicated on the use of the soil classification system set forth in this appendix.

(b) *Definitions.* The definitions and examples given below are based on, in whole or in part, the following: American Society for Testing Materials (ASTM) Standards D653–85 and D2488; The Unified Soils Classification System, The U.S. Department of Agriculture (USDA) Textural Classification Scheme; and The National Bureau of Standards Report BSS–121.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Dry soil means soil that does not exhibit visible signs of moisture content.

Fissured means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt, (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

Soil classification system means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure.

Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Submerged soil means soil which is underwater or is free seeping.

Type A means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

(i) The soil is fissured; or

(ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or

(iii) The soil has been previously disturbed; or

(iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

(v) The material is subject to other factors that would require it to be classified as a less stable material.

Type B means:

(i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or

(ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.

(iii) Previously disturbed soils except those which would otherwise be classed as Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

(v) Dry rock that is not stable; or

(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C means:

(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or

(ii) Granular soils including gravel, sand, and loamy sand; or

(iii) Submerged soil or soil from which water is freely seeping; or

(iv) Submerged rock that is not stable, or

(v) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) *Requirements*—(1) *Classification of soil and rock deposits.* Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in paragraph (b) of this appendix.

(2) *Basis of classification.* The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses

shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those adopted by the America Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

(3) *Visual and manual analyses.* The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.

(4) *Layered systems.* In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

(5) *Reclassification.* If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

(d) *Acceptable visual and manual tests.*—(1) *Visual tests.* Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

(i) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

(ii) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

(iii) Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

(iv) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

(v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

(vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

(vii) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

(2) *Manual tests.* Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

(i) *Plasticity.* Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as ⅛-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of ⅛-inch thread can be held on one end without tearing, the soil is cohesive.

(ii) *Dry strength.* If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

(iii) *Thumb penetration.* The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. (This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2488—"Standard Recommended Practice for Description of Soils (Visual—Manual Procedure).") Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a miminum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) *Other strength tests.* Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane.

(v) *Drying test.* The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are indicated.

(B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as a unfissured cohesive material and the unconfined compressive strength should be determined.

(C) If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

Appendix B to Subpart P

Sloping and Benching

(a) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and benching protective systems is to be performed in accordance with the requirements set forth in § 1926.652(b)(2).

(b) *Definitions.*

Actual slope means the slope to which an excavation face is excavated.

Distress means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and ravelling, i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V).

Short term exposure means a period of time less than or equal to 24 hours that an excavation is open.

(c) *Requirements*—(1) *Soil classification.* Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(2) *Maximum allowable slope.* The maximum allowable slope for a soil or rock deposit shall be determined from Table B-1 of this appendix.

(3) *Actual slope.* (i) The actual slope shall not be steeper than the maximum allowable slope.

(ii) The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least ½ horizontal to one vertical (½H:1V) less steep than the maximum allowable slope.

(iii) When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with § 1926.651(i).

(4) *Configurations.* Configurations of sloping and benching systems shall be in accordance with Figure B-

TABLE B-1

MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V) [1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [3]
STABLE ROCK	VERTICAL (90°)
TYPE A [2]	3/4 : 1 (53°)
TYPE B	1:1 (45°)
TYPE C	1½: 1 (34)

NOTES:

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°).
3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

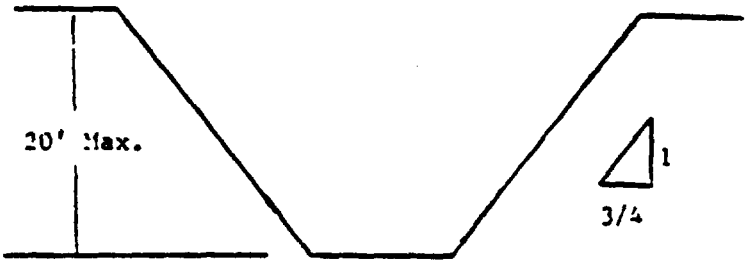
Figure B-1

Slope Configurations

(All slopes stated below are in the horizontal to vertical ratio)

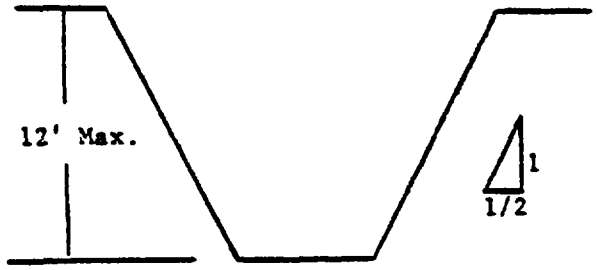
B-1.1 Excavations made in Type A soil.

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of ¾:1.



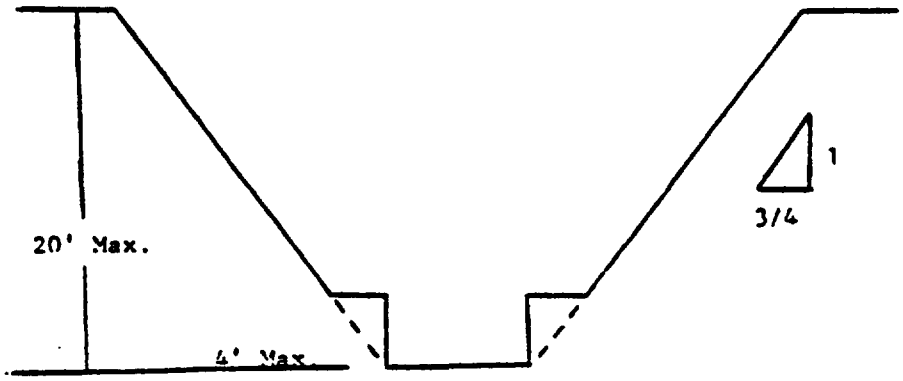
Simple Slope—General

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of ½:1.

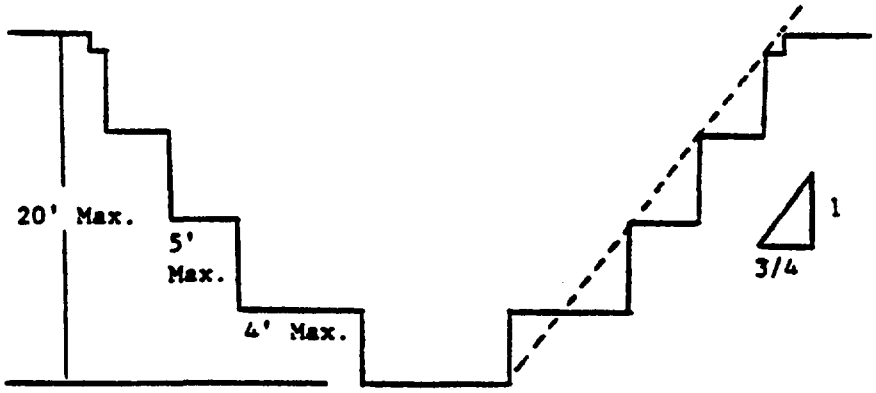


Simple Slope—Short Term

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of ¾ to 1 and maximum bench dimensions as follows:

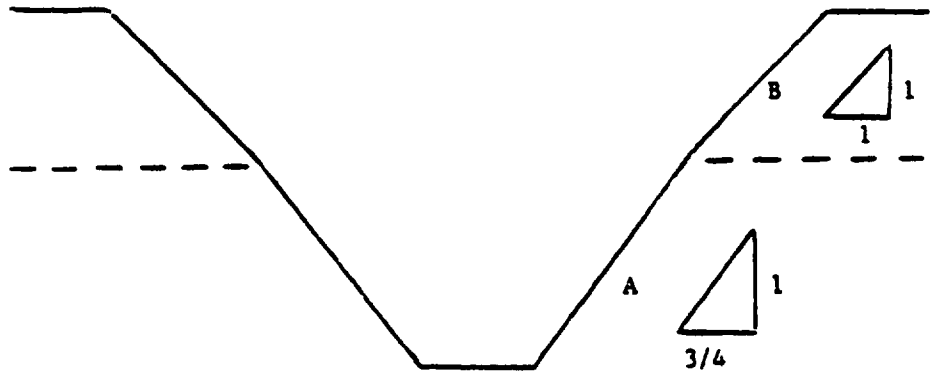


Simple Bench

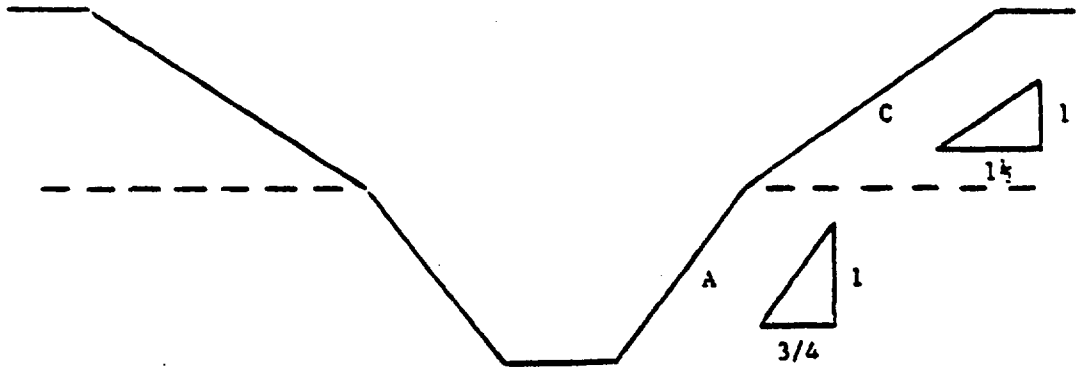


Multiple Bench

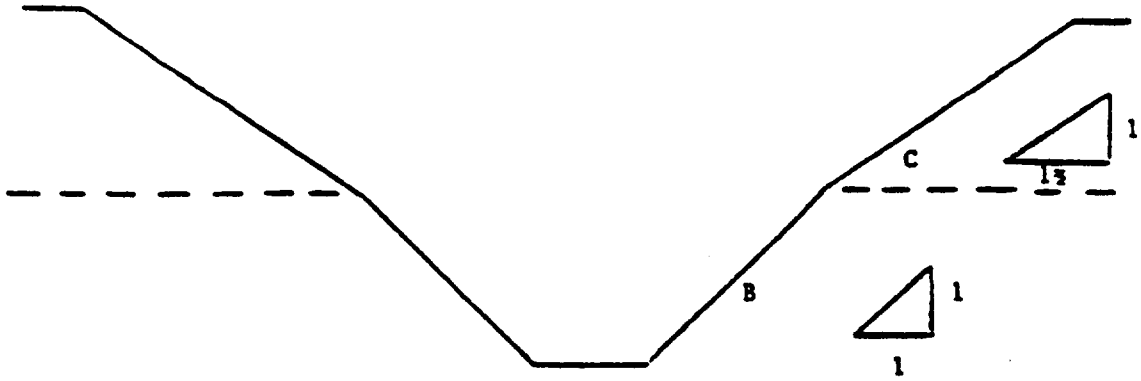
3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3½ feet.



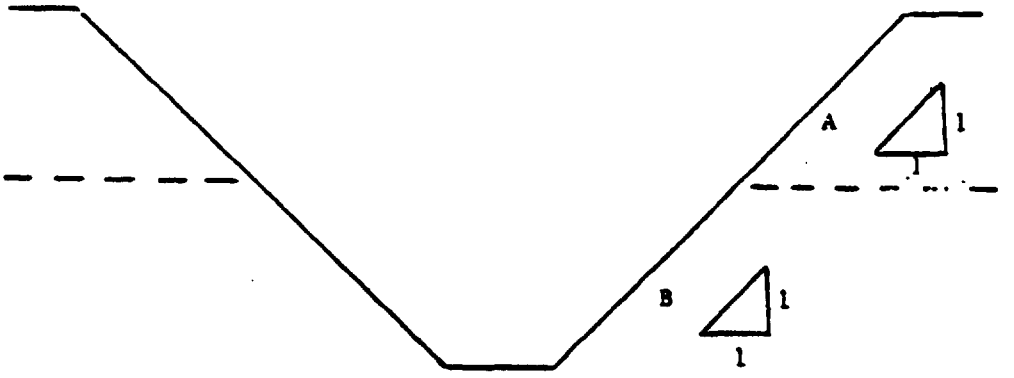
B OVER A



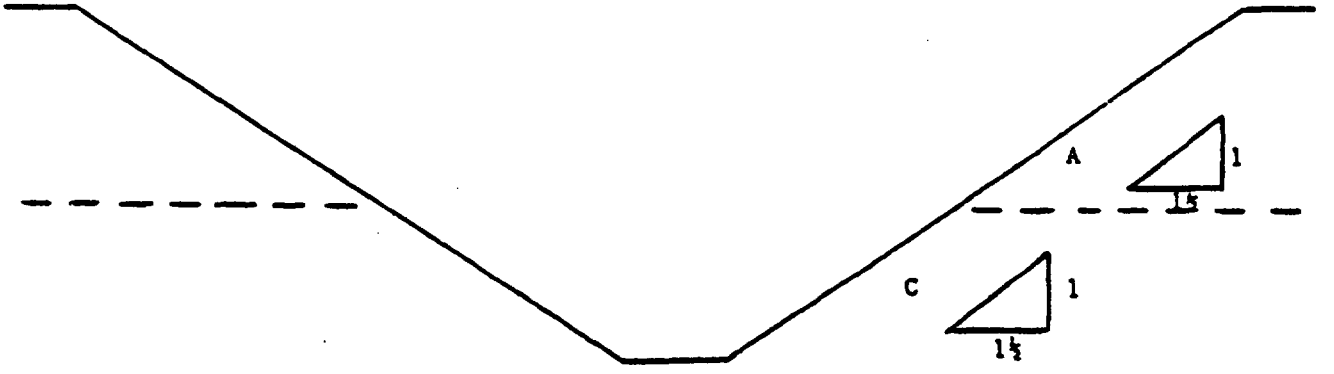
C OVER A



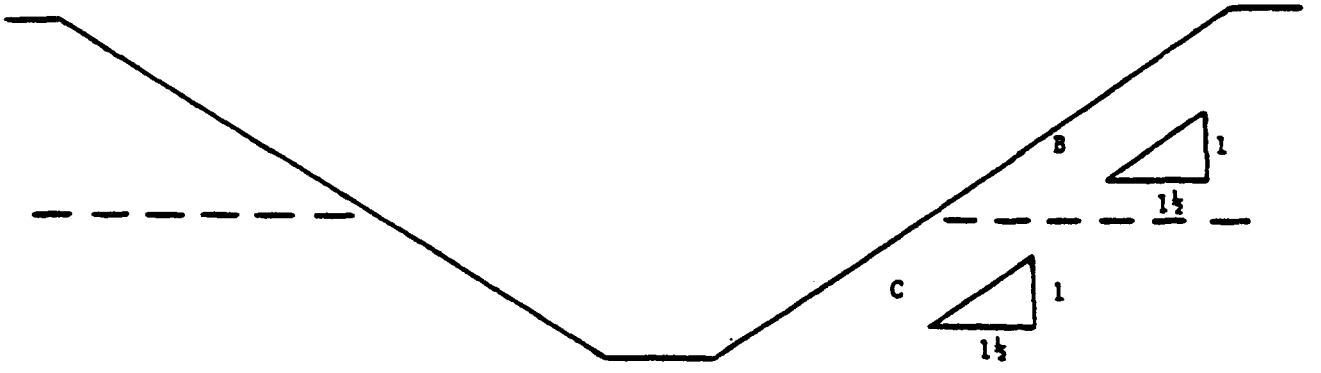
C OVER B



A OVER B



A OVER C



B OVER C

2. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

Appendix C to Subpart P

Timber Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with § 1926.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in § 1926.652(b) and § 1926.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil

classification method set forth in appendix A of subpart P of this part.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables C-1.1, C-1.2, and C-1.3, and Tables C-2.1, C-2.2 and C-2.3 following paragraph (g) of the appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix, and on the tables themselves.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations regarding Tables C-1.1 through C-1.3 and Tables C-2.1 through C-2.3 are presented in paragraph (g) of this Appendix.

(d) *Basis and limitations of the data.*—(1) *Dimensions of timber members.* (i) The sizes of the timber members listed in Tables C-1.1 through C-1.3 are taken from the National Bureau of Standards (NBS) report, "Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations." In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables C-1.1 through C-1.3 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables C-2.1 through C-2.3, or have this choice under § 1926.652(c)(3), and are referred to The Corps of Engineers, The Bureau of Reclamation or data from other acceptable sources.

(2) *Limitation of application.* (i) It is not intended that the timber shoring specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with § 1926.652.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a two-foot soil surcharge. The term "adjacent" as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables.* The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are six tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the crossbraces, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(f) *Examples to Illustrate the Use of Tables C-1.1 through C-1.3.*

(1) *Example 1.*

A trench dug in Type A soil is 13 feet deep and five feet wide.

From *Table C-1.1*, for acceptable arrangements of timber can be used.

Arrangement #1

Space 4×4 crossbraces at six feet horizontally and four feet vertically.

Wales are not required.

Space 3×8 uprights at six feet horizontally. This arrangement is commonly called "skip shoring."

Arrangement #2

Space 4×6 crossbraces at eight feet horizontally and four feet vertically.

Space 8×8 wales at four feet vertically.

Space 2×6 uprights at four feet horizontally.

Arrangement #3

Space 6×6 crossbraces at 10 feet horizontally and four feet vertically.

Space 8×10 wales at four feet vertically.

Space 2×6 uprights at five feet horizontally.

Arrangement #4

Space 6×6 crossbraces at 12 feet horizontally and four feet vertically.

Space 10×10 wales at four feet vertically.

Spaces 3×8 uprights at six feet horizontally.

(2) *Example 2.*

A trench dug in Type B soil in 13 feet deep and five feet wide. From Table C-1.2 three acceptable arrangements of members are listed.

Arrangement #1

Space 6×6 crossbraces at six feet horizontally and five feet vertically.

Space 8×8 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement #2

Space 6×8 crossbraces at eight feet horizontally and five feet vertically.

Space 10×10 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement #3

Space 8×8 crossbraces at 10 feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Space 2×6 uprights at two feet vertically.

(3) *Example 3.*

A trench dug in Type C soil is 13 feet deep and five feet wide.

From Table C-1.3 two acceptable arrangements of members can be used.

Arrangement #1

Space 8×8 crossbraces at six feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Position 2×6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

Arrangement #2

Space 8×10 crossbraces at eight feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Position 2×6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(4) *Example 4.*

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15 feet in depth is determined using Table C-1.3. Only one arrangement of members is provided.

Space 8×10 crossbraces at six feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Use 3×6 tight sheeting.

Use of Tables C-2.1 through C-2.3 would follow the same procedures.

(g) *Notes for all Tables.*

1. Member sizes at spacings other than indicated are to be determined as specified in

2. When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least three inches thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

3. All spacing indicated is measured center to center.

4. Wales to be installed with greater dimension horizontal.

5. If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds two and one-half feet, uprights shall be firmly embedded or a mudsill shall be used. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench shall not exceed 36 inches. When mudsills are used, the vertical distance shall not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

6. Trench jacks may be used in lieu of or in combination with timber crossbraces.

7. Placement of crossbraces. When the vertical spacing of crossbraces is four feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is five feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

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TABLE C-1.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE A $P_a = 25 \times H + 72$ psf (2 ft Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS **													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				2X6	
	UP TO 8	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---					2X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			2X6		
	UP TO 12	4X6	4X6	6X6	6X6	6X6	4	8X8	4				2X6	
10 TO 15	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				3X8	
	UP TO 8	4X6	4X6	6X6	6X6	6X6	4	8X8	4		2X6			
	UP TO 10	6X6	6X5	6X6	6X8	6X8	4	8X10	4			2X6		
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	10X10	4				3X8	
15 TO 20	UP TO 6	6X6	6X6	6X6	6X8	6X8	4	6X8	4	3X6				
	UP TO 8	6X6	6X6	6X6	6X8	6X8	4	8X8	4	3X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X10	4	8X10	4	3X6				
	UP TO 12	8X8	8X8	8X8	8X8	8X10	4	10X10	4	3X6				
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B $P_a = 45 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3			
5 TO 10	UP TO 6	4X6	4X6	6X6	6X6	6X6	5	6X8	5			2X6			
	UP TO 8	6X6	6X6	6X6	6X8	6X8	5	8X10	5			2X6			
	UP TO 10	6X6	6X6	6X6	6X8	6X8	5	10X10	5			2X6			
	See Note 1														
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5		2X6				
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5		2X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X10	5	10X12	5		2X6				
	See Note 1														
15 TO 20	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	3X6					
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	3X6					
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6					
	See Note 1														
OVER 20	SEE NOTE 1														

* Mixed oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.3

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C P_a = 80 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**														
	CROSS BRACES									UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET) (See Note 2)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE					
5 TO 10	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	2X6					
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6					
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6					
	See Note 1														
10 TO 15	UP TO 6	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6					
	UP TO 8	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6					
	See Note 1														
	See Note 1														
15 TO 20	UP TO 6	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6					
	See Note 1														
	See Note 1														
	See Note 1														
OVER 20	SEE NOTE 1														

* Mixed Oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B P_a = 45 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3	4	6
5 TO 10	UP TO 6	4X6	4X6	4X6	6X6	6X6	5	6X8	5			3X12 4X8		4X12
	UP TO 8	4X6	4X6	6X6	6X6	6X6	5	8X8	5		3X8		4X8	
	UP TO 10	4X6	4X6	6X6	6X6	6X8	5	8X10	5			4X8		
	See Note 1													
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5	3X6	4X10			
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5	3X6	4X10			
	UP TO 10	6X8	6X8	8X8	8X8	8X8	5	10X12	5	3X6	4X10			
	See Note 1													
15 TO 20	UP TO 6	6X8	6X8	6X8	6X8	8X8	5	8X10	5	4X6				
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X12	5	4X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

Appendix D to Subpart P

Aluminum Hydraulic Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used when aluminum hydraulic shoring is provided as a method of protection against cave-ins in trenches that do not exceed 20 feet (6.1m) in depth. This appendix must be used when design of the aluminum hydraulic protective system cannot be performed in accordance with § 1926.652(c)(2).

(b) *Soil Classification.* In order to use data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of part 1926.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables D–1.1, D–1.2, D–1.3 and E–1.4. Each table presents the maximum vertical and horizontal spacings that may be used with various aluminum member sizes and various hydraulic cylinder sizes. Each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. Tables D–1.1 and D–1.2 are for vertical shores in Types A and B soil. Tables D–1.3 and D1.4 are for horizontal waler systems in Types B and C soil.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations (footnotes) regarding Table D–1.1 through D–1.4 are presented in paragraph (g) of this appendix.

(6) Figures, illustrating typical installations of hydraulic shoring, are included just prior to the Tables. The illustrations page is entitled "Aluminum Hydraulic Shoring: Typical Installations."

(d) *Basis and limitations of the data.*

(1) Vertical shore rails and horizontal wales are those that meet the Section Modulus requirements in the D–1 Tables. Aluminum material is 6061–T6 or material of equivalent strength and properties.

(2) Hydraulic cylinders specifications. (i) 2-inch cylinders shall be a minimum 2-inch inside diameter with a minimum safe working capacity of no less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufaturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe working capacity of not less than 30,000 pounds axial compressive load at extensions as recommended by product manufacturer.

(3) Limitation of application.

(i) It is not intended that the aluminum hydraulic specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be otherwise designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the Tables are not considered adequate. In this case, an alternative aluminum hydraulic shoring system or other type of protective system must be designed in accordance with § 1926.652.

(A) When vertical loads imposed on cross braces exceed a 100 Pound gravity load distributed on a one foot section of the center of the hydraulic cylinder.

(B) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(C) When only the lower portion or a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables D–1.1, D–1.2, D–1.3 and D–1.4.* The members of the shoring system that are to be selected using this information are the hydraulic cylinders, and either the vertical shores or the horizontal wales. When a waler system is used the vertical timber sheeting to be used is also selected from these tables. The Tables D–1.1 and D–1.2 for vertical shores are used in Type A and B soils that do not require sheeting. Type B soils that may require sheeting, and Type C soils that always require sheeting are found in the horizontal wale Tables D–1.3 and D–1.4. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is made. The selection is based on the depth and width of the trench where the members are to be installed. In these tables the vertical spacing is held constant at four feet on center. The tables show the maximum horizontal spacing of cylinders allowed for each size of wale in the waler system tables, and in the vertical shore tables, the hydraulic cylinder horizontal spacing is the same as the vertical shore spacing.

(f) *Example to Illustrate the Use of the Tables:*

(1) Example 1:

A trench dug in Type A soil is 6 feet deep and 3 feet wide. From Table D–1.1: Find vertical shores and 2 inch diameter cylinders spaced 8 feet on center (o.c.) horizontally and 4 feet on center (o.c.) vertically. (See Figures 1 & 3 for typical installations.)

(2) Example 2:

A trench is dug in Type B soil that does not require sheeting, 13 feet deep and 5 feet wide. From Table D–1.2: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(3) A trench is dug in Type B soil that does not require sheeting, but does experience some minor raveling of the trench face. The trench is [illegible] Table D–1.2: Find vertical shores and 2 inch diameter cylinder (with special oversleeves as designated by footnote #2) spaced 5.5 feet o.c. horizontally and 4 feet o.c. vertically, plywood (per footnote (g)(7) to the D–1 Table) should be used behind the shores. (See Figures 2 & 3 for typical installations.)

(4) Example 4: A trench is dug in previously disturbed Type B soil, with characteristics of a Type C soil, and will require sheeting. The trench is 16 feet deep and 12 feet wide. 8 foot horizontal spacing between cylinders is desired for working space. From Table D–1.3: Find horizontal wale with a section modulus of 14.0 spaced at 4 feet o.c. vertically and 3 inch diameter cylinder spaced at 9 feet maximum o.c. horizontally. 3×12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(5) Example 5: A trench is dug in Type C soil, 9 feet deep and 4 feet wide. Horizontal cylinder spacing in excess of 6 feet is desired for working space. From Table D–1.4: Find horizontal wale with a section modulus of 7.0 and 2 inch diameter cylinders spaced at 6.5 feet o.c. horizontally. Or, find horizontal wale with a 14.0 section modulus and 3 inch diameter cylinder spaced at 10 feet o.c. horizontally. Both wales are spaced 4 feet o.c. vertically. 3×12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(g) *Footnotes, and general notes, for Tables D–1.1, D–1.2, D–1.3, and D–1.4.*

(1) For applications other than those listed in the tables, refer to § 1926.652(c)(2) for use of manufacturer's tabulated data. For trench depths in excess of 20 feet, refer to § 1926.652(c)(2) and § 1926.652(c)(3).

(2) 2 inch diameter cylinders, at this width, shall have structural steel tube (3.5×3.5×0.1875) oversleeves, or structural oversleeves of manufacturer's specification, extending the full, collapsed length.

(3) Hydraulic cylinders capacities. (i) 2 inch cylinders shall be a minimum 2-inch inside diameter with a safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe work capacity of not less than 30,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(4) All spacing indicated is measured center to center.

(5) Vertical shoring rails shall have a minimum section modulus of 0.40 inch.

(6) When vertical shores are used, there must be a minimum of three shores spaced equally, horizontally, in a group.

(7) Plywood shall be 1.125 in. thick softwood or 0.75 inch. thick, 14 ply, arctic white birch (Finland form). Please note that plywood is not intended as a structural member, but only for prevention of local raveling (sloughing of the trench face)

ALUMINUM HYDRAULIC SHORING
TYPICAL INSTALLATIONS

FIGURE NO. 1
VERTICAL ALUMINUM HYDRAULIC SHORING (SPOT BRACING)

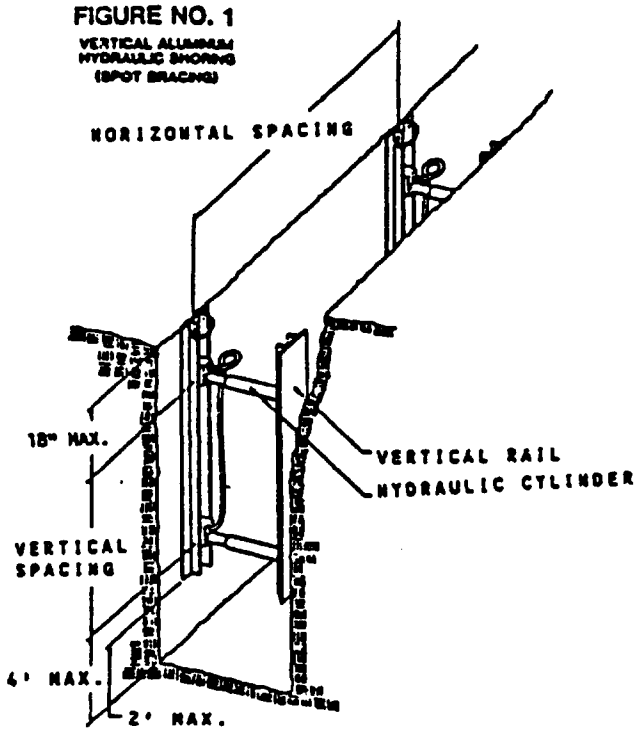

FIGURE NO. 2
VERTICAL ALUMINUM HYDRAULIC SHORING (WITH PLYWOOD)

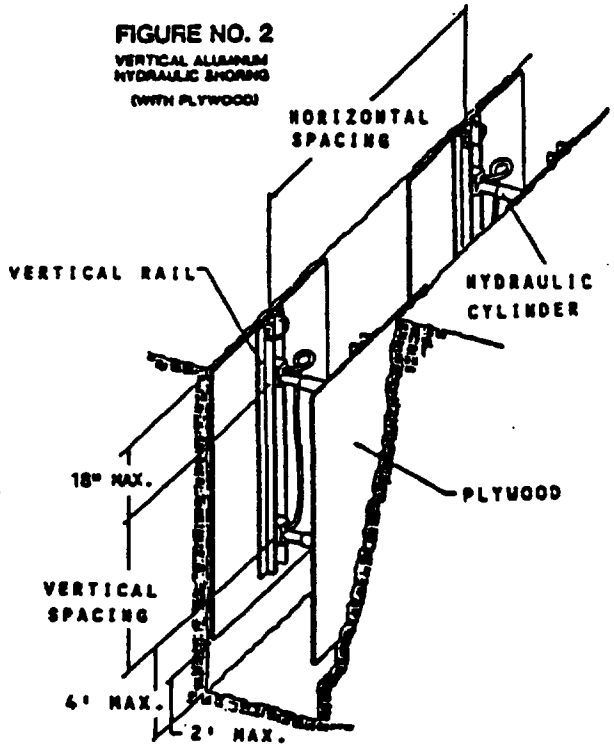

FIGURE NO. 3
VERTICAL ALUMINUM HYDRAULIC SHORING (STACKED)

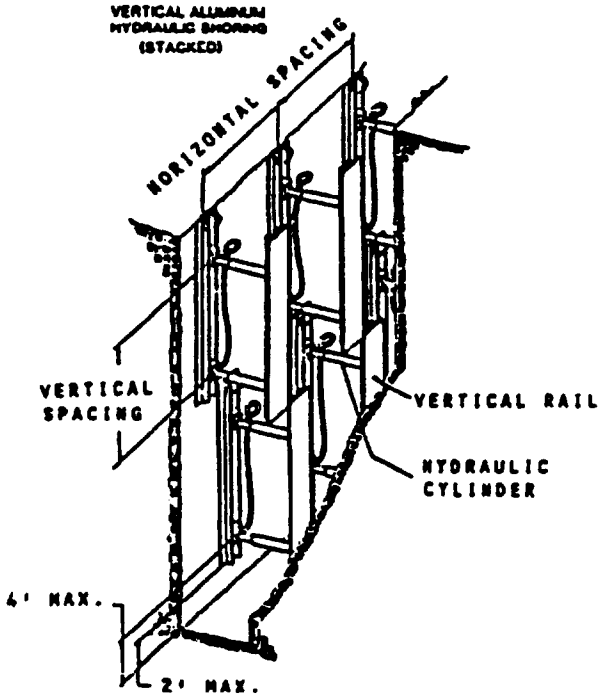

FIGURE NO. 4
ALUMINUM HYDRAULIC SHORING WALER SYSTEM (TYPICAL)

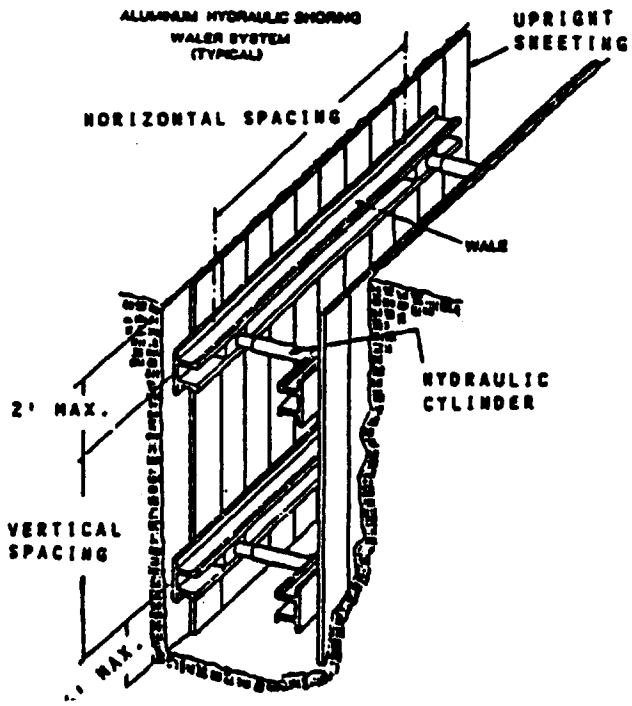

TABLE D - 1.1
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE A

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	8				
OVER 15 UP TO 20	7				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.2
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	6.5				
OVER 15 UP TO 20	5.5				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.3
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX.HORIZ.SPACING (ON CENTER)		
	VERTICAL SPACING (FEET)	* SECTION MODULUS (IN^3)	UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 5 UP TO 10	4	3.5	8.0	2 IN	8.0	2 IN NOTE(2)	8.0	3 IN	—	—	3x12
		7.0	9.0	2 IN	9.0	2 IN NOTE(2)	9.0	3 IN			
		14.0	12.0	3 IN	12.0	3 IN	12.0	3 IN			
OVER 10 UP TO 15	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	—	3x12	—
		7.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 15 UP TO 20	4	3.5	5.5	2 IN	5.5	2 IN NOTE(2)	5.5	3 IN	3x12	—	—
		7.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
		14.0	9.0	3 IN	9.0	3 IN	9.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Notes (1): See Appendix D, item (g) (1)
Notes (2): See Appendix D, Item (g) (2)
* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

TABLE D - 1.4
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE C

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX.HORIZ SPACING (ON CENTER)		
	VERTICAL SPACING (FEET)	SECTION MODULUS* (IN³)	UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 5 UP TO 10	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	3x12	—	—
		7.0	6.5	2 IN	6.5	2 IN NOTE(2)	6.5	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 10 UP TO 15	4	3.5	4.0	2 IN	4.0	2 IN NOTE(2)	4.0	3 IN	3x12	—	—
		7.0	5.5	3 IN	5.5	3 IN	5.5	3 IN			
		14.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
OVER 15 UP TO 20	4	3.5	3.5	2 IN	3.5	2 IN NOTE(2)	3.5	3 IN	3x12	—	—
		7.0	5.0	3 IN	5.0	3 IN	5.0	3 IN			
		14.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Notes (1): See Appendix D, item (g) (1)
Notes (2): See Appendix D, Item (g) (2)
* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

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Appendix E to Subpart P—Alternatives to Timber Shoring

Figure 1. Aluminum Hydraulic Shoring

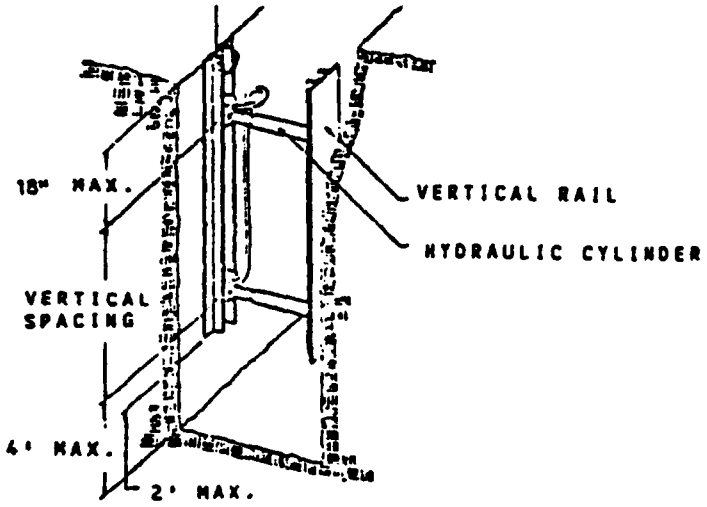
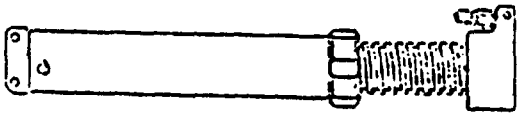


Figure 2. Pneumatic/hydraulic Shoring



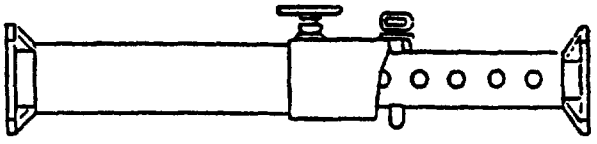


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Figure 3. Trench Jacks (Screw Jacks)

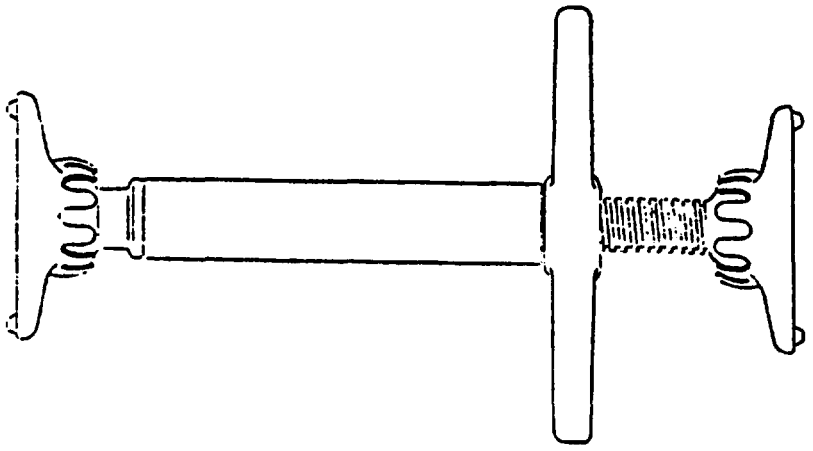
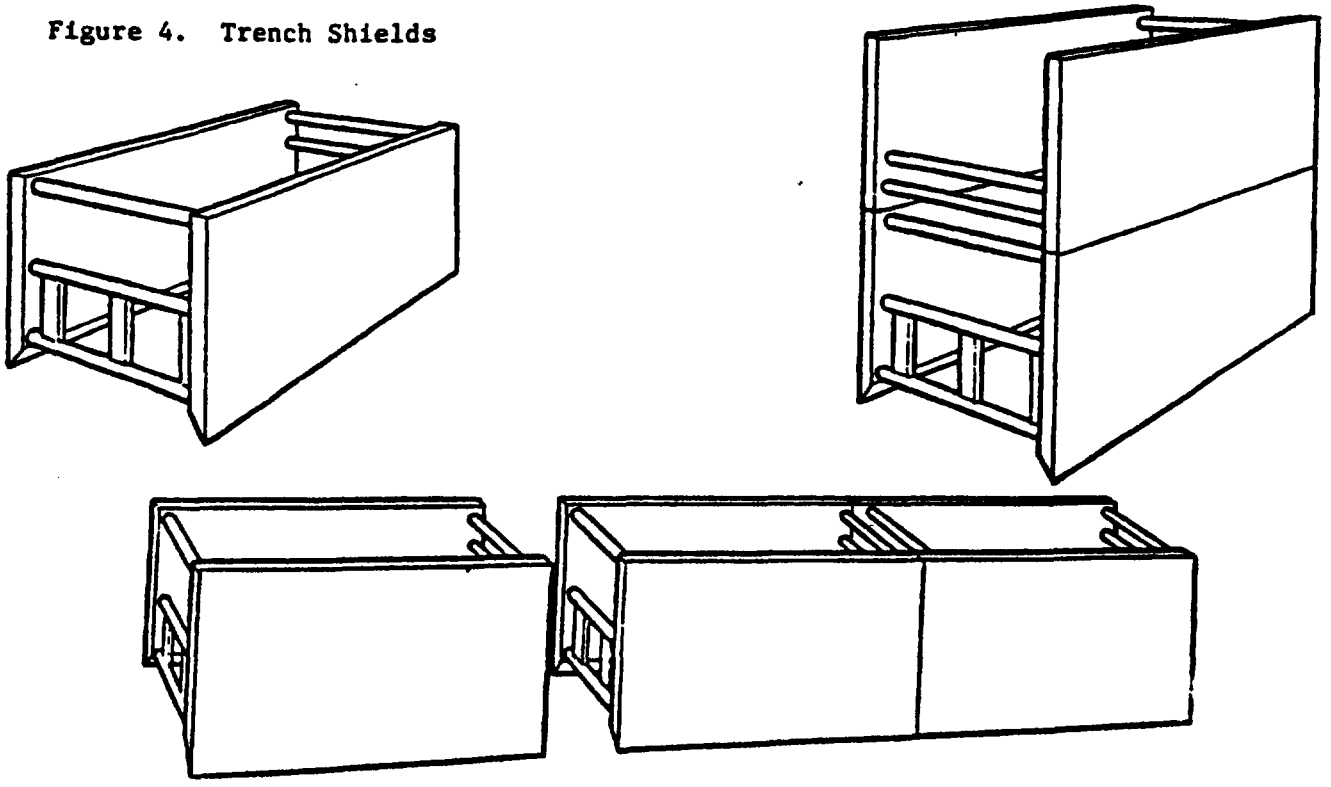


Figure 4. Trench Shields



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Appendix F to Subpart P—Selection of Protective Systems

The following figures are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in depth. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordance with § 1926.652 (b) and (c).

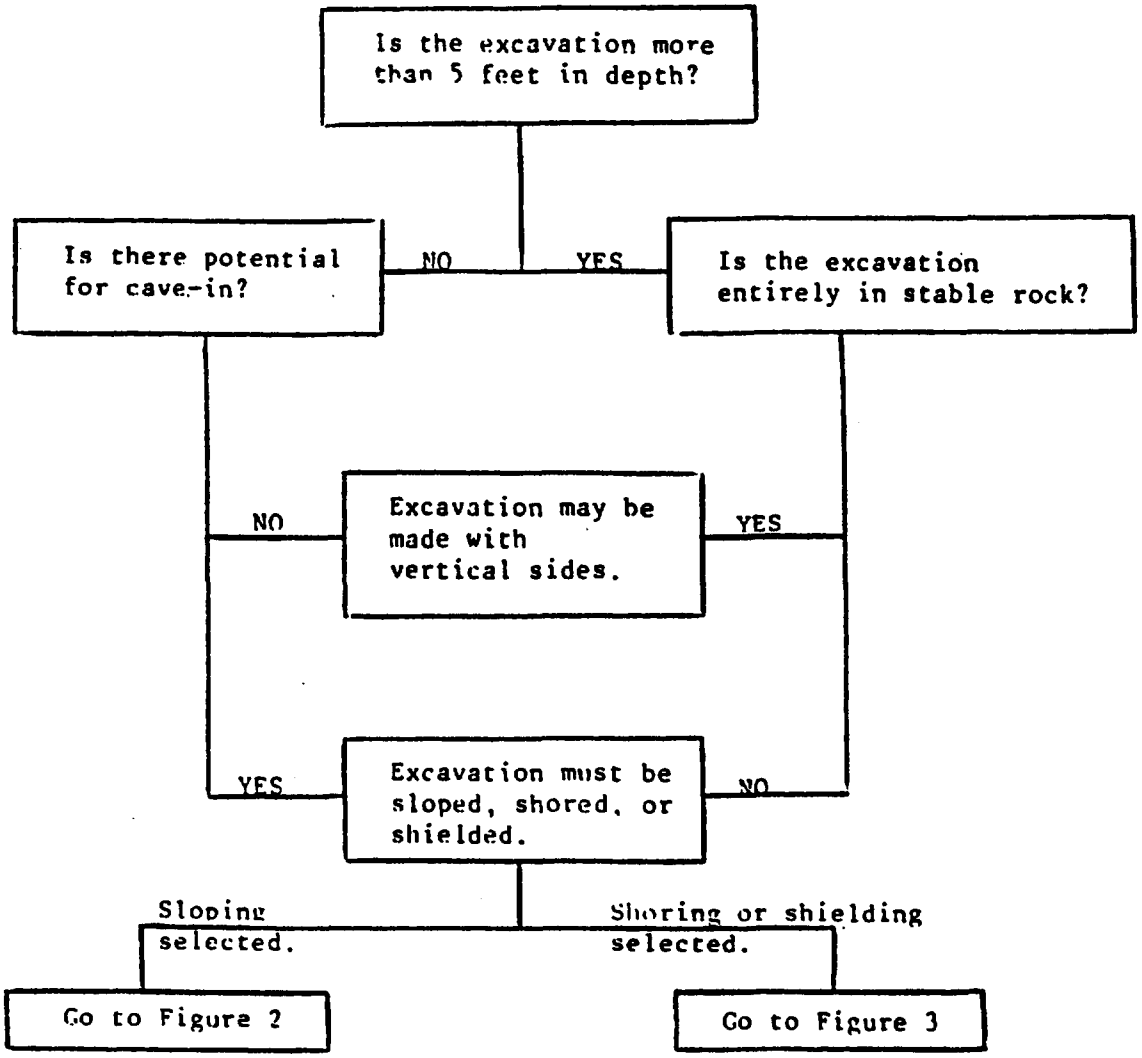

FIGURE 1 - PRELIMINARY DECISIONS

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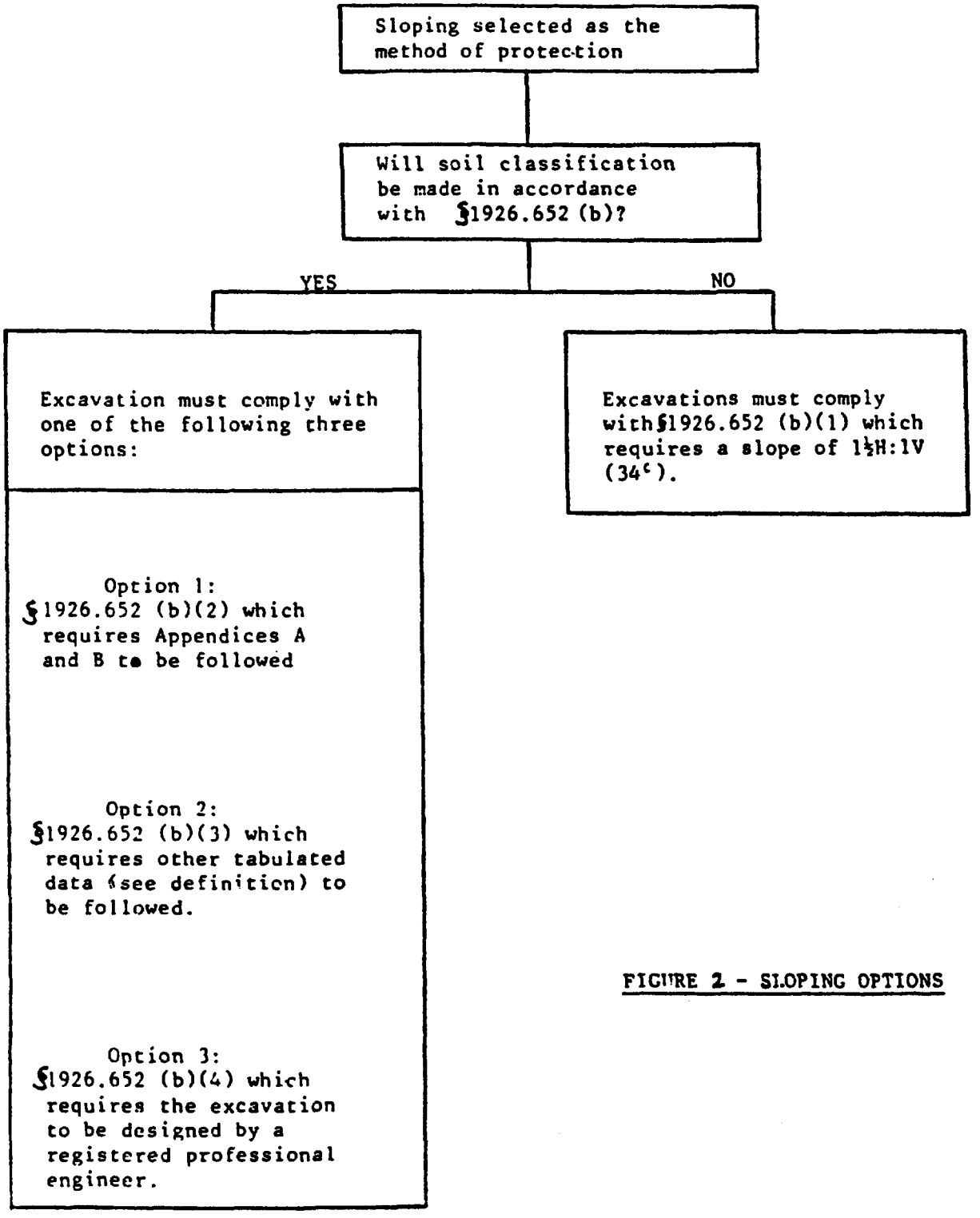

FIGURE 2 - SLOPING OPTIONS

EXCAVATION AND TRENCHING
NOTIFICATION LOG

Date: _____ Project Number: _____

Customer: _____ OSHA Permit Required: YES ___ NO ___

Customer: _____ Project Manager: _____

H&S Internal Permit Number: _____

Comments: _____

****

Date: _____ Project Number: _____

Customer: _____ OSHA Permit Required: YES ___ NO ___

Customer: _____ Project Manager: _____

H&S Internal Permit Number: _____

Comments: _____

****

Date: _____ Project Number: _____

Customer: _____ OSHA Permit Required: YES ___ NO ___

Customer: _____ Project Manager: _____

H&S Internal Permit Number: _____

Comments: _____

****

Date: _____ Project Number: _____

Customer: _____ OSHA Permit Required: YES ___ NO ___

Customer: _____ Project Manager: _____

H&S Internal Permit Number: _____

Comments: _____

****

ATTACHMENT U
TRUCK LOADING

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 13
	DATE 9/17/93
	PAGE 1 OF 1
SUBJECT	SUPERCEDES
Truck Loading	APPROVED

If drivers must enter the exclusion zone, they must have the proper level of HAZWOPER training.

Personnel covering the load must have the proper level of Personal Protective Equipment. The specific level will be contaminant specific. The Health and Safety Manager should be consulted if the level of PPE is not designated in the Health and Safety Plan.

Proper equipment must be provided to personnel for getting in and out of the truckbed for lining and covering (ladder, etc.).

Proper equipment and experienced operators must be utilized for loading trucks.

The load must be centered and evenly distributed on the truck.

ATTACHMENT V
SOIL SAMPLING

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 14 DATE 9/17/93 PAGE 1 OF 4
SUBJECT Soil Sampling	SUPERCEDES APPROVED

SITE SELECTION

Areas selected for soil sampling shall be strategically located in order to collect a representative fraction of the soils with the minimum number of samples and effort. A surface inspection of the subject area shall be made to locate pertinent features (e.g., rock outcrops, drainage patterns, surface runoff, ponds, lakes, wet areas, seeps, springs, permanent structures, fill areas, erosional areas, depositional areas, etc.) and to evaluate the relationship between these features and potential sources of pollution. The locations of sediment depositional areas are good indicators of surface runoff directions. If direction of surface runoff or drainage is difficult to detect, observation of new deposition or sediment movement following a rain may prove helpful in establishing this direction. The spreading or fanning out of the sediment body will indicate direction of flow.

In most instances, the first investigation of a site will be a reconnaissance or screening type study. Sampling in these instances will generally be confined to surface soils or shallow coring using hand equipment such as shovels, post hole diggers, or hand augers. For screening purposes, surface soil/sediment sampling shall be constructed in depositional areas on the periphery of the study area, primarily in the downstream or downgradient portion of the area of interest; however, an upgradient sample is often valuable as a control site. (Note: sampling at depositional areas tends to bias the sampling toward high concentrations - this is a valuable screening tool but should not be construed as representative of the area conditions).

Following initial screening, more sophisticated investigations may involve the use of power equipment such as drilling rigs or backhoes. The number of samples or test holes and the specific depth of sampling will vary according to site conditions and the scope of the investigation. In general, a minimum of three sampling sites or test holes shall be installed in order to adequately determine subsurface conditions. Test holes or sites selected for soil sampling should be located where the water table is far enough below the ground surface so not to interfere with the sampling operation unless the study involves groundwater sampling.

Sampling of undisturbed soils may be achieved by both hand and power equipment. Hand equipment such as spoons, scoops, shovels, hand augers, and small diameter push tubes are available and shall be used for sampling at shallow depths. Hand equipment is limited even at shallow depths when the soils are difficult to penetrate. Power equipment such as augers and backhoes may be used for sampling at shallow depths when hand boring equipment cannot be utilized. Drilling rigs can be used for both shallow and deep soil sampling.

Shelby tubes or thin wall push tubes can be used with both power and hand equipment to sample undisturbed soils. Stainless steel construction is recommended for most types of sampling. Soils can be extruded from the tubes for logging and selective sampling or sealed and sent directly to the laboratory in the tubes. When using drilling rigs for collecting relatively undisturbed soil samples, split spoon samplers shall be the preferred WSB method. These samples are made of steel tubing that will split open to reveal the soil sample. The sample then can be examined, logged, and placed in appropriate sample containers. Hollow stemmed augers shall be used when possible in boring test holes to eliminate potential caving problems and contamination from both soil and water. Shelby tubes or split spoons shall be used with the hollows stemmed augers for sampling. If test holes need to be used for groundwater sampling purposes at a later date, well casing shall be set inside the hollow stemmed augers before augers are pulled out of the hole.

SAMPLING TECHNIQUES

Undisturbed/uncontaminated (Note: contamination in this context refers to the introduction of foreign materials into the sample through collection methodology) samples of surface exposures such as road banks, creek banks, shallow soil horizons, test pits and trenches may be obtained as push tube samples and "chunk" samples. A push tube sample is collected by pressing or pushing a tube firmly into the soil until the tube is full of sample; the sample is extracted by digging to a depth below the sample while making sure that the sample is not disturbed. The sample is cut off at the bottom of the tube with a shovel or knife and removed from hole. The sample may then be shipped to the laboratory or extruded and placed in sample containers. A "chunk" sample is obtained by smoothing the ground or face surface to remove any disturbed soil, and marking the outline of the chunk to be taken. A trench is then excavated around the chunk. The chunk is cut off with a knife or trowel, trimmed, removed from the hole and placed directly into the appropriate sample container(s) for shipment to the laboratory.

Another method of obtaining an uncontaminated (see previous note) soil sample from the soil surface is to use a spoon or scoop. Shallow depth samples may be collected by digging a hole with a shovel, then removing all the loose soil and collected a sample at the desired depth using a sampling spoon. For deeper sampling using hand equipment a large diameter auger is used until the desired depth is reached. A small diameter auger is then used to collect the sample. If an undisturbed sample is

required, a Shelby tube can be placed on a sampling head connected to the correct length of push rod and pushed into the undisturbed soil. The sample is extruded, the portions that are disturbed and/or contaminated are discarded, and the remainder is placed in the appropriate sample container(s). The Shelby tube and sample may also be shipped intact to the laboratory for analysis. These procedures shall be repeated until the desired number of samples are collected.

The split spoon sampler is used mostly with power equipment because of its weight. The hollow stem auger is used to advance the hole to the desired depth. The split spoon is added to the correct length of drill rod and forced into the undisturbed soil by means of a 140 pound weight or hammer. The split spoon is retrieved from the hole and opened to reveal the sample. The top two or three inches of the sample normally will be disturbed and should be discarded. The undisturbed portion should be placed in a sample container by means of a clean stainless steel spoon or spatula. The procedure is repeated until the desired number of samples are collected.

Sediment samples can be obtained by means of grab sampling. This method consists of collecting sediment in a sample container by scooping or by using a spoon, small shovel, spatula, jar, or bottle to place the sediment in the container. There are also various types of mechanical samplers available, especially where sediment sampling in water is required.

SPECIFIC SAMPLING EQUIPMENT QUALITY ASSURANCE TECHNIQUES

All sampling equipment utilized to collect soil samples including hand augers, split spoons, hollow stem augers, drilling rigs, Shelby tubes, etc., will be numbered so that this equipment can be traced through field records. A log book shall be established for this equipment, so that all cleaning, maintenance and repair procedures can be traced to the person performing these procedures and to the specific repairs made.

All equipment utilized to collect soil samples shall be cleaned and repaired if necessary before being stored at the conclusion of field studies.

All such equipment shall be tested before being issued for field studies.

Any cleaning procedures conducted in the field or field repairs should be thoroughly documented in field records.

AUXILIARY DATA COLLECTION

Before and after sites have been selected, additional information and data can be collected from various city, county, state, and federal agencies. Most areas of concern to EPA usually have data from surveys or studies that have been previously made. Water quality studies, hydrologic and geologic data, soil surveys, and well monitoring studies are examples.

A system of logging all pertinent data collected during drilling and sampling operations should be used and maintained. The test hole locations should be recorded and referenced to the site map and/or datum base so that each location can be permanently established. Samples should be accurately tagged and labeled with all pertinent site information at the time of sampling.

ATTACHMENT W
LIQUID SAMPLING

STANDARD PROCEDURE	PROCEDURE NO. 15 DATE 9/17/93 PAGE 1 OF 11
SUBJECT Waste Sampling (Sludge, Liquid, Waste Pile)	SUPERCEDES APPROVED

WASTE SAMPLING

1. GENERAL

Waste sampling as discussed in this section includes the collection of sludge samples from municipal and industrial wastewater treatment facilities; samples of liquid waste and sludge from pits, ponds and lagoons; the collection of concentrated waste samples from open and closed containers such as drums, barrels, tank trucks, and storage tanks; and waste piles.

Generally the collection of sludge samples from municipal and industrial wastewater treatment plants is a low risk operation. However, the collection of liquid waste and sludge samples from open containers and liquid waste from pits, ponds, or lagoons and solid waste from waste piles may involve sampling operations that are inherently dangerous to the personnel involved. Sampling of closed containers (barrels, drums, etc.) shall be considered a high hazard operation by all personnel. Additional safety guidance is included in the draft EPA Safety Manual for Hazardous Waste Site Investigations.

1.1 Collection of Municipal Wastewater, Industrial Wastewater, and Municipal Water Treatment Plant Sludge Samples

1.1.1 Sampling Locations

Sampling locations must be carefully selected to insure that the samples are truly representative of the material being sampled. The following are suggested locations for different sampling conditions.

1.1.1.1 Municipal Sludge Being Drawn to a Drying Bed

Collect samples from the pipe flowing to the bed or at the discharge point into the bed. Take three or more aliquots of samples during the draw period to insure that variations in the sludge concentrations and consistency are accounted for.

1.1.1.2 Sludge from an Anaerobic Digester

It is difficult to insure that the contents in these units are well mixed. Samples can be taken from sample ports in the recirculation lines if so equipped. Otherwise, samples can be taken from "thief holes" in the floating top of the digester.

1.1.1.3 Sludge from an Aerobic Digester

It is much easier to sample these units because of the clear view of the contents. Samples should be taken while the contents are being mixed and from the 1/3 - 2/3-depth zone.

1.1.1.4 Sludge from a Quiescent Holding Basis (Water or Wastewater)

One sample cannot be collected which will be representative of the total contents of the basin since the material is generally stratified. Samples can be collected from the upper relatively clear liquid layer as one would collect any water sample. Sludge samples should be collected from the basis from a boat or a platform. Sediment sampling devices are required to collect these samples.

1.1.1.5 Sludge from Drying Beds

After sludge is partially dried and cracked, samples can be collected with a stainless steel spoon, shovel or similar device. Samples should be collected from three or four locations in the bed to insure a representative sample. The sample should be collected of the full depth of sludge on the bed.

1.1.2 Equipment

Equipment required for the collection of sludge samples includes: sample containers; stainless steel spoons and shovels; stainless steel ponar dredges; stainless steel scoops attached to a conduit pipe; stainless steel push tubes; and Peterson and Eckman dredge.

1.1.3 Sampling Technique

If the sampling techniques involves multiple aliquots or if the final sample will consist of aliquots from several locations, all aliquots should be placed into a Pyrex® dish, or other suitable container, and mixed thoroughly before containerization.

If the sludge layer is shallow or if only the surface is to be sampled, samples can be collected directly into the sample container.

If depth samples are required, the methods described in Section 1.2.4.2 Sampling Techniques - may be used.

Regardless of the method used, special care must be taken when collecting the sludge sample to ensure that excess water flowing out of the sampling device does not wash out much of the fine material, thus biasing the sample.

1.2 Pits, Ponds, and Lagoons

1.2.1 General

For the purposes of this subsection, pits, ponds, and lagoons refer to any basin, pit or open tank, lined or unlined, which contain or are suspected of containing unknown concentrated liquid chemical waste. This discussion does not include municipal and industrial wastewater treatment ponds or natural or man made surface water impoundments.

1.2.2 Sampling Locations

Sampling locations within pits, ponds, and lagoons should yield samples which are representative of that section, or of the entire pit, pond, or lagoon is being sampled. All phases in the pit, pond, or lagoon (floating solids, all liquid phases, and sludge) should be sampled. The only exception to this policy will be situations where

representative samples cannot be safely collected or where the investigative team is attempting to determine worst case conditions.

Because of the inherent dangers with sampling known or unknown concentrated waste, sampling personnel should never attempt to sample pits, ponds, and lagoons by using a boat. All sampling should be accomplished from the banks of pits, ponds, and lagoons or from piers. Any deviation from this policy must be cleared with the PM and HSO.

1.2.3 Liquid Waste Sampling

1.2.3.1 Equipment

The following equipment may be needed for field use in collecting liquid waste samples from pits, ponds, and lagoons: sampling containers; sampling container affixed to a piece of conduit pipe; stainless steel scoop affixed to a piece of conduit pipe with tape or scoop bracket; stainless steel spoon attached to a conduit pipe; peristaltic pump and vacuum jug arrangement; Bacon-Bomb samplers; and profile tubes for phase determination and possible sampling.

1.2.3.2 Sampling Techniques

If the sampling technique utilized requires multiple aliquots, or if the final sample will consist of aliquots from several different locations in the pit, pond, or lagoon, all aliquots should be placed into a Pyrex® dish or large glass sample container, or other suitable compositing container, and mixed thoroughly before containerization.

Floating solids can be sampled directly or with a stainless steel scoop or spoon attached to a piece of conduit pipe.

The presence of individual liquid phases can be determined by using a profile tube. The top liquid phase can be sampled by directly dipping with the sample container; dipping with the sample container attached to a conduit pipe, either directly or by way of a fishing pole type arrangement, or dipping the sample with a stainless

steel scoop attached directly to conduit pipe. Other liquid phases can be sampled with a peristaltic pump/vacuum jug arrangement with the end of the Teflon® tube intake attached to a conduit pipe and held at the desired depth or with Bacon-Bomb sampler opened at the desired depth. The Bacon-Bomb sampler can be operated directly from the banks of pits, ponds, and lagoons or from piers or operated by way of a fishing pole type arrangement using a piece of conduit pipe.

1.2.4 Sludge Sampling

1.2.4.1 Equipment

The following equipment is required for field use in collecting sludge samples from pits, ponds, and lagoons: stainless steel ponar dredges; stainless steel scoop attached to a conduit pipe; and stainless steel push tubes.

1.2.4.2 Sampling Techniques

If the sampling technique involved multiple aliquots, or if the final sample will consist of aliquots from several different locations in the pit, pond, or lagoon, all aliquots should be placed into a Pyrex® dish or other suitable container and mixed thoroughly before containerization.

Sludge samples can be collected by pushing a stainless steel push tube into the sludge and emptying the tube contents into a Pyrex® dish or other suitable container. "Empty" can include shaking to remove sludge or extrusion of thick or gummy sludge with a new wooden dowel. A disadvantage of this technique is the need for multiple insertions of the tube into the sludge to collect sufficient sample volume.

Sludge samples can also be collected with a stainless steel ponar dredge. An advantage of this technique is that one operation of the dredge usually yields sufficient sample volume for most sampling efforts.

One of the easiest methods of collecting a sludge sample consists of attaching a stainless steel scoop to a

piece of conduit pipe with either strapping tape or a scoop bracket, and dipping the scoop into the sludge. An advantage of strapping tape is that it generates less equipment to decontaminate. However, glue on the tape may dissolve rapidly in oily or solvent type wastes. The scoop bracket has a decided advantage in that it allows sampling personnel to adjust the angle between the scoop and the conduit pipe.

1.2.5 Open and Closed Container Sampling

1.2.5.1 General

Sampling of closed containers (drums, barrels, tanks) should only be conducted when absolutely necessary. Whenever container sampling is necessary, the first priority should be the collection of samples from open containers since open containers generally present less hazard to the samplers than closed containers (i.e., volatile compounds have already evaporated, extreme acute toxicity would probably be evident from dead animal life or vegetation around the site). Closed containers must be considered as extremely hazardous from either the toxicity, explosion, or fire standpoints. Chronic toxicity may be a danger in both open or closed containers. Because of the dangers involved with container sampling, the sampling of drums, barrels, or other containers containing either unknown material or known hazardous material shall be considered a hazardous duty assignment. Additional information regarding container sampling is available in the draft EPA Safety Manual for Hazardous Waste Site Inspections.

A problem which often arises in container sampling is stratification and/or phase separation of the container contents. When this condition occurs or is suspected, care must be taken to insure that the sample collected is representative of the container contents. If only one layer or phase is sampled, this should be noted and taken into account when interpreting analytical results. For example, if a large tank is being sampled for PCB's and the only valve or access port available for sampling is at the bottom of the tank, it should be noted that the concentrations of PCB's might be biased toward high

concentrations, since PCB's are heavy and tend to collect near the bottom of a container.

Where possible, samples should be composited with depth (i.e., collected throughout the entire depth of the container or at several different depths) to provide a representative sample. When a drum or cylindrical container is standing vertically, depth compositing provides a good quantitative estimate of the container content. In other cases where such containers are tipped, horizontal, deformed, etc., depth compositing will provide a representative sample at least on a qualitative basis. (Note: A quantitatively representative sample could be collected, but would require sophisticated sampling methodology involving multilayer sampling and volume measurements; this is not recommended unless initial screening indicates it is absolutely necessary.)

1.2.5.2 Equipment

The following equipment is required for collecting waste samples from open and closed containers: a complete set of spark-proof tools including barrel bung wrenches, adjustable wrenches, etc.; a remote barrel opening device; glass tubes for barrel sampling; glass profile tubes for container sampling; Bacon-bomb samplers for container sampling; and peristaltic pumps and vacuum bottles arrangements for liquid waste sampling from containers.

1.2.5.3 Sampling Techniques

Closed drums, barrels, or other containers (including storage tanks) containing unknown materials or known hazardous materials shall be opened only using spark proof opening devices. A remotely controlled device may be used when deemed necessary. Such a device involves the use of a remotely operated pneumatic wrench along with a brass pressure fitting bung socket.

Samples from drums or barrels can be collected using a four-foot length of glass tube. In most instances, glass tubes with a one-half inch or less inside diameter work best. The tube is inserted into the opening of the drum or barrel as far as possible. The open end is then

sealed either with the thumb or a rubber stopper to hold the sample in the tube while removing the tube from the container. The sample is then placed in the appropriate container and the procedure is repeated until an adequate amount of sample is collected. Sample volume shall be held to the absolute minimum required for analysis. An optional method involves the use of a piercer valve which is inserted into the drum or barrel using a remotely operated hydraulic jack; however, this method should be used only as a last resort. Several valves may be required at different depths on the drum or barrel if stratification has occurred. The sample is collected directly from the valve.

Other sampling procedures that include the use of automatic samplers, pumps, siphons, multiple valves and ports, etc. may be used depending on the specific container involved. These procedures should not be used unless it can be established that their use will not constitute a fire or explosion hazard. This determination shall be made only after field reconnaissance, collection of appropriate field data (explosion meter, photoionizer, etc.) and consideration of available file information on the site.

Tank trucks and storage tanks containing liquid wastes are a special case. Samples may be collected from access ports on top of these tanks or trucks using the techniques outlined above. Tank trucks are often compartmentalized and the investigator should insure that all compartments of the tank truck are sampled. Sampling from discharge valves usually found on tank trucks is not recommended due to potential stratification of tank contents. However, if the investigator has to sample from a tank truck discharge valve, the valving arrangement of the particular tank truck being sampled must be clearly understood to insure that the contents of all compartments are sampled. The same precautions apply to sampling from storage tank valves. In either case, the investigator must realize that samples obtained from valves (particularly those at or near the bottom of the tank truck and storage tanks) may not yield representative samples.

1.2.6 Waste Piles

1.2.6.1 General

Waste piles may consist of sludges and other solid waste, liquid waste mixed with soil, or any type of waste mixed with construction debris, household garbage, etc. Each situation presents an unique challenge to the sampler in the selection of an appropriate sampling location and technique.

1.2.6.2 Sampling Locations

Sampling locations should be selected which will yield a sample which is representative of the waste pile being investigated. The only exception to this policy will be situations in which representative samples cannot be collected safely or where the investigative team is attempting to determine worst case conditions. A representative sample from a small waste pile can often be obtained by collecting a single sample. The collection of a representative sample(s) from large waste piles, however, presents problems with both the number and locations of samples. For a sample(s) both the number of samples and the location where they are to be collected. A discussion of statistical methods which can be utilized is given in the Test Methods for Evaluating Solid Waste (SW-846) issued by the EPA Office of Solid Waste and Emergency Response.

1.2.6.3 Equipment

The following equipment is required for field use in collecting samples from waste piles: stainless steel hand augers; stainless steel push tubes; stainless steel shovels, stainless steel scoops; and stainless steel spoons.

1.2.6.4 Sampling Techniques

All samples collected should be placed into a Pyrex® dish and mixed thoroughly before containerization. Stainless steel shovels, spoons, or scoops should be used to clear away surface material before samples are collected. Near surface samples can then be collected with a clean stainless steel spoon. Depth samples can be collected from the cleared location by forcing a stainless steel push tube into the pile or by augering to the desired depth with a stainless steel hand auger. When the desired depth is reached with a hand auger, a clean auger head should be used for collecting the sample. An alternate method for collecting depth samples is to dig to the desired depth with a stainless steel shovel or scoop and collecting the sample with a stainless steel spoon.

1.2.7 Specific Quality Control Procedures for Sampling Equipment

All major sampling and safety equipment used during investigations at hazardous waste sites including barrel openers, safety equipment (other than disposable gear), Geiger counters, explosion meters, cameras, etc. shall be identified so that this equipment can be traced through field records. A logbook shall be established for this equipment, so that all cleaning, maintenance, and repair procedures can be traced to the person performing such procedures and to specific repairs made. Quality control procedures for certain pieces of equipment, such as automatic samplers, pumps, soil sampling equipment, etc. are contained elsewhere in this manual.

All equipment used to collect waste samples shall be cleaned and repaired, if necessary, before being stored at the conclusion of a field study. In some instances, special decontamination procedures in excess of cleaning procedures will be necessary. These procedures will be developed on a case-by-case basis according to the specific material encountered. Provisions should also be made for disposal (preferably burial at the sampling site) of contaminated disposable equipment.

All equipment shall be tested before being issued for field studies.

Any cleaning procedures conducted in the field or field repairs, shall be thoroughly documented in the field logbooks.

1.2.8 Collection of Auxiliary Information and Data

The collection of auxiliary information and data is particularly important when collecting waste samples. Any field analyses, including those conducted with safety equipment such as photoionizers, explosion meters or approximate analyses such as those obtained with pH indicator paper shall be recorded in field logbooks. Sketches of sampling locations, valving arrangements of tank trucks and storage tanks, markings on barrels, drums tanks, etc. should be thoroughly documented and in the logbooks. Photographs are particularly useful for recording this information and they should be used extensively during waste sampling operations.

ATTACHMENT X
COMPATIBILITY TESTING AND COMPOSITING OF SAMPLES

Environmental Quality Management

Standard Operating Procedure

Title: Compatibility Testing		**Document No. WS-02**
Date of Issue: September 11, 1996	**Revision No. 02**	**Page 1 of 12**
Approval David J. Iacovone	**Approval** Jacqueline R. Dan	

1.0 OVERVIEW

1.1 This document describes the procedure for performing hazard categorization (Hazcat) testing and processing of that information into a usable form.

1.2 This SOP is applicable for any tasks requiring the identification of the contents of unknown containers (drums, tanks, etc.).

1.3 This SOP provides information on the proper equipment and techniques for completing the subject procedure.

1.4 Review of the information contained within facilitates the planning and execution of hazard categorization testing. This is accomplished by providing reference documents, general information, definitions, responsibilities, standard procedure, equipment, and supporting data.

2.0 RELATED DOCUMENTS

2.1 For further information on Hazcat testing, and the methods used, refer to:

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (National Institute for Occupational Safety and Health, Occupational Safety and Health Administration, United State Coast Guard, and United States Environmental Protection Agency).

Standard Methods for the Examination of Water and Wastewater (American Public Health Association)

1996 Annual Book of ASTM Method, Section 5, Volume 05.02 (American Society for Testing and Materials

Test Methods for Evaluating Solid Waste: Physical/Chemical Methods
(Office of Solid Waste and Emergency Response)

3.0 GENERAL INFORMATION

3.1 Hazcat testing general requirements.

3.1.1 Hazcat testing will be performed in a hood with a face velocity of 100 ft/min. If a hood is not available (as in the case of in-the-field Hazcat testing), testing should be conducted while wearing Level C personal protective equipment.

3.1.2 For safety reasons, no more than fifty Hazcat samples are to be in the laboratory at one time.

3.2 Laboratory general requirements

3.2.1 Safety glasses must be worn at all times. Latex or nitrile gloves must be worn while handling chemicals or performing tests. Gloves should be changed frequently.

3.2.2 All reagent containers must be properly labeled. Material safety data sheets for all reagents used during testing must be readily available.

3.2.3 Safety equipment (fire extinguisher, eye wash, etc.) must be easily accessable and clearly marked.

3.3 Field general requirements

3.3.1 A minimum of level C respiratory protection must be worn when performing Hazcat testing in the field.

3.3.2 A pair of outer gloves (latex or nitrile) must be worn while handling chemicals or performing tests. This is in addition to the inner and outer gloves worn as required by the level of protection in use as specified in the Site Specific Health and Safety Plan (SSHSP).

3.3.3 All reagent containers must be properly labeled. Material safety data sheets for all reagents used during testing must be readily available.

3.3.4 Safety equipment (fire extinguisher, eye wash, etc.) must be easily accessable and clearly marked.

4.0 DEFINITIONS

4.1 **Hazard categorization testing** - a series of tests performed on a sample to indicate a tentative hazard class for that sample. This allows samples with similar chemical composition to be grouped together, by hazard class and characterization, into bulk groups.

4.2 **Photoionization Detector (PID)** - an instrument utilized to detect organic and inorganic volatile compounds.

4.3 **Flame Ionization Detector (FID)** - an instrument utilized to detect volatile organic compounds.

4.4 **Peroxide** - compounds that contain a bivalent oxygen-oxygen group (such as hydrogen peroxide, H_2O_2). Because they release oxygen readily, peroxides are strong oxidizers.

4.5 **Oxidizers** - any compound that spontaneously evolves oxygen at either room temperature or under slight heating.

4.6 **Bielstein test** - a qualitative test used for testing samples for the presence of halogens (chlorine, bromine, fluorine, etc.).

4.7 **Level C personal protective equipment** - air purifying respirator, gloves (properly duct taped), latex or PVC boots (properly duct taped), hooded coveralls (Tyvek, Polytyvek, or Saranex), and a hard hat.

5.0 RESPONSIBILITIES

5.1 The Site Manager (On-Scene Coordinator) is responsible for the overall safety of site personnel.

5.2 The Site Quality Control Supervisor is responsible for the following:

5.2.1 Oversight of the field analysts to ensure that Hazcat testing is performed correctly.

5.2.2 Coordinating the Hazcat data generated for the samples.

5.2.3 Reviewing the Hazcat data for discrepancies.

5.2.4 Generating daily reports for the Site Manager.

5.2.5 Interfacing with and providing support to the personnel arranging transportation and disposal of the contents of the containers.

5.3 Site Chemists are responsible for the following:

5.3.1 Performing the Hazcat analyses as specified in the Sampling and Analysis Plan (SAP).

5.3.2 Bringing any problems and discrepancies to the attention of the Site Quality Control Supervisor.

5.3.3 Maintaining an inventory of supplies and notifying the team leader when additional supplies need to be ordered.

5.4 In many instances, the Site Quality Control Supervisor is also the Site Chemist.

6.0 PROCEDURE

6.1 Sample Documentation

6.1.1 Each sample undergoing hazard categorization (Hazcat) testing must be accompanied by a drum/container sampling log (Attachment A). The Hazcat data sheet is on the reverse side of the EQ drum/container log. For the purposes of Hazcat testing, each layer of a multilayered sample will be considered an individual sample. The sampling log must include all sampling information pertaining to the collection of the sample and information about the drum/container. The sampling log must also contain a description (color, clarity, and physical state) of the sample. The sample should be examined to ensure that the description of the sample on the sampling log matches that of the sample in the corresponding sample container. If at any time during Hazcat testing any result differs from information on the sampling log, the sampling information must be confirmed in the field.

6.1.2 Record the color of the sample at the time of Hazcat testing. The color of the sample should match what is recorded on the sampling log. If it does not, the contents of the drums must be double-checked. The colors, and their abbreviations, which may be used are listed. Only these colors are to be utilized. If the sample is multi-colored, use the most predominant color.

Amber (AMB)	Gray (GRY)	Purple (PUR)
Black (BLK)	Green (GRN)	Red (RED)
Blue (BLU)	Green-Blue (GRB)	Tan (TAN)
Brown (BRN)	Orange (ORG)	White (WHT)

Colorless (CLS) Pink (PNK) Yellow (YLW)
Cream (CRM)

6.1.3 Record the clarity of the sample at the time of Hazcat testing. The three choices for clarity are clear (CLR), cloudy (CDY), or opaque (OPQ). Clarity is determined by holding the sample up to the light and observing the transmittance of light through the sample. Clarity is determined after first mixing the contents of the sample and then allowing it to stand for one minute.

6.1.4 Record the physical state of the sample at the time of Hazcat testing. The four choices for physical state are liquid (LQD), solid (SOL), sludge (SLG), and gel (GEL). Sludges should be identified as pumpable or non-pumpable. If the physical state of the sample differs from that logged in the field the contents of the drum must be double-checked.

6.2 Air Monitoring

6.2.1 Immediately after opening the sample container, the sample should be screened with either a photoionization detector (PID) or a flame ionization detector (FID). This will help identify the presence of volatile compounds in the sample.

6.2.2 Each of aforementioned instruments have limitations and it is necessary to keep these in mind when screening the samples. For instance, a PID may not detect volatile organic compounds if the ionization potentials of those compounds are greater than that of the bulb in use with the PID.

6.3 Solubility Testing

6.3.1 Hexane - Place approximately one milliliter (ml) of sample and approximately two milliliters of hexane in a culture tube. Gently shake or swirl the culture tube to mix the contents (use a Vortex Genie, if available). Allow the contents of the tube to settle for one minute. If only one phase results, then the sample is soluble and is classified as organic. If the result is two layers, but the hexane takes on the color of the sample, then the sample is partially soluble and is classified as organic. If the sample is not completely soluble in hexane, the sample is not necessarily inorganic. For instance, methanol and ethanol are slightly soluble in hexane but both are organic. Record the result as soluble (S), insoluble (I), or partially soluble (PS). Record any other observations that are

deemed relevant. Retain the culture tube, sample, and hexane for further testing.

6.3.2 Water - Place approximately one milliliter of sample and two milliliters of water in a culture tubes. Note the ratio of sample volume to water volume at this time. Gently shake or swirl the culture tube to mix the contents (use a Vortex Genie, if available). While performing this test, check for water reactivity (see Section 6.5.2). If only one layer results, the sample is soluble. If the ratio of sample to water changes, then the sample is partially soluble. If there are two distinct layers then the sample is insoluble. Record the result as soluble (S), insoluble (I), or partially soluble (PS).

6.3.3 Alternative solvents - Alternative solvents, such as dichloromethane (DCM) and ethyl acetate, may be used in place of hexane. The procedure is the same at that described in Section 6.3.1. Organic compounds are more soluble in these solvents than in hexane. The drawbacks to these two compounds are that DCM is a suspected carcinogen and difficult to dispose of and ethyl acetate is highly flammable and the vapor is heavier than air (which means the compound is highly susceptible to flashback).

6.3.4 The main interferences encountered when performing testing are the physical properties of the samples themselves. Some samples coat the side of the culture to making it appear that only one layer is present upon conclusion of the test (this is remedied by tilting the culture tube and observing the results). Some samples appear to be soluble only to settle out upon standing. This can be remedied by performing the remaining tests and then checking the contents of the culture tube a second time before disposing of the contents. Also, if not enough sample or solvent is placed in the tube, the interface may blend in with the curved bottom of the culture tube. The sample is then mistakenly identified as soluble. This problem may be alleviated by ensuring that enough sample and solvent are used and by performing the test in small diameter culture tubes (16mm x 125mm or 16mm x 150mm).

6.4 Density Test

6.4.1 Density is observed if the sample is insoluble or partially soluble in water. Upon completion of the water solubility test, examine the contents of the tube. If the sample is the top layer, the sample is lighter (L) than water. If the sample is the bottom layer, the sample is heavier (H) than water. Record the results with the water

solubility results (e.g., if a sample is lighter than water then the result is recorded as IL - insoluble, lighter).

6.4.2 Solubility and density results are difficult to determine with clear, colorless liquid samples. Two ways of alleviating these problems are ensuring that you use twice as much volume of water as sample and observing the interface between the two layers. Usually, if the interface is convex (curved upward), the bottom layer is the sample. If the interface is concave (curved downward), the upper layer is the sample.

6.4.3 A sample that adheres to the sides of the tube may also cause problems when determining density. This problem can be alleviated by shaking the tube or using a tongue depressor to break off a small part of the sample into the solvent.

6.5 Sample Reactivity

6.5.1 Air Reactivity - There are two instances during which air reactivity may be observed; during sampling in the field or after opening the sample prior to Hazcat testing. In most cases air reactivity is the result of a reaction with moisture in the air, or the sample may be light sensitive. In some cases, exposure to air causes the loss of inhibiting compounds, resulting in polymerization of the sample. A sample is considered air reactive if it smokes, polymerizes, or changes physical state, color, or clarity upon exposure to air. Record the result as either a positive (+) or a negative (-).It is difficult to determine if a sample is air reactive. If you have any doubts hold a wetted pH strip above the surface of the sample. If the pH changes, the sample should be considered air reactive.

6.5.2 Water Reactivity - Water reactivity is noted during water solubility testing. Water solubility testing must be performed in a hood as some materials, such as sodium and phosphorus tribromide, react violently with water. Other compounds, such as acids and bases, exhibit a small exothermic reaction. Some samples may exhibit an endothermic reaction. To detect these reactions, hold the culture tube with the sample in your hand while waiting for the contents of the tube to settle (Section 6.3.2). Still other samples may polymerize upon the addition of water. Record the result as either a positive (+) or a negative (-).Most samples that are exothermically water reactive have a high or low pH following completion of the reaction. If you have any doubts as to whether or not a sample is water reactive keep this in mind.

6.6 pH Test

6.6.1 The pH of the sample should be tested during water solubility testing. Testing for pH is accomplished by immersing a pH strip into the water (regardless of whether or not the sample is soluble). The pH strip is then compared against a color chart to determine the value. The value should then be recorded on the Hazcat data sheet. The pH of a sample should never be recorded as zero (it should be identified as <1).

6.6.2 The most effective pH strips use a four zone system for identifying pH. The dyes in these zone are deactivated in the presence of most organic compounds. Therefore, it is more accurate to test the water phase during water solubility testing as, more often than not, the water takes on the pH of the sample it comes in contact with. Another interference for pH testing are the physical characteristics of the sample. Dark colors make it difficult to accurately read the strip. To alleviate this problem, care should be taken when immersing the strip in the culture tube.

6.7 Peroxide Test

6.7.1 Using the culture tube with the results of the solubility tests, immerse a peroxide strip into the culture tube containing the solvent in which the sample was most soluble. If the sample was not soluble in any of the solvents used, immerse the strip into the hexane solubility culture tube. A blue color in the reaction zone indicates the presence of a peroxide. Record the result as a positive (+), a negative (-), or a concentration if the strip provides that capability.

6.7.2 A quality control check of the strips is performed by immersing the strip in hydrogen peroxide. A QC check should be performed at the beginning of each day or upon the opening of a new tube.

6.7.3 Certain heavy metals, such as hexavalent chromium, cause false positives for this test. The result is usually green or black. However, the intended purpose of the peroxide strip test is to determine the presence of organic peroxides. Usually, heavy metals are not present in drums which contain organic peroxide compounds.

6.7.4 Another interference for this test are sample matrices that are dark in color (particularly blue). Dark colors often make the strips

difficult to read. This problem may be alleviated by diluting the sample.

6.8 Oxidizer Test

6.8.1 Immerse an oxidizer (potassium iodide-starch) test strip into the culture tube containing the water solubility test until the test strip has been wetted by the contents. Remove the test strip from the tube and add one drop of 5% hydrochloric acid to the strip. Wait 2-4 minutes and check the strip. The development of a blue-black color on the strip indicates a positive result. Record the result as a positive (+) or a negative (-).

6.8.2 A quality control check of the oxidizer strips is performed in the same manner and with the same frequency as for the peroxide strips (Section 6.7.2).

6.8.3 Dark colored samples (particularly blue, purple, and black) interfere with this test. The sample should be diluted if this situation occurs.

6.9 Cyanide Test

6.9.1 There are many different test kits available on the market for screening a sample for the presence of cyanide compounds. The Merck cyanide test kits are preferred as they are quick and easy to use. Always read the instructions provided with any test kit that is used.

6.9.2 The Merck cyanide test kit is based upon the pyridine barbituric acid colorimetric test. To perform this test, fill the vial provided with 5 ml of sample or water extract. Add 25% sulfuric acid if the pH of the sample was greater than 9 until the pH drops to 6-7 (usually one small drop is enough). Add one level dosing spoon of Reagent 1 until completely dissolved. Add five drops of Reagent 2 and shake well. Immerse the reaction zone of a test strip into the liquid for thirty seconds. Remove the strip and shake/wipe off excess liquid. Immediately compare the strip against the color chart on the side of the test strip tube a positive result is purple.

6.9.3 This test has the following interferences:

a. Copper, palladium, mercury, and silver cyanide compounds are only partially detected.

b. Complex cyanides (isocyanates, ferrocyanates) are not detected.

c. Bromides and iodides decrease the intensity of the color.

d. Strong reducing agents interfere with the reaction as one of the main reagents used in the test is chloramine-T, an oxidizer. Examples of reducing agents are sugars and sodium thiosulfate.

e. The presence of strong sulfides also cause a false positive. Sulfides can be removed by cadmium carbonate, if available.

f. Dark colored samples also interfere with this test. The sample should be diluted if this problem occurs.

6.9.4 Sample that have either a low pH or test positive on the oxidizer test do not have to be tested for cyanides.

6.10 Sulfide Test

6.10.1 Immerse a sulfide (lead acetate) test strip into the culture tube that contains the water solubility test until the test strip has been wetted by the water fraction (if the sample is insoluble) or the contents of the tube (if the sample is soluble). After removing the test strip from the culture tube, add one drop of 5% hydrochloric acid to the strip. A change of color to brown-black indicates the presence of sulfide compounds. Record the result as either a positive (+) or a negative (-).

6.10.2 Dark colored samples (particularly brown and black) interfere with this test. This problem may be alleviated by further diluting the sample.

6.10.3 Samples that have either a low pH or test positive on the oxidizer test do not have to be tested for sulfides.

6.11 Bielstein Test

6.11.1 Break off a piece of copper wire approximately six inches long and loop one of the ends. Wrap the other end around a tongue depressor. Place the loop of the wire into the sample and then place the loop into the tip of the flame of a propane torch. The presence of a green flame indicates a positive result. This test

may also result in other colors. These colors should be noted when recording the results.

6.11.2 Use a dark background when observing the results.

6.11.3 Ensure that the wire is cooled and rinsed between samples. This is accomplished by dowsing the loop end of the wire with water. Inserting a hot wire into a sample may resulting in ignition of the sample.

6.11.4 It is not necessary to have the propane torch on the highest setting.

6.11.5 Low pH samples may result in false positive as they corrode the copper wire and the elemental copper yields a green flame.

6.11.6 Certain nitrogen non-halogenated compounds may yield a green flame. Examples of these compounds are quinoline, pyridine derivatives, organic acids, urea, and copper cyanide.

6.12 Flash Point

6.12.1 Dip either the end of a spatula or a tongue depressor (split in half lengthwise) into your sample. Place the tip of the spatula/tongue depressor in the flame of a propane torch set on low. If the sample begins burning immediately remove it from the flame. If the sample continues burning consider the sample flammable. If the flame extinguishes slowly consider the sample combustible. If you are using a tongue depressor ensure that it is the sample burning not the tongue depressor.

6.12.2 An alternate method is to place a small amount of the sample on a watch glass. A lighted match is then passed over the sample. If the sample ignites it is flammable.

7.0 EQUIPMENT

7.1 The materials required to perform Hazcat testing may include the following.

- Hood with a fan
- PID or FID
- Cyanide and sulfide monotoxes
- Distilled water
- Hexane, dichloromethane, or ethyl acetate

- 5% hydrochloric acid
- Polyethylene squeeze bottles
- Tongue depressors, wood
- Spatula, stainless steel
- Culture tubes (16mm x 125mm or 16mm x 150mm)
- Polyethylene transfer pipets
- Watch glasses
- 8 oz. jars
- 32 oz. jars
- pH test strips, range 0-14
- Potassium iodide-starch test strips
- Lead acetate test strips
- Peroxide test strips
- Cyanide test kits
- Copper wire 16-20 gauge
- Test tube racks (16mm width)
- Propane torch with a flow control valve
- Bench liner
- Fire extinguisher
- Eyewash station or bottle
- Safety glasses
- Safety shower
- Fire blanket
- Latex or nitrile gloves
- Indelible ink pens
- Trash bags
- Ultra fine point permanent markers
- 11" x 17" columnar ledger sheets
- Tyvek coveralls or laboratory coat
- Vortex genie (optional)

8.0 ATTACHMENTS

- Drum/Container Sampling Log

EQ

Container No._____

Waste Stream_____

DRUM/CONTAINER SAMPLING LOG

GENERAL INFORMATION

Site Name:_____ Location:_____ Samplers:_____

Date:_____ Time:_____ _____

DRUM/CONTAINER INFORMATION (circle all that apply)

Type: Drum Vat Pit Tank

Construction: Steel Poly Fiber Poly-lined Open-top Closed-top Other:_____

Total Volume: 85 gal 55 gal 30 gal 10 gal 5 gal Other:_____

Waste Volume: 100% 75% 50% 25% <25% Empty Other_____

Field Screening: OVA/HNu_____ %LEL_____ %O_2_____ Rad. Meter_____ pH____

Condition: Poor Fair Good

DRUM/CONTAINER CONTENTS

Layer	*Color*	*Clarity*	*Physical State*	*% of Total Volume*
Top				
Middle				
Bottom				

Clarity choices are clear, cloudy or opaque

DRUM/CONTAINER LABELING INFORMATION

Manufacturer Name_____ Chemical Name:_____

Other Information:_____

Container Number:_____

Sample Description

Layer	Color	Clarity	Physical State
Top			
Middle			
Bottom			

Abbreviations: OPQ = Opaque CLR = Clear CDY = Cloudy LIQ = Liquid SOL = Solid SDG = Sludge

Hazard Categorization Testing Results

Layer	Water Sol.	Hex. Sol.	React.	pH	Per.	Oxid.	CN^-	Sulf.	Cl^-	Flam.
Top										
Middle										
Bottom										

Solubility Abbreviations: S = Soluble I = Insoluble PS = Partially Soluble IL = Insoluble, Lighter IH = Insoluble, Heavier

Reactivity Abbreviations: A = Air Reactive W = Water Reactive - = No Reaction

Test Results: + = Positive result - = Negative result

Additional Test Performed (Result):_____

Comments_____

Waste Streams: **Top**_____

Middle_____

Analyst_____ **Date:**_____ **Bottom**_____

ACC89383

****** MATERIAL SAFETY DATA SHEET ******

Barbituric Acid
000002264

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Barbituric Acid

```
     2,4,(1H,3H,5H)-pyrimidinetrione
Company Identification:  Acros Organics
                         Janssen Pharmaceuticalaan 3
                         2440 Geel, Belgium
For information in North America, call: 800-ACROS-01
For information in Europe, call:        0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call:     0032(0) 14575299
```

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	Einecs#
67-52-7	Barbituric acid	100	2006580

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: White or off-white crystalline solid.
Caution! Contact with eyes or skin may cause mechanical irritation.
May cause respiratory tract irritation. Ingestion of large amounts may cause digestive tract irritation. This chemical is expected to be a low hazard for usual industrial handling.
Appearance: White or off-white crystalline solid.
Target Organs: None.

Potential Health Effects

Eye:
Dust may cause mechanical irritation.

Skin:
Dust may cause mechanical irritation.
Low hazard for usual industrial handling.

Ingestion:
Ingestion of large amounts may cause gastrointestinal irritation.
Expected to be a low ingestion hazard.

Inhalation:
May cause respiratory tract irritation.
Low hazard for usual industrial handling.

Chronic:
No information found.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids.
Get medical aid.

Skin:
Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.
Get medical aid if irritation develops or persists.

Ingestion:
If victim is conscious and alert, give 2-4 cupfuls of milk or water.
Never give anything by mouth to an unconscious person.
Get medical aid.

Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Get medical aid if cough or other symptoms appear.

Notes to Physician:
Treat symptomatically and supportively.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.
This material in sufficient quantity and reduced particle size is capable of creating a dust explosion.

Extinguishing Media:
In case of fire, use water, dry chemical, chemical foam, or alcohol-resistant foam.

Autoignition Temperature: Not applicable.
Flash Point: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:
Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Use with adequate ventilation.
Avoid contact with eyes, skin, and clothing.
Avoid ingestion and inhalation.

Storage:
Store in a cool, dry place.
Keep from contact with oxidizing materials.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Barbituric acid	none listed	none listed	none listed

OSHA Vacated PELs:

Barbituric acid:

No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to minimize contact with skin.

Respirators:

Follow the OSHA respirator regulations found in 29CFR 1010.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Solid
Appearance:	White or off-white crystalline solid.
Odor:	Odorless.
pH:	Strong acid in sol.
Vapor Pressure:	Negligible.
Vapor Density:	Not available.
Evaporation Rate:	Negligible.
Viscosity:	Not available.
Boiling Point:	500.F
Freezing/Melting Point:	478.F
Decomposition Temperature:	478.F
Solubility:	Slightly soluble in water.
Specific Gravity/Density:	Not available.
Molecular Formula:	C4H4N2O3
Molecular Weight:	128.0396

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:

Stable. However, may decompose if heated.

Conditions to Avoid:

High temperatures, strong oxidants.

Incompatibilities with Other Materials:

Strong oxidizing agents.

Hazardous Decomposition Products:

Nitrogen oxides, carbon monoxide, carbon dioxide.

Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:

CAS# 67-52-7: CP8000000

LD50/LC50:
Not available.
Carcinogenicity:
Barbituric acid
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
No components are listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No data available.
Teratogenicity:
No data available.
Reproductive Effects:
No data available.
Neurotoxicity:
No data available.
Mutagenicity:
No data available.
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Not available.
Environmental Fate:
Not available.
Physical/Chemical:
Not available.
Physical/Chemical:
Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: Not listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
No information available
IMO
Not regulated as a hazardous material.
IATA
Not regulated as a hazardous material.
RID/ADR
Not regulated as a hazardous material.
Canadian TDG
No information available.

**** SECTION 15 - REGULATORY INFORMATION ****

A. Federal
TSCA
CAS# 67-52-7 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA/SARA

Section 302 (RQ)

None of the chemicals in this material have an RQ.

Section 302 (TPQ)

None of the chemicals in this product have a TPQ.

Section 313

No chemicals are reportable under Section 313.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

B. State

Not present on state lists from CA, PA, MN, MA, FL, or NJ.
California No Significant Risk Level:
None of the chemicals in this product are listed.

C. International

Canada

CAS# 67-52-7 is listed on Canada's DSL/NDSL List.
CAS# 67-52-7 is not listed on Canada's Ingredient Disclosure List.

European Labeling in Accordance with EC Directives

Hazard Symbols: Not available.
Risk Phrases:
Safety Phrases:

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:

No additional information available.

MSDS Creation Date: March 23, 1995

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

ACC89157

****** MATERIAL SAFETY DATA SHEET ******

Pyridine
000019990

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Pyridine

41854-5000, 1032606, 1032614, 1032689, 1032705, 1154061, 1154681, 1167022, 1167048, 1468313, 1468453, 1595081, 1796994, EK 103 2689, EK 103 2705, EK 116 7022, EK 116 7048, EK 159 5081, EK 179 6994

Synonyms:
Azabenzene; Azine

Company Identification: Acros Organics
Janssen Pharmaceuticalaan 3
2440 Geel, Belgium

For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	Einecs#
110-86-1	PYRIDINE	100	203-809-9

Hazard Symbols: XN F
Risk Phrases: 11 20/21/22

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: Clear colorlss liquid. Strong "fishy" odor.
WARNING! Flammable liquid and vapor. Flash point=68.F. May cause eye and skin irritation with possible burns. May be absorbed through the skin. May cause digestive and respiratory tract irritation with possible burns. Ingestion and inhalation may cause central nervous system depression.
Appearance: Clear colorless liquid. Flash Point: 68.F.
Target Organs: Kidneys, central nervous system, liver, bone marrow.

Potential Health Effects

Eye:
Contact with eyes may cause severe irritation, and possible eye burns.

Skin:
May cause skin irritation.
May be absorbed through the skin in harmful amounts.

Ingestion:
May cause central nervous system depression, kidney damage, and

liver damage.
May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
May cause effects similar to those for inhalation exposure.

Inhalation:
Inhalation of high concentrations may cause central nervous system effects characterized by headache, dizziness, unconsciousness and coma.
May cause respiratory tract irritation.
Prolonged exposure may result in dizziness and general weakness.

Chronic:
Prolonged or repeated skin contact may cause dermatitis.
Chronic inhalation and ingestion may cause effects similar to those of acute inhalation and ingestion.
May cause liver and kidney damage.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids.
Get medical aid immediately.

Skin:
Get medical aid immediately.
Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion:
Do NOT induce vomiting.
If victim is conscious and alert, give 2-4 cupfuls of milk or water.
Never give anything by mouth to an unconscious person.
Get medical aid immediately.

Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Get medical aid.

Notes to Physician:
Treat symptomatically and supportively.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.

Extinguishing Media:
Use water spray to cool fire-exposed containers.
In case of fire, use water fog, dry chemical, carbon dioxide, or regular foam.

Autoignition Temperature: 900.F (482.22.C)
Flash Point: 68.F (20.00.C)
Explosion Limits, Lower: 1.80
Upper: 12.40

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:
Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Remove all sources of ignition.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:

Wash thoroughly after handling.
Remove contaminated clothing and wash before reuse.
Use with adequate ventilation.
Follow all MSDS and label precautions even after container is emptied because they may contain product residues.
Use spark-proof tools and explosion proof equipment.
Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, sparks or open flames.
Do not get on skin or in eyes.
Do not ingest or inhale.

Storage:

Keep away from heat, sparks, and flame.
Store in a cool, dry place.
Store in a tightly closed container.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
PYRIDINE	5 ppm ; 16 mg/m3	5 ppm TWA; 15 mg/m3 TWA	5 ppm TWA; 15 mg/m3 TWA

OSHA Vacated PELs:

PYRIDINE:
5 ppm TWA; 15 mg/m3 TWA

Personal Protective Equipment

Eyes:
Wear safety glasses and chemical goggles if splashing is possible.

Skin:
Wear appropriate protective gloves and clothing to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to minimize contact with skin.

Respirators:
Wear a NIOSH/MSHA-approved (or equivalent) full-facepiece airline respirator in the positive pressure mode with emergency escape provisions.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Appearance:	Clear colorless liquid
Odor:	Strong "fishy" odor.
pH:	8.5 (0.2 M solution)

Vapor Pressure:	20 mm Hg
Vapor Density:	2.73 (Air=1)
Evaporation Rate:	Not available.
Viscosity:	0.95 mPa s 20 C
Boiling Point:	115-116.C
Freezing/Melting Point:	-42.C
Decomposition Temperature:	Not available.
Solubility:	Miscible in water. Volatile in steam.
Specific Gravity/Density:	.9780
Molecular Formula:	C5H5N
Molecular Weight:	79.0417

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials.
Incompatibilities with Other Materials:
Acids; acid chlorides; oxidizing agents; chloroformates; bromine trifluorate; mixtures with formamide, iodine, and sulfur trioxide.
Hazardous Decomposition Products:
Nitrogen oxides, carbon monoxide, carbon dioxide, nitrogen.
Hazardous Polymerization: Will not occur.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 110-86-1: UR8400000
LD50/LC50:
Oral, rat: LD50 = 891 mg/kg Skin, rabbit: LD50 = 1121 mg/kg
Carcinogenicity:
PYRIDINE
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
No components are listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
A low number of injection-site tumors were found in rats that received subcutaneous injections of pyridine at doses up to 100 mg/kg/day, twice weekly for a year; however, there were no indications of real oncogenic potential.
Teratogenicity:
No studies in mammals were found. Tests in the hydra did not suggest the material should be tested in mammals.
Reproductive Effects:
No data available.
Neurotoxicity:
No data available.
Mutagenicity:
Pyridine's mutagenicity potential is equivocal. It was reported to be both positive and negative in Salmonella typhimurium strains. It was not mutagenic in tests for chromosome aberrations, but did give weak positive results in tests that d
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Not available.
Environmental Fate:
Not available.

Physical/Chemical:
Not available.
Physical/Chemical:
Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: waste number D038; regulatory le
RCRA D-Series Chronic Toxicity Reference Levels: chronic toxicity reference level = 0
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: waste number U196
This material is banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: PYRIDINE - POISON
Hazard Class: 3
UN Number: UN1282
Packing Group: II
IMO
Shipping Name: PYRIDINE
Hazard Class: 3.2
UN Number: 1282
Packing Group: 2
IATA
Shipping Name: PYRIDINE
Hazard Class: 3
UN Number: 1282
Packing Group: 2
RID/ADR
Shipping Name: PYRIDINE
Dangerous Goods Code: 3(3B)
UN Number: 1282
Canadian TDG
Shipping Name: PYRIDINE
Hazard Class: 3(6.1)
UN Number: UN1282
Other Information: FLASHPOINT 17 C

**** SECTION 15 - REGULATORY INFORMATION ****

A. Federal
TSCA
CAS# 110-86-1 is listed on the TSCA inventory.
Health & Safety Reporting List
CAS# 110-86-1: Effective Date: October 4, 1982
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA/SARA
Section 302 (RQ)
None of the chemicals in this material have an RQ.
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
Section 313

Section 313:

This material contains PYRIDINE (CAS# 110-86-1, 100%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

B. State

PYRIDINE can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level:

None of the chemicals in this product are listed.

C. International

Canada

CAS# 110-86-1 is listed on Canada's DSL/NDSL List.
CAS# 110-86-1 is listed on Canada's Ingredient Disclosure List.

European Labeling in Accordance with EC Directives

Hazard Symbols: XN F

Risk Phrases:

R 11 Highly flammable.
R 20/21/22 Harmful by inhalation, in contact with skin and if swallowed.

Safety Phrases:

S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 28A After contact with skin, wash immediately with plenty of water.

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:

No additional information available.

MSDS Creation Date: March 28, 1995

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

ACC89573

****** MATERIAL SAFETY DATA SHEET ******

Sodium Phosphate Monobasic Monohydrate
000015191

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Sodium Phosphate Monobasic Monohydrate

Synonyms:

Company Identification: Acros Organics
Janssen Pharmaceuticalaan 3
2440 Geel, Belgium
For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	Einecs#
10049-21-5	Sodium Phosphate Monobasic Monohydrate		unlisted

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: White crystalline solid
Caution! May cause eye, skin, respiratory and digestive tract irriatation.
Appearance: White crystalline powder.
Target Organs: None.

Potential Health Effects

Eye:
May cause eye irritation.

Skin:
May cause skin irritation.

Ingestion:
Ingestion of large amounts may cause gastrointestinal irritation.

Inhalation:
May cause respiratory tract irritation.

Chronic:
No information found.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Flush eyes with plenty of water for at least 15 minutes,

occasionally lifting the upper and lower lids.
Get medical aid.

Skin:
Get medical aid.
Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion:
If victim is conscious and alert, give 2-4 cupfuls of milk or water.
Get medical aid.
DO NOT induce vomiting. Allow the victim to rinse his mouth and then to drink 2-4 cupfuls of water, and seek medical advice.

Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Get medical aid if cough or other symptoms appear.

Notes to Physician:
Treat symptomatically and supportively.
None reported.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.
Dusts at sufficient concentrations can form explosive mixtures with air.
Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products.

Extinguishing Media:
For small fires, use water spray, dry chemical, carbon dioxide or chemical foam.

Autoignition Temperature: Not available.
Flash Point: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equpiment as indicated in Section 8.

Spills/Leaks:
Vacuum or sweep up material and place into a suitable disposal container. Sweep up, then place into a suitable container for disposal.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Use with adequate ventilation.
Avoid prolonged or repeated contact with skin.
Avoid contact with eyes.
Avoid ingestion and inhalation.

Storage:
Store in a tightly closed container.
Store in a cool, dry, well-ventilated area away from incompatible substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Use adequate ventilation to keep airborne concentrations low.
Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sodium Phosphate Monobasic Monohydrate	none listed	none listed	none listed

OSHA Vacated PELs:

Sodium Phosphate Monobasic Monohydrate:
No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes:
Wear safety glasses and chemical goggles if splashing is possible. Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:
Wear appropriate protective gloves and clothing to prevent skin exposure. Wear appropriate gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to minimize contact with skin.

Respirators:
Wear a NIOSH/MSHA-approved (or equivalent) full-facepiece airline respirator in the positive pressure mode with emergency escape provisions. Follow the OSHA respirator regulations found in 29CFR 1010.134. Always use a NIOSH-appro

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Not available.
Appearance:	White crystalline powder
Odor:	Not available.
pH:	4.4-4.5
Vapor Pressure:	Not available.
Vapor Density:	Not available.
Evaporation Rate:	Not available.
Viscosity:	Not available.
Boiling Point:	Not available.
Freezing/Melting Point:	100.00.C
Decomposition Temperature:	100.C
Solubility:	1103 g/l (20 C)
Specific Gravity/Density:	Not available.
Molecular Formula:	H2 Na O4 P . H2 O
Molecular Weight:	Not available.

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:

Stable. Stable under normal temperatures and pressures.

Conditions to Avoid:

None reported.
Incompatibilities with Other Materials:
None reported with common materials.
Hazardous Decomposition Products:
Carbon monoxide, oxides of phosphorus, carbon dioxide.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 10049-21-5 unlisted.
LD50/LC50:
CAS# 10049-21-5: Not available.
Carcinogenicity:
Sodium Phosphate Monobasic Monohydrate
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
No components are listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No data available.
Teratogenicity:
No data available.
Reproductive Effects:
No data available.
Neurotoxicity:
No data available.
Mutagenicity:
No data available.
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
No information found.
Environmental Fate:
No information found.
Physical/Chemical:
No information found.
Physical/Chemical:
No information found.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: Not listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
No information available
IMO
Not regulated as a hazardous material.
IATA
Not regulated as a hazardous material.
RID/ADR
Not regulated as a hazardous material.

Canadian TDG

No information available.

**** SECTION 15 - REGULATORY INFORMATION ****

A. Federal

TSCA

CAS# 10049-21-5 is not on the TSCA Inventory. It is a hydrate and exempt from TSCA Inventory requirements (40CFR270.3(u)(2)).

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA/SARA

Section 302 (RQ)

None of the chemicals in this material have an RQ.

Section 302 (TPQ)

None of the chemicals in this product have a TPQ.

Section 313

No chemicals are reportable under Section 313.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

B. State

Not present on state lists from CA, PA, MN, MA, FL, or NJ.
California No Significant Risk Level:
None of the chemicals in this product are listed.

C. International

Canada

None of the chemicals in this product are listed on the DSL/NDSL list.
CAS# 10049-21-5 is not listed on Canada's Ingredient Disclosure List.

European Labeling in Accordance with EC Directives

Hazard Symbols: Not available.
Risk Phrases:
Safety Phrases:

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:

No additional information available.

MSDS Creation Date: June 13, 1995

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the

information for their particular purposes.

ACC89317

****** MATERIAL SAFETY DATA SHEET ******

Hexane
000010950

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Hexane

EK 195 1490
Synonyms:
Dipropyl, hexyl hydride, n-hexane.
Company Identification: Acros Organics
Janssen Pharmaceuticalaan 3
2440 Geel, Belgium
For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	Einecs#
110-54-3	Hexane	>85%	203-777-6

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: Colorless liquid with a mild gasoline odor.
Danger! Extremely flammable liquid, FP=-7.6F. Eye contact produces irritation. Skin contact causes immediate burning irritation and blistering. Liquid and vapor may be absorbed through skin. Ingestion poses an aspiration hazard with possible asphyxia, brain damage, and cardiac arrest. Inhalation produces nervous system and visual disturbances. Substance has caused adverse birth and reproductive effects in lab animals.
Appearance: Colorless. Flash Point: -7.6 F.
Target Organs: Heart, muscles, nervous system.

Potential Health Effects

Eye:
Contact produces irritation, tearing, and burning pain.

Skin:
May be absorbed through the skin in harmful amounts.
Contact causes immediate redness, painful burning, and possible blistering. Substance in vapor form may also absorbed.

Ingestion:
Aspiration hazard.
Aspiration can cause asphyxia, brain damage, and cardiac arrest.

Exposure may cause cardiac sensitization.

Inhalation:

Exposure produces central nervous system depression.
Exposure may cause vertigo, hallucinations, fatigue, muscle weakness, visual disturbances, and nervous system disturbances.

Chronic:

Prolonged or repeated exposure may cause adverse reproductive effects.
Repeated exposure may cause nervous system abnormalities with muscle weakness and damage, motor incoordination, and sensation disturbances. Visual abnormalities have also been reported.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids.
Get medical aid immediately.
Do NOT allow victim to rub or keep eyes closed.

Skin:

Get medical aid if irritation develops or persists.
Rinse area with large amounts of water for at least 15 minutes.
Remove contaminated clothing and shoes.

Ingestion:

Do NOT induce vomiting.
If victim is conscious and alert, give 2-4 cupfuls of milk or water.
Possible aspiration hazard.
Get medical aid immediately.

Inhalation:

Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Get medical aid.

Notes to Physician:

Treat symptomatically and supportively.
No specific antidote exists.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.
Vapors can travel to a source of ignition and flash back.
Extremely flammable. Material will readily ignite at room temperature.
Use water spray to keep fire-exposed containers cool.
Containers may explode in the heat of a fire.

Extinguishing Media:

For small fires, use water spray, dry chemical, carbon dioxide or chemical foam.
Use water spray to cool fire-exposed containers.

Autoignition Temperature: 437.F (225.00.C)
Flash Point: -7.6.F (-22.00.C)
Explosion Limits, Lower: 1.2
Upper: 7.5

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Wear a self contained breathing apparatus and appropriate Personal protection. (See Exposure Controls, Personal Protection section). Scoop up with a nonsparking tool, then place into a suitable container for disposal. Remove all sources o

**** SECTION 7 - HANDLING and STORAGE ****

Handling:

Wash thoroughly after handling.
Remove contaminated clothing and wash before reuse.
Use only in a well ventilated area.
Ground and bond containers when transferring material.
Use spark-proof tools and explosion proof equipment.
Avoid contact with heat, sparks and flame.
Do not get on skin or in eyes.
Do not ingest or inhale.

Storage:

Keep away from sources of ignition.
Store in a cool, dry, well-ventilated area away from incompatible substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Use explosion-proof ventilation equipment.
Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Hexane	50 ppm ; 176 mg/m3	50 ppm TWA; 180 mg/m3 TWA	500 ppm TWA; 1800 mg/m3 TWA

OSHA Vacated PELs:

Hexane:
50 ppm TWA; 180 mg/m3 TWA

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:
Wear an impervious apron.

Clothing:
Wear appropriate protective clothing to prevent skin exposure.

Respirators:
Follow the OSHA respirator regulations found in 29CFR 1010.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State: Liquid
Appearance: Colorless.
Odor: Mild gasoline type.

pH:	Neutral.
Vapor Pressure:	150 mm Hg @27C
Vapor Density:	3.0 (air=1)
Evaporation Rate:	Not available.
Viscosity:	0.31 cP @27C.
Boiling Point:	156.F
Freezing/Melting Point:	-139.F
Decomposition Temperature:	Not available.
Solubility:	0.014% @20C.
Specific Gravity/Density:	0.66 (water=1)
Molecular Formula:	C6H14
Molecular Weight:	86.098

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable at room temperature in closed containers under normal storage and handling conditions.
Conditions to Avoid:
Incompatible materials, ignition sources, excess heat.
Incompatibilities with Other Materials:
Dinitrogen tetroxide and strong oxidizers.
Hazardous Decomposition Products:
Acrid smoke and fumes.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 110-54-3: MN9275000
LD50/LC50:
Oral, rat: LD50 = 28710 mg/kg
Carcinogenicity:
Hexane
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
No components are listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No information available.
Teratogenicity:
Effects on Newborn: reduced weight gain, ihl-rat TCLo=1000 ppm/6H.
Embryo or Fetus: Stunted fetus, ihl-rat TCLo=5000 ppm/20H.
Reproductive Effects:
Paternal Effects: Testes/sperm duct/epididymis, ihl-rat TCLo=1 pph/6H.
Neurotoxicity:
No information available.
Mutagenicity:
No information available.
Other Studies:
None.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
No information available.
Environmental Fate:
Substance readily volatilizes when released on soil or to water (with minor absorption to soil or sediment). The potential for aquatic bioconcentration is low. In air, substance is predicted to exist in vapor phase and will react with photochemically produced hydroxyl radicals.

Physical/Chemical:
No information available.
Physical/Chemical:
None.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: Not listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: HEXANES
Hazard Class: 3
UN Number: UN1208
Packing Group: II
IMO
Shipping Name: HEXANES
Hazard Class: 3.1
UN Number: 1208
Packing Group: 2
IATA
Shipping Name: HEXANES
Hazard Class: 3
UN Number: 1208
Packing Group: 2
RID/ADR
Shipping Name: HEXANES
Dangerous Goods Code: 3(3B)
UN Number: 1208
Canadian TDG
Shipping Name: HEXANES
Hazard Class: 3
UN Number: UN1208
Other Information: FLASHPOINT -22C

**** SECTION 15 - REGULATORY INFORMATION ****

A. Federal
TSCA
CAS# 110-54-3 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA/SARA
Section 302 (RQ)
None of the chemicals in this material have an RQ.
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
Section 313

No chemicals are reportable under Section 313.

Clean Air Act:

CAS# 110-54-3 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

B. State

Hexane can be found on the following state right to know lists: New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level:
None of the chemicals in this product are listed.

C. International

Canada

CAS# 110-54-3 is listed on Canada's DSL/NDSL List.
CAS# 110-54-3 is listed on Canada's Ingredient Disclosure List.

European Labeling in Accordance with EC Directives

Hazard Symbols: Not available.
Risk Phrases:
Safety Phrases:

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:

No additional information available.

MSDS Creation Date: February 2, 1995

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

ACC64288

Chloramine-T trihydrate, 98%

Acros Catalog #s: AC227850010 AC227850250 AC227852500
*** This product is for research and development purposes only. ***

711 Forbes Avenue
Pittsburgh, PA 15219-4785
1-800-ACROS-01 (1-800-227-6701)
For Emergency Transportation Information call CHEMTREC: 800-424-9300

Date of Preparation: 03/22/86 Accession Number: 901022
Modified by Fisher Scientific: 12/94

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SECTION I. IDENTIFICATION

- Product Name: Chloramine-T
- Synonym(s): N-Chloro-4-methylbenzenesulfonamide Sodium Salt
- Formula: C7 H7 Cl N Na O2 S
- CAT No(s): 109 7971; 109 7997; 109 8003
- Chem. No(s): 01022

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SECTION II. PRODUCT AND COMPONENT HAZARD DATA

COMPONENT(S):	Percent	TLV(R)	CAS Reg. No.
Chloramine-T	approx 100	---	127-65-1

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SECTION III. PHYSICAL DATA

- Appearance: White crystalline solid
- Melting Point: Not Available
- Vapor Pressure: Negligible
- Evaporation Rate (n-butyl acetate = 1): Negligible
- Volatile Fraction by Weight: Negligible
- Specific Gravity (H2O = 1): Not Available
- Solubility in Water (by Weight): Appreciable

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SECTION IV. FIRE AND EXPLOSION HAZARD DATA

- Flash Point: Not Applicable
- Extinguishing Media: Water spray; Dry chemical; CO2
- Special Fire Fighting Procedures: Wear self-contained breathing apparatus and protective clothing. Use water spray to keep fire exposed containers cool.
- Unusual Fire and Explosion Hazards: Fire or excessive heat may produce hazardous decomposition products. This material in sufficient quantity and reduced particle size is capable of creating a dust explosion.

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SECTION V. REACTIVITY DATA

- Stability: Stable, however, can decompose above 100 C. Avoid temperatures above 50 C.

- Incompatibility: Strong oxidizers
- Hazardous Decomposition Products: Combustion will produce CO_2 and probably CO. Hydrogen chloride gas and oxides of sulfur and nitrogen may also be present.
- Hazardous Polymerization: Will not occur.

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R-0075.400B 86-6651

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SECTION VI. TOXICITY AND HEALTH HAZARD DATA

A. EXPOSURE LIMITS: Not established.

B. EXPOSURE EFFECTS:
Inhalation: Harmful if inhaled. Dust extremely irritating.
Skin: Causes irritation. Can cause allergic skin reaction.
Eye: Causes irritation.
Ingestion: Harmful if swallowed.

C. FIRST AID:
Inhalation: Remove to fresh air. Treat symptomatically. If symptoms are present get medical attention.
Skin: Immediately flush skin with plenty of water for at least 15 minutes. Get medical attention if symptoms are present after washing.
Eye: Immediately flush eyes with plenty of water for at least 15 minutes and get medical attention.
Ingestion: Drink 1-2 glasses of milk or water and induce vomiting. Call a physician immediately.

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SECTION VII. VENTILATION AND PERSONAL PROTECTION

A. VENTILATION:
Good general room ventilation should be used. Local exhaust may be needed.

B. RESPIRATORY PROTECTION:
A NIOSH-approved dust respirator should be worn, if needed.

C. SKIN AND EYE PROTECTION:
Protective gloves and clothing should be worn. Safety glasses, goggles, or a face shield should be worn.

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SECTION VIII. SPECIAL STORAGE AND HANDLING PRECAUTIONS

Fire or excessive heat may cause explosive decomposition if confined. Keep from contact with oxidizing materials. Store in cool place.

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SECTION IX. SPILL, LEAK, AND DISPOSAL PROCEDURES

Sweep up material and package for safe feed to an incinerator. Dispose by incineration or contract with licensed chemical waste disposal agency. Discharge, treatment, or disposal may be subject to federal, state or local laws.

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The information contained herein is furnished without warranty of any kind. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of the suitability and completeness of information from all sources to assure proper use and disposal of these materials and the safety and health of employees and customers.

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ACC89107

****** MATERIAL SAFETY DATA SHEET ******

Hydrochloric Acid
000011155

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Hydrochloric Acid

1146414, 1299320, 1650092, EK 114 6372, EK 114 6414, EK 129 9320, EK 165 0092

Synonyms:
Chlorohydric acid, hydrogen chloride, muriatic acid, spirits of salt.

Company Identification: Acros Organics
Janssen Pharmaceuticalaan 3
2440 Geel, Belgium

For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	Einecs#
7647-01-0	Hydrogen chloride	36-38%	unlisted
7732-18-5	Water	62-64%	unlisted

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: Clear, colorless to faintly yellow liquid with a strong, pungent odor.
Danger. Corrosive. Contact with liquid causes eye and skin burns. Vapor may cause eye and skin burns. Inhalation causes severe respiratory tract irritation with coughing, choking, and possible burns. Ingestion causes severe irritation and burns of the digestive tract with possible permanent damage and tissue destruction. Repeated exposure may cause tooth erosion and photosensitization.
Appearance: Clear, colorless to faintly yellow.
Target Organs: None.

Potential Health Effects

Eye:
May cause irreversible eye injury.
Vapor or mist may cause irritation and severe burns.
Contact with liquid is corrosive to the eyes and causes severe burns.

Skin:
May be absorbed through the skin in harmful amounts.

Contact with liquid is corrosive and causes severe burns and ulceration.

Ingestion:

May cause circulatory system failure.
Causes severe digestive tract burns with abdominal pain, vomiting, and possible death.
May cause corrosion and permanent tissue destruction of the esophagus and digestive tract.

Inhalation:

Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma.
May cause pulmonary edema and severe respiratory disturbances.

Chronic:

Prolonged or repeated skin contact may cause dermatitis.
Repeated exposure may cause erosion of teeth.
May cause conjunctivitis and photosensitization.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids.
Get medical aid immediately.
Do NOT allow victim to rub or keep eyes closed.

Skin:

Get medical aid.
Rinse area with large amounts of water for at least 15 minutes.
Remove contaminated clothing and shoes.

Ingestion:

Do NOT induce vomiting.
If victim is conscious and alert, give 2-4 cupfuls of milk or water.
Get medical aid immediately.

Inhalation:

Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Get medical aid.

Notes to Physician:

Treat symptomatically and supportively.
No specific antidote exists.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.
Not flammable, but reacts with most metals to form flammable hydrogen gas.
Use water spray to keep fire-exposed containers cool.

Extinguishing Media:

Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.

Autoignition Temperature: Not available.
Flash Point: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Large spills may be neutralized with dilute alkaline solutions of soda ash, or lime. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:

Wash thoroughly after handling.
Remove contaminated clothing and wash before reuse.
Use with adequate ventilation.
Do not get on skin or in eyes.
Do not ingest or inhale.

Storage:

Keep away from heat and flame.
Do not store in direct sunlight.
Store in a cool, dry, well-ventilated area away from incompatible substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Hydrogen chloride	C 5 ppm; C 7.5 mg/m3	C 5 ppm; C 7 mg/m3	C 5 ppm; C 7 mg/m3
Water	none listed	none listed	none listed

OSHA Vacated PELs:

Hydrogen chloride:
C 5 ppm; C 7 mg/m3
Water:
No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:
Wear appropriate protective gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to prevent skin exposure.

Respirators:
Follow the OSHA respirator regulations found in 29CFR 1010.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State: Liquid

Appearance:	Clear, colorless to faintly yellow.
Odor:	Strong, pungent.
pH:	1.1 (0.1N sol).
Vapor Pressure:	160 mm Hg
Vapor Density:	1.257 (Air=1)
Evaporation Rate:	2.0 (Butyl acetate=1)
Viscosity:	Not available.
Boiling Point:	230.F
Freezing/Melting Point:	-101.F
Decomposition Temperature:	3239.6.F
Solubility:	823g/L water at 32F.
Specific Gravity/Density:	1.19 (Water=1)
Molecular Formula:	HCl
Molecular Weight:	36.46

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, light.
Incompatibilities with Other Materials:
Acetate, acetic anhydride, alcohols + hydrogen cyanide, 2-aminoethanol, ammonium hydroxide, calcium carbide, calcium phosphide, cesium acetylene carbide, cesium carbide, chlorosulfonic acid, 1,1-difluoroethylene, ethylene diamine, ethyleneimine, fluorine, lithium silicide, magnesium boride, mercuric sulfate, oleum, perchloric acid, potassium permanganate, b-propiolactone, propylene oxide, rubidum acetylene carbide, rubidum carbide, silver perchlorate + carbon tetrachloride, sodium, sodium hydroxide, sulfuric acid, uranium phosphide, vinyl acetate.
Substance polymerizes on contact with aldehydes or epoxides.
Hazardous Decomposition Products:
Hydrogen chloride, hydrogen gas.
Hazardous Polymerization: May occur.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 7647-01-0: MW4025000
CAS# 7732-18-5: ZC0110000
LD50/LC50:
Inhalation, rat: LC50 = 3124 ppm 1 hr. Oral, rabbit: LD50 = 900 mg/kg
Carcinogenicity:
Hydrogen chloride
ACGIH: (A2)-suspected human carcinogen
California: carcinogen
NIOSH: occupational carcinogen
NTP: Suspect carcinogen
OSHA: Possible Select carcinogen
IARC: Group 3 carcinogen
Water
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
No components are listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No information available.
Teratogenicity:
Embryo or Fetus: Stunted fetus, ihl-rat TCLo=450 mg/m3/1H Specific Developmental Abnormalities: homeostasis, ihl-rat TCLo=450 mg/m3/1H.
Reproductive Effects:
No information available.

Neurotoxicity:
No information available.
Mutagenicity:
No information available.
Other Studies:
None.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Trout LC100=10 mg/L/24H
Shrimp LC50=100-330 ppm
Starfish LC50=100-330mg/L/48H
Shore crab LC50=240 mg/L/48H
Chronic plant toxicity=100 ppm
Environmental Fate:
Substance will neutralize soil carbonate-based components.
Physical/Chemical:
No information available.
Physical/Chemical:
None.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: Not listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: HYDROCHLORIC ACID, SOLUTION
Hazard Class: 8
UN Number: UN1789
Packing Group: II
IMO
Shipping Name: HYDROCHLORIC ACID, SOLUTION
Hazard Class: 8
UN Number: 1789
Packing Group: 2
IATA
Shipping Name: HYDROCHLORIC ACID SOLUTION
Hazard Class: 8
UN Number: 1789
Packing Group: 2
RID/ADR
Shipping Name: HYDROCHLORIC ACID SOLUTION
Dangerous Goods Code: 8(5B)
UN Number: 1789
Canadian TDG
Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8(9.2)
UN Number: UN1789

**** SECTION 15 - REGULATORY INFORMATION ****

A. Federal

TSCA

CAS# 7647-01-0 is listed on the TSCA inventory.
CAS# 7732-18-5 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA/SARA

Section 302 (RQ)

None of the chemicals in this material have an RQ.

Section 302 (TPQ)

CAS# 7647-01-0: TPQ = 500 pounds

Section 313

Section 313:

This material contains Hydrogen chloride (CAS# 7647-01-0, 36-38%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

CAS# 7647-01-0 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

CAS# 7647-01-0 is listed as a Hazardous Substance under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

CAS# 7647-01-0 is considered highly hazardous by OSHA.

B. State

Hydrogen chloride can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
Not present on state lists from CA, PA, MN, MA, FL, or NJ.
California No Significant Risk Level:
None of the chemicals in this product are listed.

C. International

Canada

CAS# 7647-01-0 is listed on Canada's DSL/NDSL List.
CAS# 7732-18-5 is listed on Canada's DSL/NDSL List.
CAS# 7647-01-0 is listed on Canada's Ingredient Disclosure List.
CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

European Labeling in Accordance with EC Directives

Hazard Symbols: Not available.
Risk Phrases:
Safety Phrases:

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:

No additional information available.

MSDS Creation Date: January 9, 1995

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the

information for their particular purposes.

ACC89771

****** MATERIAL SAFETY DATA SHEET ******

Sulfuric Acid
000022350

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Sulfuric Acid

EK 114 6919, EK 802 4614
Synonyms:
Hydrogen Sulfate, Oil of Vitriol, Vitriol Brown Oil, Matting Acid, Battery Acid
Company Identification: Acros Organics
Janssen Pharmaceuticalaan 3
2440 Geel, Belgium
For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	Einecs#
7664-93-9	Sulfuric acid	95-98.0%	unlisted

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: Colorless, odorless liquid.
DANGER! Corrosive. Causes severe respiratory tract irrtitation with possible burns. Causes eye and skin burns. Harmful if swallowed. Causes corrosion of the digestive tract.
Appearance: Colorless (pure) to brown (impure), fuming liquid.
Target Organs: None.

Potential Health Effects

Eye:
Causes severe eye burns.
May cause irreversible eye injury.

Skin:
Causes skin burns.

Ingestion:
May cause severe and permanent damage to the digestive tract.
Causes gastrointestinal tract burns.

Inhalation:
Harmful if inhaled.
May cause severe irritation of the respiratory tract with sore throat, coughing, shortness of breath and delayed lung edema.
May cause mucous membrane burns.

Chronic:

Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis.

Prolonged or repeated eye contact may cause conjunctivitis.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:

Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids.

Get medical aid immediately.

Skin:

Get medical aid immediately.

Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.

Speedy action is critical.

Ingestion:

Do NOT induce vomiting.

If victim is conscious and alert, give 2-4 cupfuls of milk or water.

Get medical aid immediately.

Inhalation:

Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Notes to Physician:

Treat symptomatically and supportively.

None reported.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:

Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products.

Contact with water can cause violent liberation of heat and splattering of the material.

Extinguishing Media:

Do not use water directly on fire.

Use water spray to cool fire-exposed containers.

Use dry chemical to fight fire.

Autoignition Temperature: Not available.

Flash Point: Not available.

Explosion Limits, Lower: Not available.

Upper: Not available.

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equpiment as indicated in Section 8.

Spills/Leaks:

Clean up spills immediately, observing precautions in the Protective Equipment section. Cover with sand, dry lime or soda ash and place in a closed container for disposal.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:

Wash thoroughly after handling.

Remove contaminated clothing and wash before reuse.

Do not get in eyes, on skin, or on clothing.

Keep container tightly closed.
Do not allow contact with water.
Use only in a chemical fume hood.

Storage:

Do not store near combustible materials.
Keep container closed when not in use.
Store in a dry area.
Store in a cool, dry, well-ventilated area away from incompatible substances.
Do not store near alkaline substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sulfuric acid	1 mg/m3; 3 mg/m3 STEL	1 mg/m3 TWA	1 mg/m3 TWA

OSHA Vacated PELs:

Sulfuric acid:
1 mg/m3 TWA

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin:

Wear appropriate gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to minimize contact with skin.

Respirators:

Follow the OSHA respirator regulations found in 29CFR 1010.134. Always use a NIOSH-approved respirator when necessary.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Liquid
Appearance:	Colorless (pure) to brown (impure), fuming liquid.
Odor:	Odorless
pH:	0.3 (1N Solution)
Vapor Pressure:	< .00120 mm Hg
Vapor Density:	1.2 kg/m3
Evaporation Rate:	Slower than ether.
Viscosity:	Neglible
Boiling Point:	554.F
Freezing/Melting Point:	50.6.F
Decomposition Temperature:	340.C
Solubility:	Soluble in Water and Ethanol.
Specific Gravity/Density:	1.841

Molecular Formula: H_2SO_4
Molecular Weight: 98.0716

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, contact with water, metals, excess heat, combustible materials, organic materials, oxidizers, amines, bases.
Incompatibilities with Other Materials:
Acetic Anhydride, Acetone Cyanhydrin, Acetone + Nitric Acid, Acetone + Potassium Dichromate, Acetonitrile, Acrolein, Acrylonitrile, Alcohols + Hydrogen Peroxide, Allyl Alcohol, Allyl Chloride, 2-Aminoethanol, Ammonium Hydroxide, Ammonium Triperchromate, Aniline, Bromates + Metals, Bromine Pentafluoride, n-Butyraldehyde, Carbides, Cesium Acetylene Carbide, Chlorates, Chlorine Trifluoride, Chlorosulfonic Acid, Cuprous Nitride, Diisobutylene, Epichlorohydrin, Ethylene Cyanohydrin, Ethylene Diamine, Ethylene Glycol, Ethylenimine, Fulminates, Other Acids, Iodine Heptafluoride, Metals, Isoprene, Lithium Silicide, Mercuric Nitride, Mesityl Oxide,
Hazardous Decomposition Products:
Oxides of sulfur.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 7664-93-9: WS5600000
LD50/LC50:
Inhalation, rat: LC50 = 510 mg/m3 2 hr Oral, rat: LD50 = 2140 mg/kg
Carcinogenicity:
Sulfuric acid
ACGIH: A2-suspected human carcinogen
California: carcinogen
NIOSH: occupational carcinogen
NTP: Suspect carcinogen
OSHA: Select carcinogen
IARC: Group 1 carcinogen
No components are listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
Workers exposed to industrial sulfuric acid mist showed a statistical increase in laryngeal cancer. This data suggests a possible relationship between carcinogenisis and inhalation of sulfuric acid mist.
Teratogenicity:
No data available.
Reproductive Effects:
No data available.
Neurotoxicity:
No data available.
Mutagenicity:
No data available.
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
Sulfuric acid is harmful to aquatic life in very low concentrations. It may be dangerous if it enters water intakes. The aquatic toxicity

for bluegill in fresh water was 24.5 ppm/24 hr, which was lethal.

Environmental Fate:

Not available.

Physical/Chemical:

Not available.

Physical/Chemical:

Not available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: Not listed.
RCRA D-Series Chronic Toxicity Reference Levels: Not listed.
RCRA F-Series: Not listed.
RCRA P-Series: Not listed.
RCRA U-Series: Not listed.
Not listed as a material banned from land disposal according to RCRA.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: SULFURIC ACID
Hazard Class: 8
UN Number: UN1830
Packing Group: II

IMO
Shipping Name: SULPHURIC ACID, WITH MORE THAN 51% ACID
Hazard Class: 8
UN Number: 1830
Packing Group: 2

IATA
Shipping Name: SULPHURIC ACID
Hazard Class: 8
UN Number: 1830
Packing Group: 2

RID/ADR
Shipping Name: SULPHURIC ACID
Dangerous Goods Code: 8(1B)
UN Number: 1830

Canadian TDG
Shipping Name: SULFURIC ACID
Hazard Class: 8(9.2)
UN Number: UN1830

**** SECTION 15 - REGULATORY INFORMATION ****

A. Federal

TSCA

CAS# 7664-93-9 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA/SARA

Section 302 (RQ)

None of the chemicals in this material have an RQ.

Section 302 (TPQ)

CAS# 7664-93-9: TPQ = 1000 pounds

Section 313

Section 313:

This material contains Sulfuric acid (CAS# 7664-93-9, 95-98.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

CAS# 7664-93-9 is listed as a Hazardous Substance under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

B. State

Sulfuric acid can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

California No Significant Risk Level:

None of the chemicals in this product are listed.

C. International

Canada

CAS# 7664-93-9 is listed on Canada's DSL/NDSL List.
CAS# 7664-93-9 is listed on Canada's Ingredient Disclosure List.

European Labeling in Accordance with EC Directives

Hazard Symbols: Not available.
Risk Phrases:
Safety Phrases:

**** SECTION 16 - ADDITIONAL INFORMATION ****

Additional Information:

No additional information available.

MSDS Creation Date: December 28, 1994

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

ACC89436

****** MATERIAL SAFETY DATA SHEET ******

Potassium iodide
000019435

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Potassium iodide

EK 100 8093, EK 113 0095, EK 113 0103, EK 121 4816
Synonyms:
Knollide, potide
Company Identification: Acros Organics
Janssen Pharmaceuticalaan 3
2440 Geel, Belgium
For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies outside the US, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	Einecs#
7681-11-0	Potassium iodide (ki)	100	unlisted

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Appearance: Colorless or white deliquescent granules or powder.
Caution! May cause eye, skin and respiratory tract irritation.
Ingestion may cause digestive tract irritation with nausea, vomiting, and dirrhea. Chronic ingestion may cause "iodism", which is characterized by sneezing, salivation, runny nose, headache, fever, mucous membrane irritation, and varous skin rashes. May cause fetal effects.
Appearance: Colorless or white granules or powder.
Target Organs: None.

Potential Health Effects

Eye:
Causes eye irritation.

Skin:
May cause skin irritation.

Ingestion:
Causes gastrointestinal irritation with nausea, vomiting and diarrhea.

Inhalation:
May cause respiratory tract irritation.

Chronic:
Chronic overexposure can lead to "iodism", a mild toxic syndrome,

with symptoms of salivation, coryza, sneezing, conjunctivitis, fever, laryngitis, bronchitis, stomatitis, and various skin rashes. Chronic ingestion of iodides during pregnancy has resulted in fetal death, severe goiter and cretinoid appearance of the newborn.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids.
Get medical aid.

Skin:
Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.
Get medical aid if irritation develops or persists.

Ingestion:
If victim is conscious and alert, give 2-4 cupfuls of milk or water.
Never give anything by mouth to an unconscious person.
Get medical aid.

Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Get medical aid if cough or other symptoms appear.

Notes to Physician:
Treat symptomatically and supportively.
None reported.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products.

Extinguishing Media:
For small fires, use water spray, dry chemical, carbon dioxide or chemical foam.

Autoignition Temperature: Not applicable.
Flash Point: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:
Vacuum or sweep up material and place into a suitable disposal container. Avoid generating dusty conditions.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling.
Use with adequate ventilation.
Avoid contact with eyes, skin, and clothing.
Avoid ingestion and inhalation.

Storage:
Store in a cool, dry, well-ventilated area away from incompatible substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

ATTACHMENT Y
LAB PACKING AND LAB INVENTORY

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 17 DATE 9/17/93 PAGE 1 OF 8
SUBJECT Lab Pack Inventory and Classification	SUPERCEDES APPROVED

LAB PACK INVENTORY AND CLASSIFICATION

Lab packing is one operation which requires knowledge of chemical names, terminology and meticulous record keeping. If possible, review definitions and structures of common chemical names (sulfates, nitrites, peroxides, acids, etc.) and types of reactions that might occur (acid/base, oxidation, addition, etc.), before the job starts.

1. SETUP

An open area is needed for the inventory of containers, temporary storage, packing and storage before transportation. Any small containers that were originally found as part of a lab pack need to be unpacked and repackaged prior to shipment.

2. SURVEY OF STORAGE AREAS

Prior to beginning the inventory of the containers a thorough search of the lab facilities is made to ensure that all small containers are located. In labs, a various amount of equipment will be found. Items such as test tubes, beakers, flasks, test strips, tubing, etc., will usually be present in large numbers. It is the job of the lab pack personnel to ensure that this material is searched through and relocated so that enough room is created for the storage on inventoried containers. In some cases, the client/EPA may request that anything of value be kept and packed away. An example of such items are instruments and specialty glassware.

As areas are searched, containers of specialty chemicals may be found. Mercury, shock sensitive material, radioactive compounds, pyrophoric material, water reactive material and gas cylinders are a few of the specialty chemicals that are found in the laboratory. Each of the aforementioned hazards should be handled only if absolutely necessary and by qualified personnel.

Containers located in refrigerators often present the greatest danger. Materials such as ethers, peroxide-forming ketones and highly volatile liquids are usually stored in refrigerators because of the effects of heat on the chemical. The presence of these containers creates a great risk when opening the refrigerator itself. These containers should also be handled only when necessary and then only by qualified personnel. The door of the refrigerator should only be opened if it is free of obstruction (i.e., as long as no glass can be heard moving).

3. SURVEY FOR RADIOACTIVE COMPOUNDS

Once all the small containers have been located a scan of the containers should be performed with a radmeter. Containers noted as showing any detectable radioactivity above the normal background can not be lab packed. These containers should be identified so that they are easily recognizable by personnel entering the area. The containers should then be sorted in a manner that will contain the radiation emission. For this purpose, a lead-lined envelope/pouch is recommended. Using the label information, the manufacturer should be contacted to determine if they would be willing to take the material back.

4. INVENTORY OF THE CONTAINERS

Lab pack inventory sheets should contain the following information:

A. Name of chemical
If the name of the chemical is not evident, any information gathered from label of the container may prove useful (for instance, CAS numbers or drawn out chemical structures can be used to help identify the chemical). The concentration and form the chemical is present in (crystalline, granular, powder, anhydrous, etc.) should also be written down.

B. Container size (pint, quart, 1 Lb., etc.)
This information is usually printed on the label. If the size is not printed make an estimate of the volume of the container (this can be done by comparing the container to sample jars used by EQ). Also note that for solids the size is usually given in mass as opposed to volume for liquids and gases.

C. Manufacturer and address (if possible)
To save space and time, company names should be abbreviated. The abbreviation should be logged into a separate logbook along with the address, telephone number and full name of the company.

D. Physical state (solid, liquid, gas)
If the physical state is not evident (as in the case of metal cans), mark this space with an N/A (not available). **DO NOT** open the container to find out.

E. Container type (metal, glass, etc.)
The container type can be abbreviated using the first letter of the substance it is made out of (e.g., G for glass, M for metal).

F. Inventory control number (OPTIONAL)
Inventory control numbers allow for better tracking of the containers although it is time consuming. The container would be labeled with the number assigned to it.

G. Percent full (OPTIONAL)
Rough estimate of the amount of material in the container.

Five gallon containers should not be inventoried unless the client/EPA requires it to be lab packed at which point the material should be broken down into five gallon charges (if possible).

Containers with handwritten labels should initially be listed as unknown although any label information should still be written down and used to determine hazard class. Information contained on handwritten labels will be considered valid at the discretion of the disposal firm.

Containers identified as holding shock-sensitive forming compounds will not be moved, except by qualified personnel, and should be clearly marked. Fluorescent tape is often ideal for this purpose.

5. CLASSIFICATION

Classification of the inventoried containers should take place concurrently with the inventory process itself. Manufacturer and handwritten labeled containers will both be classified by DOT category. Containers that do not have any markings will be designated as unknowns. Once again, keep in mind that even though containers with handwritten labels are to be classified, they may not be accepted by the disposal firm. Since the lab pack drums have to be shipped according to DOT regulations and most of the major disposal firms prefer DOT classification, it is often wise to classify the containers by DOT category as opposed to chemical families.

6. DRUM PACKING AND DISPOSAL

6.1 Limitations

Prior to any packing, **make sure** you have an up-to-date copy of the guidelines for the disposal firm who is receiving the material. Keep in mind that there are several limits to what you can and cannot pack in the drum. Some of the limitations are:

- The number and size of container type per lab pack container. Example: ThermalKem will accept no more than four one gallon packages of type "A" or "C" organic containers per lab pack container.

- Certain elements have a limit to the amount of material accepted.

6.2 Proposed Drum Packing Lists

Following the documentation phase (inventory and classification) of a lab pack project, the drum packing and disposal phase of the project begins. Proposed packing lists for the containers should be filled out by the lead technical on site (preferably a project chemist or a field chemist with experience in lab pack projects). The proposed packing lists will be written in accordance with the lab packing guidelines of the selected disposal firm. These proposed packing lists need not be completely filled out as the disposal firm will invariably make corrections and changes. Only after the disposal firm has approved the drum packing lists can the drums be packed. Having a representative of the disposal firm on site is recommended but not always possible.

6.3 Drum Packing

Packing Material: Most landfills (ex.: Chemical Waste Management) require the material to be packaged in a 17-H steel drum with vermiculite as packing around the bottles. Enough packing material must be included to absorb any spillage that may occur.

For direct incineration, most disposal firms prefer cardboard (fiber) to plastic drums. The packing material is usually sawdust or ground corncobs. Oxidizers should be packed in either vermiculite or kitty litter. Few disposal firms will accept vermiculite for direct incineration, one exception being ThermalKem (with an increase in cost). However, these companies may accept a vermiculite packed drum and will repack it for incineration when the drum reaches their facility. This process incurs higher cost.

Materials that are being disposed of by neutralization (example: BDT, Inc.) will be packaged as required by DOT regulations. This kind of disposal firm may prefer certain types of containers because they have to dispose of the containers also.

Packing Methodology: The method in which the containers are packed in the drums is determined by the disposal firm. Packing methods vary little from one disposal firm to another. Make sure that you follow the packing instructions of the disposal firm that is receiving the drums.

Three to four inches of packing material must first be put in the bottom of the drum. On top of this layer of packing, the first tier (layer of containers) should be placed in the drum so that no container shall be within 3-4 inches of another container or the side of the drum. These containers are then covered by more packing until 3-4 inches covers the first tier of containers. Rocking the drum slightly is recommended as the packing material will settle.

On top of this second layer of packing, another tier of containers is added following the same separation limits as for the first tier. Add more packing to cover up this layer. Continue this process until only 3-4 inches of space is left in the drum. At this point, add packing material until the drum is full and then rock the drum slightly. After the packing settles, add more packing until the drum is slightly overfilled. Place a copy of the drum packing list, inside a ziploc bag, on top of the packing material. Then put the lid on the drum and close and lock with the lid ring.

Place a copy of the drum packing list, two hazardous waste labels, any necessary hazard labels and the number of the drum on the outside of the drum.

6.4 Drum Packing Lists for Shipment

The official drum packing lists, the three copies that accompany the drum to its destination, should generally contain the following information:

1. chemical name
2. number of containers of each chemical
3. amount of each chemical
4. DOT number and hazard class
5. EPA number
6. reportable quantity (if applicable)
7. the generator's name
8. the date

9. project location
10. drum number

Also, bear in mind that drum packing lists for the different disposal companies may vary and additional information may be required.

7. CRUSHING OF UNKNOWNS OR REJECTED MATERIAL

7.1 Method

Environmental Quality Management, Inc.'s (EQ) procedure for the remote opening and stabilization of "unknowns" is similar to that described in the United States Environmental Protection Agency (USEPA) procedure with the exception that the containers are remotely opened by fracturing the container using heavy equipment, such as a trackhoe or a backhoe, instead of fracturing the container with a low-mass projectile (a .22 caliber bullet). The procedure will safety accomplish two objectives. First, the container will be opened remotely and secondly, the content can be collected, stabilized and readily handled in an inert sorbent media.

7.2 Setup

Prior to the beginning of crushing operations, all personnel directly involved will be briefed on the operation. It must be understood by everyone that the nature of the operation means that there is an inherent possibility that a reaction may occur. All personnel should attend a detailed safety meeting prior to the commencement of work.

A suitable open area should be chosen for the crushing operation. The crush pad will be constructed in this area. In some cases, vapor control buildings are constructed on site due to the extreme volatility and reactivity of the known materials on site. It is theorized that the unknown materials are often very similar to, if not identical to, the products that are known. A portable crush "box" is a very useful piece of equipment as it is readily transportable.

Crush pads constructed on site may vary in size. The floor of the crush pad should incorporate metal plating, or a minimum of two sheets of plywood if plating is not available, so that the trackhoe/backhoe does not drive the crushed materials into the ground. The pad should be surrounded on three sides by a berm made of sand. Both the sand berm and the pad floor should be covered by visqueen. A "bed" of floor-dry/lime mixture is then placed on the floor of the crushing pad to

absorb, neutralize and stabilize the contents of the containers. The floor dry/lime mixture should contain a minimum of 15 percent lime.

Extinguishing material, such as inert sand for smothering and 150-pound ABC fire extinguishers should be readily available in the event that a fire occurs.

All work should be performed in level "B" personal protective equipment. In some instances, the level of protection may be upgraded to "A".

7.3 Transfer of Unknowns to Crushing Area

All containers designated as unknown can be transferred to the crushing area in a number of ways. The containers can be packed in boxes with absorbent, to contain spillage, and transported to the crushing pad using a vehicle, or the containers may be placed in the sand-filled bucket of a backhoe, reducing the risk to personnel involved, and transported to the crushing pad.

7.4 Handling and Crushing

The chemist will remove the containers from the carrier, used to transport the material to the crushing area, and will place the containers in the floor dry/lime bed in a manner that will allow the equipment operator to crush the containers one at a time. The floor dry/lime mixture will be piled around the containers in such a was so as to cover all but the neck of the container. The floor dry/lime mixture will slope in such a way as to provide the necessary volume of neutralization material. Depth requirements for the neutralization mixture are outlined in Table 7-1.

When crushing begins the operator should have a nearby pile of sand available in the event that a reaction would need to be controlled. Under no circumstances should anyone but the spotter (usually the chemist) or the equipment operator be in close proximity to the crushing pad during crushing operations. When the operator feels he has crushed all the containers he should radio the chemist for a quality control check.

TABLE 7-1. DEPTH REQUIREMENTS FOR NEUTRALIZATION MIXTURE

Container		Average Container		Floor Dry/Lime
Size	Height	Weight	Pad Thickness	
1 pint	4 inches	1/4 pounds	3 inches	
1 pint-1 gallon	8 inches	5 pounds	6 inches	
1-5 gallons	12 inches	16 pounds	10 inches	

7.5 Containerization of Crushed Material

At the completion of a successful crush, the operator should mix the contents to minimize any reaction that could occur from the contact after the contents are bulked. The material that made up the crushing bed will then be containerized in 55-85 gallon drums (preferably poly). A sample of the drum should then be taken in order to dispose of the contents of the drum.

The crushing procedure should be repeated as many times as necessary to crush all of the unknown lab pack containers.

Keep in mind that all crushing jobs are different and variations on the preceding procedure are permissible with the approval of senior technical personnel.

ATTACHMENT Z
SITE SAFETY PLAN
ACKNOWLEDGMENT FORM

SITE SAFETY PLAN ACKNOWLEDGMENT FORM

I have been informed and understand and will abide by the procedures set forth in the Safety and Health Plan and Amendments for the site.

Printed Name	Signature	Representing	Date
T.E. FITZGERALD	T.E. Fitzgerald	E&E	10/26/99
Robert J Randle	Robert J Randle	ER	10/26/99
ORVILLE J. CRUMP	Orville J Crump	ER	10/26/99
Daniel W. Chamberlin	Daniel Chamberlin	Eagle Marine In	10/26/99
RANDY STAEHLING	Randy Staehling	EQ	10/26/99
Matthew GREAVET	Matthew Greavet	ER	10-29-99
John C Johnson Jr	John C Johnson Jr	ER	11-1-99
MATT DUKE	Matt Duke	ER	11-1-99
Mike McAteer	M. McAteer	U.S EPA	11-3-99
John McClure	John McClure	EQ	11-5-99
Rick D Gibbs	Rick D Gibbs	ER	11-8-99
John C Johnson	John C Johnson	ER	11-8-99
Mark Douglas	Mark Douglas	EQ	11-10-99
STEVE DUKE	Steve Duke	ER	11/15/99
PAUL ATKOCIUNAS	Paul Atkociunas	STMET/E&E	11/15/99
Dennis Greaney	Dennis Greaney	ER	11/16/99
DAVID A. EMMANUEL	David A. Emmanuel	U.S. EPA	11/18/99
R R. E. SAUSELEIN, USCG	R. E. Sauselein	USCG	12/01/99
Matthew Schalick	Matthew Schalick	USCG	12/01/99
Jess Wolfgang	Jessica Wolfgang	EQ	12/01/99
MIKE KUYKENDALL	Mike Kuykendall	SKI	1-3-00
Ricky Johnson	Ricky Johnson	ER	1-3-00
Adam Detrich	Adam Detrich	ER	1-5-00
Keith Calhoun	Keith Calhoun	ER	1-5-00

SITE SAFETY PLAN ACKNOWLEDGMENT FORM

I have been informed and understand and will abide by the procedures set forth in the Safety and Health Plan and Amendments for the site.

Printed Name	Signature	Representing	Date
Sam Borries	Sam Borries	US EPA	1/17/00
Jason Keys	Jason Keys	ER	2-14-00
Bob Sims	[illegible]	ER	2-18-00
Billie Kilgore	Billie Kilgore	EQM	03/06/00
Joe Davis	Joe Davis	ER	03/27/00
GERALD HUGHES	Gerald Hughes	ER	03/27/00
RICK KARL	Richard Karl	US EPA	3/27/00
BILL BOLTON	[illegible]	US EPA	3/27/00
Brian Harvell	Brian Harvell	ER	3-28-00
MARI NORO	Mari Noro	USEPA	4-13-00
MARC PAGANI	[illegible]	USEPA	4-13-00
Tony Moore	Tony Moore	USEPA	4-13-00
Terrance Patterson	Terrance Patterson	USEPA	4-13-00

SITE SAFETY PLAN ACKNOWLEDGMENT FORM

I have been informed and understand and will abide by the procedures set forth in the Safety and Health Plan and Amendments for the site.

Printed Name	Signature	Representing	Date

ATTACHMENT AA

FLAMMABLE/COMBUSTIBLE LIQUID TRANSFER AND CORROSIVE LIQUID TRANSFER

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 18 DATE 9/17/93 PAGE 1 OF 8
SUBJECT Flammable/Combustible Liquid Transfer Corrosive Liquid Transfer	SUPERCEDES APPROVED

SOLVENTS AND FLAMMABLE LIQUIDS

1. OBJECTIVE

It is the intent of Environmental Quality Management, Inc. (EQ) to protect employees against exposure to, and fires involving solvents and flammable or combustible liquids. All employees who may work with such materials must be familiar with and comply with the provisions of this procedure.

2. PURPOSE

This procedure outlines general precautions that are to be taken by personnel when handling solvents and flammable or combustible liquids. Precautions and required personal protective equipment (PPE) for specific chemicals are included in Material Safety Data Sheets (MSDS). This procedure is an overview of 29 CFR 1910.106. If questions arise concerning flammable or combustibles or the labeling of flammable or combustible liquid containers, reference should be made to the above standard. In the event of a conflict between the referenced standard and the MSDS, the more stringent requirement will prevail.

3. DEFINITIONS

3.1 Hydrocarbon solvents are compounds consisting solely of hydrogen and carbon atoms. They are flammable in varying degrees and may leave a combustible residue or oily film.

3.2 Alcohols are hydrocarbon derivatives in which one or more hydrogen atoms have been replaced by a hydroxyl group (oxygen-hydrogen). They are flammable, water soluble, and leave no film.

3.3 Ketones are hydrocarbon derivatives containing oxygen atoms. They are flammable, water soluble, and dissolve some materials not affected by hydrocarbons or alcohols.

3.4 Halogenated hydrocarbons are organic compounds containing chlorine, fluorine, and/or other halogens. They are primarily non-flammable and leave no oily residue. Depending on their boiling point, they are used cold or in heated vapor degreasers. When exposed to flames, hot surfaces, or welding arcs, vapors of these materials decompose into highly toxic and corrosive vapors, such as phosgene or hydrogen chloride.

3.5 Flammable solvents are classified according to flash points and boiling points.

3.6 TLV is the acronym for threshold limit value. Atmospheric contaminants in the form of gas or vapor are generally expressed as parts per million (ppm) by volume denoting parts of the material in 1,000,000 parts of air. Threshold limit values are the occupationally acceptable limits set by the American Conference of Governmental Industrial Hygienists to which most employees may be continuously exposed during their 8 hour working days without any adverse effect on their health.

3.7 Boiling point is that temperature at which a liquid boils and is an indicator of the relative vapor concentration present over liquids at any given temperature. (The higher the boiling point, the lower the vapor concentration.)

3.8 Flash point is that temperature at which sufficient flammable vapors are evolved from a liquid to obtain ignition. (The lower the flash point, the more flammable the solvent.)

3.9 Flammable limits denote the range, in percentage by volume, of the material with air which will burn.

3.10 Positive ventilation is venting provided by ducting and fans or blowers at opposed to comfort or natural ventilation.

3.11 Safety containers are of welded seam construction with excess pressure relieving closure and wire mesh screens to prevent the propagation of flame into the container. Safety containers are painted red (some with one yellow stripe). The container must be plainly labeled as contents. Containers must be National Fire Protection Association or Underwriters Laboratory approved.

4. SOLVENTS

4.1 Skin contact should be avoided. All solvents remove protective oils from the skin on contact, increasing the possibility of dermatitis and infection.

Some solvents may be absorbed through the skin to produce systemic effects.

4.2 Repeated skin contact can cause a person to become sensitized to a given solvent.

4.3 All solvents have varying adverse effects if ingested. Hydrocarbon liquids produce respiratory complications if allowed to enter the lungs.

4.4 Vapor concentrations above a given solvent are difficult to predict, depending on the method of dispensing, agitation, temperature, air movement, and confinement. In any case, the concentration will be directly proportional to the area of the surface wetted under a given set of conditions.

4.5 Some of the solvent vapors may be detected by odor before the TLV is reached. However, this is not a reliable method for protection against overexposure, since some solvents paralyze the sense of smell.

4.6 Miscellaneous solvent supplies in work areas shall be reduced to the minimum amount necessary for daily operation.

4.7 Solvent containers for bench use shall be of smallest practical size and shall provide a method of dispensing without pouring (by wetting cloth, squeeze bottle, or plunger type safety container).

4.8 All wiping cloths used for solvents shall be placed in a closed container immediately after use.

4.9 Disposition of all solvent wastes must be by an environmentally approved method.

4.10 Spills shall be cleaned up immediately using respiratory protection. Clear the area of other persons as necessary.

4.11 No solvent shall be used in a fashion to permit skin contact with the liquid. In most instances this means that gloves must be worn.

4.12 Solvent contaminated clothing must be removed at once.

4.13 All use of solvent not in positively ventilated equipment or in an outside area shall require the use of respiratory protection.

4.14 When using solvents inside a pit or confined area, regardless of quantity, personnel must wear adequate respiratory and contact protection and comply with confined space entry procedures.

4.15 Containers of solvents shall be labeled with an appropriate warning label.

4.16 The following precautions must be observed when opening full drums of solvents or chemicals:

- When opening full drums, all personnel in the immediate area must wear chemical goggles and a face shield.
- When removing the bung, the barrel must be in an upright position and a proper bung wrench used. The bung is to be loosened one turn, internal drum pressure allowed to reach atmospheric pressure, after which the bung may be removed. Never place your face above a bung when opening.

5. FLAMMABLE AND COMBUSTIBLE LIQUIDS

5.1 Definitions

- Class I Flammable Liquids: Includes those having a flash point below 100°F.
- Class II Combustible Liquids: Includes those have a flash point at or above 100°F, but below 140°F.
- Class III Combustible Liquids: Includes those have a flash point at or above 140°F, but below 200°F.

5.2 Handling and storing of flammable or combustible liquids in closed or approved safety containers and avoiding exposure of the liquid surface to air are of fundamental importance in preventing potential fires or employee exposure.

5.3 Signs for flammable or combustible liquids are as follows:

- Flash point of 20°F or below: "DANGER! EXTREMELY FLAMMABLE."
- Flash point from 20°F to 100°F: "WARNING! FLAMMABLE."
- Flash point from 100°F to 200°F: "CAUTION! COMBUSTIBLE."

6.12 Additional information and requirements for handling and storage of specific flammable or combustible liquids are included in the MSDS's or site safety plans.

6.13 A suitable storage area must be designated for flammable or combustibles on temporary job sites.

7. PAINT SPRAY BOOTHS

7.1 Spray booths are power-ventilated structures designed to enclose spraying operations, confine and limit the escape of spray, vapor, and residue, and to safety conduct or direct them to an exhaust system. Spray booths must be built to the specifications of 29 CFR 1910.107 (b), have electrical and other sources of ignition designed to conform with 29 CFR 1910.107 (c), and have ventilation designed to conform with 29 CFR 1910.107 (d).

7.2 The storage of flammable and combustible liquids shall be in conformance with 29 CFR 1910.106 and .107 (e). The quantity of flammable liquids kept in the vicinity of spraying operations shall be the minimum required for the operations and should ordinarily not exceed a supply for one day or one shift.

7.3 The room will have an automatic sprinkler system conforming to the requirements of 29 CFR 1910.159 and .107 (f). Special emphasis must be given to keeping sprinkler heads free of paint spray and residue. An adequate supply of suitable portable fire extinguishers shall be installed near all paint spray operations.

7.4 Spray booths shall not be used alternately for different types of coating materials, where the combination of the materials may be conducive to spontaneous ignition, unless all deposits of the first used material are removed from the booth and exhaust ducts prior to spraying with the second used material.

7.5 "NO SMOKING" sings in large letters on contracting color background shall be conspicuously posted at all spraying areas and paint storage areas.

7.6 The EQ facility safety compliance coordinator will perform air movement testing and monitoring quarterly to insure that at least 100 fpm of air movement is maintained. The EQ facility safety compliance coordinator will also establish respirator requirements for painting.

6. HANDLING AND DISPENSING

6.1 Drums or other containers containing flammable and combustible liquids should be stored in compliance with 29 CFR 1910.106(d). All drums are to be electrically grounded. Drip trays are to be provided under drum spigots.

6.2 A bond (metal-to-metal grounding strap) is to be established between the container and drum prior to filling a container from the storage drum. Drums are to be equipped with an approved type safety faucet and flexible metal hose. A pressure-vacuum relief vent is required for drums of flammable or combustible liquids.

6.3 Except in unusual cases as approved by the site safety officer, the maximum amount of flammable or combustible solvent (used for cleaning purposes) at any work station is limited to one quart.

6.4 Rags, kimwipes, etc. that are contaminated with flammable or combustible liquids are to be placed in a safety container equipped with a fusible link lid.

6.5 All containers of flammable or combustible liquids must be properly identified as to contents.

6.6 Spill containment is required for all drum dispensing areas.

6.7 All manually handled flammable or combustible liquids shall be handled in approved safety cans of not more than 5 gallons capacity, having a spring closing and flush arrestor and so designed that it will safety relieve internal pressure when subjected to heat or fire exposure.

6.8 Where flammable or combustible solvents must be used in wash containers, such as for paint sprayer cleaning, the container must be provided with self-closing or fusible link closure.

6.9 Flammable liquids in portable containers excess to the daily supply must be sorted in approved flammable liquid storage cabinets maintained closed with the door latched each time after use.

6.10 Containers of flammable or combustible liquids shall be labeled with an appropriate warning label.

6.11 NO SMOKING signs are to be posted in areas where flammable or combustible liquids are stored, dispensed, or used.

8. FLAMMABLE/COMBUSTIBLE LIQUID TRANSFER

8.1 Appropriate inspection of electrical equipment in the transfer area shall be performed prior to liquid transfer.

8.2 All ignition sources shall be eliminated and prohibited, no smoking signs erected.

8.3 Containers shall be appropriately bonded/grounded prior to and during flammable/combustible liquid transfer.

8.4 Air monitoring shall be performed during transfer as necessary.

8.5 Appropriate fire extinguishers shall be available in the area.

8.6 Personnel shall wear appropriate personal protection for the material to be transferred.

8.7 Personnel shall limit contact with materials as much as possible.

8.8 Personnel shall exercise caution if pumping material. Hoses and pumps shall be appropriate for the material and shall have adequate capacity for the rate/amount pumped.

8.9 Personnel shall elevate or otherwise protect hoses, cords, etc. to prevent falls. Good housekeeping and adequate lighting shall be used.

9. CORROSIVE LIQUID TRANSFER

9.1 Personnel shall don appropriate splash protection (may include chemical goggles and faceshield, apron, chemical resistant gloves, etc.). Respiratory protection and appropriate cartridges shall be used when necessary.

9.2 Personnel shall limit contact with materials as much as possible.

9.3 Precautions shall be taken during connecting/disconnecting hoses.

9.4 Ensure that hoses, pumps, and containers are compatible with each other as well as the material being transferred.

9.5 Personnel shall ensure that the hose and pump capacity is adequate for the rate being used.

9.6 Elevate or otherwise protect hoses and cords to prevent falls.

9.7 Be cognizant of wet surfaces and clean spills as quickly as possible.

9.8 Use adequate lighting in the work area and maintain a clean work area.

ATTACHMENT BB
CORROSIVE LIQUID TRANSFER

ATTACHMENT CC
USE OF HIGH PRESSURE WATER CLEANUP

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 19
	DATE 9/17/93
	PAGE 1 OF 3
SUBJECT	SUPERCEDES
Use of High Pressure Water Cleanup	APPROVED

HIGH PRESSURE WASHERS

1. OBJECTIVE

Environmental Quality Management, Inc. (EQ) personnel who have been trained in the proper set-up, use, and care of high pressure washers will be authorized to operate this equipment.

2. PURPOSE

This procedure describes requirements for the safe operation of the high-pressure washer.

3. PERSONAL PROTECTIVE EQUIPMENT

The following equipment will be worn by operators and assistants:

- Safety shoes or boots
- Metal foot and shin guards
- Eye protection (goggles and face shields)
- Hard hat
- Heavy Duty PVC rain suit or equivalent
- Heavy chemical resistant gloves

4. OPERATION PROCEDURE

- Only trained, authorized personnel will operate the high-pressure washer.
- The lance must always be pointed at the work area.

- The operator must maintain good footing.
- The operator must have an assistant to aid in moving the hose to different areas and backup up the operator. The assistant must remain in back of the operator.
- Non-operators must remain a safe distance from the operator. The distance must be a minimum of 25 feet.
- The operating pressure should never exceed that which is necessary to complete the job.
- No authorized attachment may be made to the unit. (The trigger should never be tied down.)
- The operator should be changed at frequent intervals to avoid fatigue (at least hourly).
- Equipment should be cleaned often to avoid oil or dirt build-up, especially around the trigger and guard area.
- An assistant should always be standing by at the pressure generator to shut down the equipment and monitor the pressure.
- All users must be trained in emergency shut down procedures and general equipment maintenance.
- All lances must be made of seamless stainless steel. Do not use carbon steel which can corrode and result in weakening of the lance.
- DO NOT MODIFY THE LANCE. The lance barrel, from trigger block to the tip, should not be less than 48 inches as recommended by manufacturers of hydroblasting equipment.
- Always increase pressure slowly to inspect for leaks. All leaks or malfunctioning equipment must be repaired immediately or the unit taken out-of-service. Never exceed the operating pressure necessary to do the job.
- Attach a cable which connects the water supply hose to the laser wand to prevent whipping should they accidentally disconnect.
- A serious risk of infection and further complications is possible from a hydroblasting laceration. If an injection injury is suspected, the treating physician should be informed so he/she can request a surgeon who

specializes in injection injuries. The specialist may have to perform surgery on the affected boy part in order to remove the material (oil, particles) that was injected directly through the skin.

ATTACHMENT DD
COMPRESSED GAS CYLINDERS

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 20 DATE 9/17/93 PAGE 1 OF 3
SUBJECT Compressed Gas Cylinders	SUPERCEDES APPROVED

PRESSURIZED CYLINDERS

1. OBJECTIVE

The use of compressed gases presents significant potential hazards to Environmental Quality Management, Inc. (EQ) employees. This procedure is established to protect EQ employees from those potential hazards.

2. PURPOSE

The purpose of this procedure is to outline the minimum requirements for safe handling and use of compressed gas and gas cylinders. This procedure is an overview of the requirements of 29 CFR 1910.101, .169, and .253.

3. USE OF COMPRESSED AIR OR GASES

3.1 Compressed air or other compressed gases are not to be used to blow dirt, chips, or dust from clothing.

3.2 The use of compressed air is to be controlled, and proper personal protective equipment or safeguards utilized, as to protect against the possibility of eye injury to the operator or other persons. Compressed air used for cleaning is to be limited to 30 psi.

3.3 Compressed gases are not to be used to elevate or otherwise transfer any hazardous substance from one container to another unless the containers are designed to withstand the pressure with a safety factor of at least four.

4. COMPRESSED GAS (CYLINDERS)

4.1 Cylinders must never be dropped, struck, or permitted to strike each other violently. Use carts or racks to move compressed gas cylinders; correct material handing techniques must be exercised when moving cylinders.

4.2 Valve protection caps must always be kept on cylinders when they are being moved, stored, or until ready for use.

4.3 Cylinder valves are to kept closed except when gas is being used or when connected to a permanent manifold. Valves of empty cylinders must be closed.

4.4 Cylinders must never be used as rollers or supports, or for any purpose other than carrying gas.

4.5 Cylinders of compressed gas shall be stored in areas where they are protected from external heat sources such as flame impingement, intense radiant heat, electric arc, or high temperature steam lines.

4.6 Cylinders are to be stored in an assigned area with full and empty cylinders separated. Stored fuel gases and oxygen cylinders are to be separated by 20 feet, or by a fire wall at least five (5) feet high having a fire-resistance rating of at least one-half (1/2) hour.

4.7 Oxygen, nitrogen, helium, or freon cylinders may be stored or transported either in an upright or horizontal position. Acetylene cylinders must always be kept in an upright position. All horizontally placed cylinders are to be secured by chocks or ties to prevent rolling.

4.8 Cylinders are to be secured to a fixed object by chain or equivalent fastening device whenever they are placed in an upright position. The protective cap is not to be removed or the cylinder valve opened until the cylinder is secured.

4.9 The repair of leaks must never be attempted on a pressurized system. If leaks develop, system pressure should be reduced to atmospheric pressure as rapidly as possible, and the supervisor notified immediately.

4.10 Compressed gas (in cylinders) must never be used to clean clothing or work surfaces.

4.11 Identification of the gas to be used must always be assured before connecting cylinders for use. All cylinders are to be labeled as to contents in addition to proper color coding. Color coding of cylinders should be posted.

4.12 Compressed gas cylinders in portable service are to be conveyed by suitable trucks to which they are securely fastened. All gas cylinders in service must be securely held in substantial racks or secured to other rigid structures so that they will not fall or be knocked over.

4.13 Gas cylinders moved by hoist must be handled in suitable cradles or boxes. The use of slings must be designed for that purpose.

4.14 Cylinders must not be placed where they might form part of an electrical circuit.

4.15 Transfer of acetylene from one cylinder to another is prohibited.

4.16 Oxygen cylinders are never to be stored near:

- Highly combustible materials, especially oil and grease
- Reserve stocks of acetylene or other fuel gas cylinders
- Any other substance likely to cause or accelerate fire.

4.17 Cylinders are not to be used unless they bear DOT markings showing that they have been tested as required by DOT regulations.

4.18 All cylinders used and stored at EQ facilities and project sites must have current hydrostatic test dates stamped on the cylinder. Any cylinder not having a current hydrostatic test should be rejected.

4.19 Compressed gas cylinders must be legibly marked for the purpose of identifying the gas content with either the chemical or the trade name of the gas. Such marking is to be by means of stenciling, stamping or labeling, and must not be readily removable. Whenever practical, the marking is to be located on the shoulder of the cylinder.

4.20 Compressed air and oxygen are not interchangeable as gases. Oxygen should <u>never</u> be used for the following:

- As breathing air.
- To purge pipelines, tanks, or any confined area.
- To supply a head-pressure tank.
- To power pneumatic tools.
- In oil preheating burners.
- To start internal combustion engines.
- Ventilation.
- Cleaning clothing.
- In any other way as a substitute for compressed air.

4.21 Use of a cylinder's contents for purposes other than those intended by the supplier is prohibited.

ATTACHMENT EE
HEAT STRESS

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 21 DATE 9/17/93 PAGE 1 OF 3
SUBJECT Heat Stress	SUPERCEDES APPROVED

HEAT STRESS

1. OBJECTIVE

In work situations where heat stress may be a factor, Environmental Quality Management, Inc. (EQ) will attempt to prevent heat related illness by use of work-rest schedules, physiological monitoring and/or personal cooling devices.

2. PURPOSE

This procedure describes the causes, symptoms, treatment, and prevention of heat-related illness.

3. GENERAL INFORMATION

3.1 Heat-related illnesses are caused by the body's inability to dissipate metabolic heat in conjunction with excessive environmental heat and wearing PPE.

3.2 A period of adjustment or acclimatization is necessary before maximum tolerance to heat is acquired. Most workers require 7 to 10 working days of gradually increasing workload to become fully acclimatized.

4. HEAT-RELATED ILLNESSES

4.1 **Heat rash** can be caused by continuous exposure to hot and humid air and skin abrasion from sweat soaked clothing.

Signs and Symptoms: The condition is characterized by a localized red skin rash and reduced sweating. Aside from being a nuisance, the ability to tolerate heat is reduced.

Treatment: Keep skin hygienically clean and allow it to dry thoroughly after using chemical protective clothing.

4.2 **Heat cramps** are caused by profuse perspiration with inadequate fluid intake and salt replacement. This often robs the larger muscle groups (stomach and quadriceps) of blood which can make them cramp.

Signs and Symptoms: Muscle spasm and pain in the extremities and abdomen.

Treatment: Remove affected person to a cool place and give sips of clear water or an electrolytic drink (Gatorade). It should be recommended to the person experiencing heat cramps to lightly salt their food to make up for the sodium lost when sweating. Manual pressure may also be applied to the cramped muscles.

4.3 **Heat exhaustion** is a mild form of shock caused by sustained physical activity in heat and profuse perspiration without adequate fluid and salt replacement.

Signs and Symptoms: Weak pulse; shallow breathing; pale, cool, moist (clammy) skin; profuse sweating; dizziness; fatigue.

Treatment: Remove affected person to a cool place and remove as much clothing as possible. Give sips of water or electrolytic solution and fan the person continually to remove heat by convection. CAUTION: Do not allow the affected person to become chilled -- treat for shock if necessary.

4.4 **Heat stroke** is the most severe form of heat stress; the body must be cooled immediately to prevent severe injury and/or death. **THIS IS A MEDICAL EMERGENCY!!**

Signs and Symptoms: Red, hot, dry skin; body temperature of 105 degrees Fahrenheit or higher; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma.

Treatment: Heat stroke is a true medical emergency. Transportation of the victim to a medical facility must not be delayed. Prior to transport, remove as much clothing as possible and wrap the victim in a sheet soaked with water. Fan vigorously while transporting to help reduce body temperature. Apply cold packs, if available; place under the arms, around the neck, or any other place where they can cool large surface blood vessels. If transportation to a medical facility is delayed, reduced body temperature by immersing victim in an ice/water bath (however, be careful not to over chill the victim once body temperature is reduced below 102 degrees Fahrenheit). If this is not possible, keep victim wrapped in a sheet and continuously douse with water and fan.

5. SPECIFIC REQUIREMENTS

5.1 The environmental hazards section of site health and safety plans will address heat stress in the ambient temperature is expected to exceed 65 degrees Fahrenheit.

5.2 The site health and safety plan will discuss work-rest cycles and provisions for monitoring the level of heat stress (i.e., pulse rate).

5.3 Workers are to be advised not to drink caffeinated or alcoholic beverages because they increase the rate of body water loss.

5.4 Increased dietary salt or lightly salted (0.2 percent) water is adequate to replace lost salt. Salt tables are not to be used.

5.5 If juice or electrolyte drinks are used, they should be diluted prior to drinking.

5.6 Thirst is not an adequate indicator of body water loss. Workers are to drink at least small amounts of water on each break.

5.7 Workers are to rest when any of the symptoms described above are present. The buddy system is mandatory, as most often the potential victim will not be aware of any symptoms. Watch out for each other.

ATTACHMENT FF
COLD STRESS

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 22 DATE 9/17/93 PAGE 1 OF 3
SUBJECT Cold Stress	SUPERCEDES APPROVED

COLD STRESS

1. OBJECTIVE

Environmental Quality Management, Inc. (EQ) recognizes that work must be performed in various weather conditions, including cold climates. In order to minimize cold related illnesses, site supervisors are to be aware of the symptoms of an environmental conditions that lead to cold-related illnesses and the appropriate steps to take to prevent their occurrence.

2. PURPOSE

This procedure describes the causes, symptoms, treatment and/or prevention of cold-related illness.

3. GENERAL INFORMATION

3.1 When the temperature of the surrounding air or water are much colder than the worker, the body's physical processes must increase to maintain thermal balance. Shivering is the body's attempt to generate increased heat.

3.2 Shivering, pain and numbness are not trustworthy indicators to cold exposures, because prolonged cold exposure numbs all body sensations.

3.3 Wind-chill temperature is a better means of evaluation as it takes into account the wind's ability to strip heat from the body through convection.

3.4 Protective clothing that is wet with sweat or from rain will cause heat loss through conduction.

3.5 Personnel are at an extreme cold stress hazard when performing spill clean-up in boats in cold weather situations. Falling into cold water can rob dry heat very quickly.

4. COLD INJURY

4.1 **Trench Foot** occurs as a result of extended exposure of the feet to cold and moisture. Capillary walls of the feet are injured, resulting in tingling, itching and pain. Blisters may form followed by ulceration of the skin.

4.2 **Frost-Nip** is localized superficial freezing of extremities such as ears, nose, toes, and fingers. Initially there is a dark bluish color due to bleeding under the skin which at times can become gangrenous. Workers experiencing frost nip are susceptible to future injury and should avoid chilling.

4.3 **Frostbite** occurs when the moisture in the skin actually freezes, forming ice crystals, resulting in the damage of skin cells. The injured area becomes red, then blue/red. A burning pain is noted initially, then pain decreases and numbness sets in. The skin becomes waxy pale in appearance because of lack of oxygen. The ears, nose, toes and fingers are most susceptible. Damaged area can become gangrenous resulting in the loss of tissue, finger tips and toes.

4.4 **Hypothermia** occurs when heat production of the body is not sufficient to replace heat lost to the environment. The results are a lowering of the core body temperature, the pulse rate slows, muscular weakness occurs, mental abilities dull and the workers become uncoordinated. Signs of hypothermia are evident at 95 degrees Fahrenheit body core temperature and consciousness is lost between 89.6 - 86.0 degrees Fahrenheit. At lower core temperatures, cardiac arrest is possible.

Exposure to cold water decreases the body core temperature rapidly and consciousness is quickly lost. Workers on or over water should be acutely aware of the danger of immersion during cold weather.

Hypothermia results in dulling of the senses and could result in poor decision making. Workers that are exposed to extreme cold should not be given tasks that are critical to their health and safety and that of others.

5. PREVENTION

Just as with heat stress, cold stress must be controlled in order to prevent cold related illness. The following are cold stress prevention guide lines.

5.1 **Education** - All personnel will receive training on the cause, symptoms, and most importantly, methods of prevention of cold stress injuries.

5.2 **Clothing** - Prevention of hypothermia and other cold injuries is best accomplished by protecting workers from cold and moisture. Clothing is the most important factor in prevention of injury. Personnel working on land should layer clothing with outer layer being wind and water resistant. The layers should be capable of being vented at wrist, neck and waist to reduce wetting by perspiration. Feet should be kept dry and socks should be changed when they become wet. Gloves which protect the hands from cold but allow freedom of movement are necessary. Never allow bare skin to contact metal surfaces at sub-zero temperatures.

5.3 **Acclimatization** - A limited degree of acclimation can occur from exposure and working in cold environments. Some physiological changes do occur but people also learn how to more effectively protect themselves from temperature extremes.

5.4 **Fluid Replacement** - Cold weather does cause significant water loss as a result of the dryness of the air. Fluid intake should be increased to prevent dehydration which directly affects blood volumes and flow to the extremities. Warm, sweet, caffeine-free, nonalcoholic drinks and soup offer the best fluid replacement and provide caloric energy.

5.5 **Work-Rest Regimes** - When temperatures are less than 20°F (actual or windchill) heated warming shelters should be made available. Workers should use these on a regular basis.

5.6 **Diet** - As with any work in extreme temperatures, personnel will be instructed to eat a well-balanced diet to replace calories burned and provide necessary vitamins and nutrients.

5.7 **Environmental Monitoring** - Regular monitoring of the environment by recording wind speed and actual thermometer readings for comparison to the windchill chart should occur at regular intervals depending on conditions.

5.8 **Prohibited Activities** - Alcohol should not be consumed since it increased blood circulation to the skin and interferes with internal thermostatic control. Alcohol also interferes with mental acuity which can lead to risk taking. Cigarette smoking should be prohibited since the nicotine restricts flow of blood to the extremities.

ATTACHMENT GG
ELECTRICAL SAFETY

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 23
	DATE 9/17/93
	PAGE 1 OF 5
SUBJECT	SUPERCEDES
Electrical Safety	APPROVED EMIC

ELECTRICAL SAFETY

1. OBJECTIVE

Environmental Quality Management, Inc. (EQ) personnel performing work on electrical systems and equipment will follow standards set by the National Electrical Code (NEC) and OSHA in selection of materials and methods of installation and maintenance. Only qualified personnel will work on electrical systems and equipment

2. PURPOSE

This procedure specifies the requirements for electrical equipment and methods and is an overview of the requirements of 29 CFR 1910, Subpart S-Electrical. If work is to be performed on any electrical circuit, lockout/tagout may be required. Refer to the Lockout/Tagout procedure.

3. GENERAL REQUIREMENTS

3.1 No electrical work should be done on an energized circuit.

3.2 Only approved electricians will be permitted to work on electrical equipment or permanent electrical wiring.

3.3 Use proper clearance and grounding procedures. All electrical circuits and equipment shall be de-energized and lockout/tagout accomplished before maintenance or repair work is started.

3.4 Single-phase electric hand tools and other single-phase portable electrical equipment must be approved by a recognized testing agency, and all exposed non-current-carrying metal parts must be grounded, or be double insulated.

3.5 Before each use, portable electrical appliances are to be examined for obvious deficiencies in the appliance, cord, and plug. If any deficiency is noted, the appliance is not to be used.

3.6 Extension cords are to be kept clean, dry, free of kinks, and protected from oil, hot or sharp surfaces, and chemicals. Extension cords used outdoors shall be Ground Fault Circuit Interrupter (GFCI) protected. All extension cords shall be free from damage and are not to be placed across aisles, through doors, through holes in the wall, or in areas where the cord may be damaged or become a tripping hazard. Extension cords must not be placed in walkways, or on stairs or steps where the cords may pose a tripping hazard.

4. PORTABLE ELECTRICAL EQUIPMENT

4.1 Double insulated portable industrial type electric tools meeting the requirements of the Underwriters Laboratory are authorized for use (ground wire not required). Where such a system is employed, the equipment must be distinctly marked.

4.2 Portable electrical tools not provided with special insulating or grounding protection are not intended for use in damp, wet or conductive location (persons standing on the ground or on metal floors).

4.3 All portable electrical appliances and equipment where the non-current carrying metal parts are exposed to contact by personnel shall be grounded by continuous conductor of adequate capacity from the device to a grounded receptacle. The site safety officer shall resolve any question which arises as to whether or not a particular appliance should be grounded.

4.4 Grounding of receptacles shall be accomplished in one of two ways:

- A built-in ground wire of green color may be attached to the ground pole of the receptacle.
- The conduit system, if installed in an approved manner, may be relied upon for grounding of a receptacle serving single phase appliances with ratings up to 230 volts.

4.5 At outside locations all single-phase 15 and 20 ampere receptacles outlets operating at 230 volts or less which are not a part of the permanent wiring of the building or structure must have GFCI for personnel protection. The GFCI should be located at the power source so that all extension cords and tools are protected by the GFCI.

The outlet box for portable extension cords for outdoor use shall be of weatherproof type maintained in good condition.

5. ELECTRICAL GUARDING

5.1 Suitable access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

5.2 The dimension of the working space in the direction of access to energized parts in switchboards, control panels, fused switches, circuit breakers, panel boards, motor controllers, and similar equipment which require examination, adjustment, servicing, or maintenance while energized, shall not be less than 36" deep (30" for installations built prior to 1981) and the side being 30" or the width of the equipment, whichever is greater.

5.3 The working space shall not be used for storage purposes. The "keep clear" area may be identified with suitable floor markings and/or posting of signs or decals on the equipment

5.4 Energized parts of electrical equipment operating at 50 volts or more shall be guarded against accidental contact by the use of approved cabinets or enclosures.

5.5 Entrance to rooms and other guarded location containing exposed energized parts shall be marked with a conspicuous warning sign forbidding unqualified persons to enter.

5.6 Temporary covers, warning signs, and/or barricades are to be used when it is necessary to remove covers of electrical panels during construction, major refurbishment, or for the purpose of providing temporary power to an area.

5.7 All openings in boxes, enclosures, or fittings shall be effectively guarded or closed to afford protection substantially equivalent to that of the wall of the box, enclosure, or fitting.

5.8 All electrical components over 230 volts shall have signs stating "High Voltage" 240 volts.

6. EXTENSION CORD REQUIREMENTS

6.1 Extension cords are designed for and will be used for TEMPORARY USE ONLY! All other electrical connections will be made permanent by proper construction methods.

6.2 Use of indoor extension cords greater than 50 feet in length is to be discouraged. All extension cords shall include a grounding conductor within the cable jacket and shall be equipped at each end with either explosion-proof or non-explosion-proof three-wire, grounded receptacles and plugs (but not with one of each), depending on the location and intended use. (No "hybrid", ungrounded or external ground wire extension cords are allowed.)

6.3 If a cord is damaged, it shall be shortened or replaced by an electrician - never patched with electrical tape.

6.4 Cords shall be protected against contact with oil, hot surfaces and chemicals.

6.5 Cords must not be hung over nails or other sharp edges or placed where vehicles may run over them.

7. ELECTRICAL FUSE REQUIREMENTS

7.1 Circuits must be de-energized by lockout and tagout procedures before attempting to replace fuses.

7.2 Bridging of fuses or circumventing the normal operation of circuit breakers is prohibited.

7.3 Blown fuses shall not be replaced with fuses having a higher amperage or voltage rating. Fuses should be replaced in kind to maintain proper circuit protection.

7.4 Use a fuse puller to remove fuses.

8. ASSURED ELECTRICAL GROUNDING REQUIREMENTS

8.1 This program provides the minimum requirements for an assured equipment grounding conductor program and reflects the requirements of 29 CFR 1910.304. It also applies to circuits and equipment not attached to a permanent building or structure.

8.2 EQ and its contractors will implement either a written assured equipment grounding conductor program or use GFCI's when using temporary wiring (cords and plugs) in field work using any temporary electrical power source.

8.3 Cords and equipment will be inspected prior to each use for damage or missing parts. Equipment which is found to be defective will be taken out of service and repaired.

8.4 The Assured Equipment Grounding Conductor Program will include the following:

- The written program.
- Designation of a competent person(s) to implement the program.
- Visual inspection of cords on a daily basis for deformed and missing pins, insulation damage, and indications of possible internal damage. Equipment found damaged or defective will be removed from service and repaired or expended.
- Cords and electrical circuits will be tested for the following:
  - Electrical grounding continuity
  - Correct attachment of grounding conductor
- Tests outlined above shall be performed before the first use, before being returned to use after repair, after possible damage (such as being run over by a vehicle), and at least every three months.
- The tests outlined above must be recorded and cords which have been tested identified.

ATTACHMENT HH
FIRE PREVENTION AND PROTECTION

STANDARD PROCEDURE	PROCEDURE NO. 25
	DATE 9/17/93
	PAGE 1 OF 3
SUBJECT	SUPERCEDES
Fire Prevention and Protection	APPROVED EWK

FIRE FIGHTING PLAN

1. INTRODUCTION

This Fire Fighting Plan has been prepared in accordance with applicable federal, state, and local regulations.

2. FIRE EMERGENCY

Because of the possible presence of flammable materials at a site, fire is an ever-present hazard. EQ personnel are not trained, professional firefighters. If there is any doubt that a fire can be quickly contained and extinguished, personnel are to sound the fire alarm and vacate the structure or area. The alarm is a 30-second blast on an air horn. The following procedures will be used in the event of a fire.

2.1 General Provisions

The following procedures should be followed in the event of a fire at any project.

- Anyone who sees a fire shall sound the alarm. The alarm is a 30-second blast on an air horn.
- Work crews shall be comprised of pairs of workers. Workers shall leave the work site with their respective "buddies" immediately after hearing the fire alarm.
- In the event of a small fire that the worker extinguishes, the on-scene safety official is to be summoned and is to be notified. All fires must be reported to the HSO.
- On hearing the general alarm, the workers are to disconnect any electrical equipment in use (if possible), turn off combustion engines, and proceed to the nearest fire exist egress point.

- Before workers being operations in an area and on a daily basis, the HSO will give instructions on egress procedures and assembly points.

EMERGENCY CONTACTS

Ambulance	911
Police	911
Fire	911
Hospital	Site Specific
Chemical-Oil Spills Cleanup	800-424-8802
National Response Center	202-462-2657
Chemtrec	800-424-9300

Representative

2.2 Small Fires

A small fire is defined as a fire that can be extinguished with a 20 lb. ABC type fire extinguisher. The following minimum procedure should be followed for small fires:

- Evacuate all necessary personnel to an upwind location if possible;
- Attempt to extinguish the fire with fire extinguisher or by smothering;
- Level B PPE will be donned by individuals designated by the on site manager and these individuals will relieve the first individual in fighting the fire.
- Emergency assistance should be requested by the site safety officer as needed (ambulance, fire department, poison control center, etc.) for injury or exposure; and
- Notify HSO of incident.

2.3 Large Fires

A large fire is one that cannot be extinguished by means outlined in Section 2.1. The same minimum action should be taken as in the event of small fire; however, contact, interaction, and cooperation with outside agencies (fire department) is crucial.

2.4 Individual Roles

Site Manager:

1. Designate individuals to don level B PPE and assist or relieve individual(s) who discovered the fire.
2. Clear the area.
3. Notify site safety officer.

Site Safety Officer:

1. Notify safety representative of the fire.
2. Call for emergency help.
3. Instruct individuals on egress areas and assembly points.

Individual who discovers fire:

1. Sound fire alarm.
2. Attempt to extinguish fire until relieved by individuals in level B PPE.
3. Do not attempt to put out a fire that is too large. In this case immediately notify the HSO to summon emergency help.

ATTACHMENT II
LOCKOUT/TAGOUT

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 29 DATE 9/17/93 PAGE 1 OF 10
SUBJECT Lockout/Tagout Procedure	SUPERCEDES APPROVED

LOCKOUT PROCEDURE

1. PURPOSE

The purpose of this procedure is to establish and maintain a program of electrical and mechanical lockouts. It specifically covers the recommended lockout procedures for electrical, mechanical, and piping equipment. Its intent is to ensure the safety of all employees and others working on electrical and mechanical equipment for the purposes of installation, maintenance, cleanout, adjustment, repair, or modification.

2. ADMINISTRATION

The Project Manager is responsible for the establishment and implementation of proper lockout procedures at EQ job sites. The Project Manager and field supervisors are responsible for enforcing the various sections of the lockout procedures and for effectively training employees in the requirements of the procedures.

All employees are responsible for complying with the requirements of the established procedure.

Hardware - Special padlocks and DANGER tags used for lockout purposes shall be issued by the Project Manager. These padlocks and tags are the only type authorized for use in locking out energy sources and shall be used for no other purpose. Each padlock and key issued will have a unique identification number. A record of individuals who have been assigned lockout padlocks shall be maintained by the Project Manager.

Each padlock shall be keyed individually.

Annual Audits - The Supervisor, Project Manager and H&S Profession shall conduct audits to ensure that this lockout procedure is being properly implemented. The written results of these audits shall identify the machine or equipment inspected, the date inspected and the name of the person performing the audit.

3. REFERENCES

A. OSHA Rule 29 CFR 1910.147, "Control of Hazardous Energy Sources (Lockout/Tagout)."

B. "Safety Requirements for the Lockout/Tagout of Energy Sources," ANSI Z44.1-1982.

4. PROCEDURE

A. General - The following procedures apply to both electrically energized equipment and mechanical lockouts.

1. A survey shall be made to identify all energy sources to be certain which switch, valve, or other energy-isolating devices apply to the equipment to be locked out. More than one energy source (electrical, mechanical, or other) may be involved. Questionable energy source problems shall be resolved before job authorization is obtained and lockout commences.

2. All energy-isolating devices, including electrical disconnect switches and valves, shall be labeled to identify the equipment supplied and the type and magnitude of energy controlled.

3. All affected employees shall be notified that a lockout is required and why.

4. If the equipment is operating, normal procedures shall be used to shut it down (stop button pressed, toggle switch opened, gate valve closed, etc.).

5. Stored energy (such as that in capacitors; springs, elevated machine parts; rotating flywheels; hydraulic systems; and air, gas, steam, and water pressure) must be dissipated or restrained by methods such as grounding, repositioning, blocking, bleeding down, etc.

6. All equipment must be de-energized and lockout out at the source of energy (starter, field disconnect) for that particular piece of equipment before any work is performed on it. For electrically energized equipment, the "source" means the main electrical wires providing power to that piece of equipment. Lockouts must be performed on approved safety switch disconnects. (Push buttons and toggle switches are not considered approved.) Note: Before

any equipment is de-energized, all push buttons or toggle switches must be OFF to eliminate any hazards.

7. DANGER tags shall be used to identify the person(s) locking out a piece of equipment. Every person working on a piece of equipment or assisting with such work must lock it out before performing that work. See Attachment 1 for Danger tags.

8. The key to any lock being used must be kept on the person performing the lockout.

9. No person should attempt to remove any lock from any locked-out equipment without the agreement of the persons who have locked out such equipment. In the event the persons who have locked out the equipment have left the facility or job site, a supervisor may authorize removal of the lock(s) after ensuring that such removal will not endanger any employee or the equipment.

10. Each lockout performed on electrically energized equipment shall include the following steps (see Figure 1):

    a. Notify - All affected employees shall be notified that a lockout is required and reason why.

    b. Lockout - Switch shall be locked in the off position with an assigned individual lock.

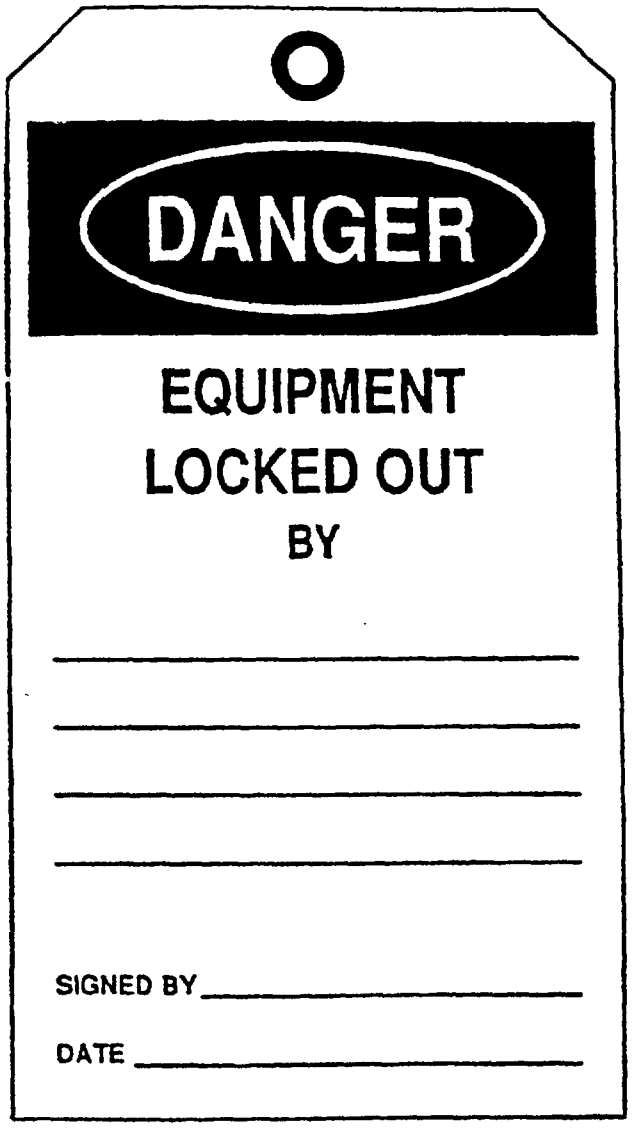
    c. Tag - Each lock shall be identified with a tag on which the performing the lockout records his or her name and the date.

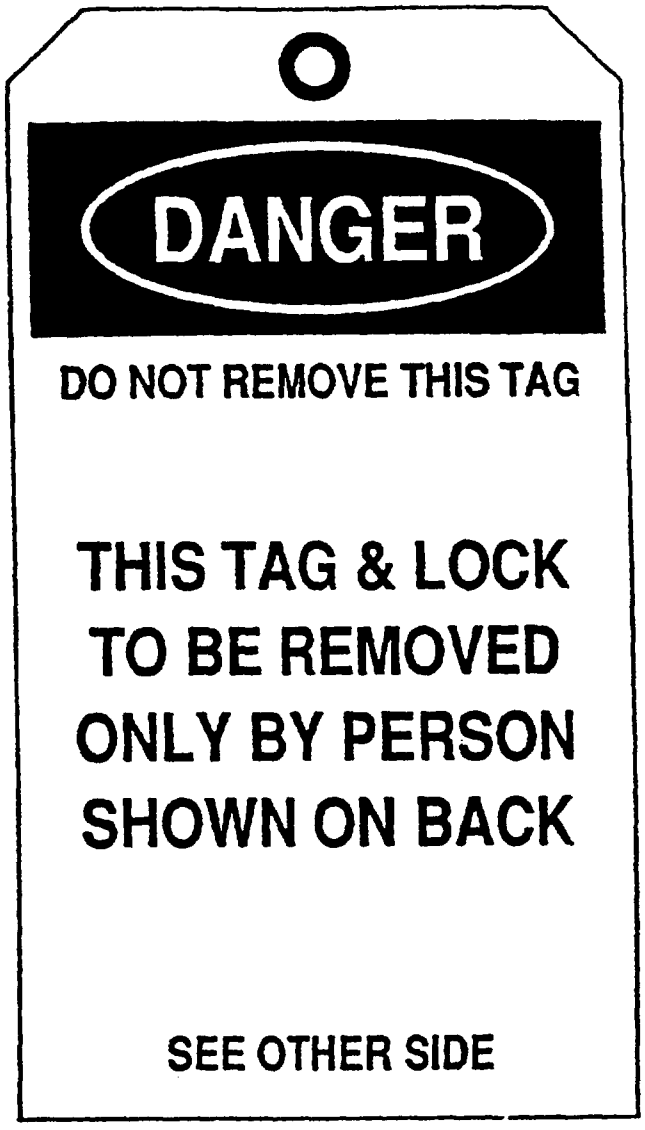
    d. Clear - The person performing the lockout will visually observe that the equipment is clear of persons and things.

    e. Try - The start switch shall be tried to ensure that the equipment has in fact been de-energized. If the system has multiple start switches, all start switches shall be tried.

    f. Stored energy - Dissipate, bleed off or restrain energy stored in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems.

    g. Keys - The key(s) to the lock(s) shall be kept by the person performing the lockout at all times when working on equipment.





Attachment 1

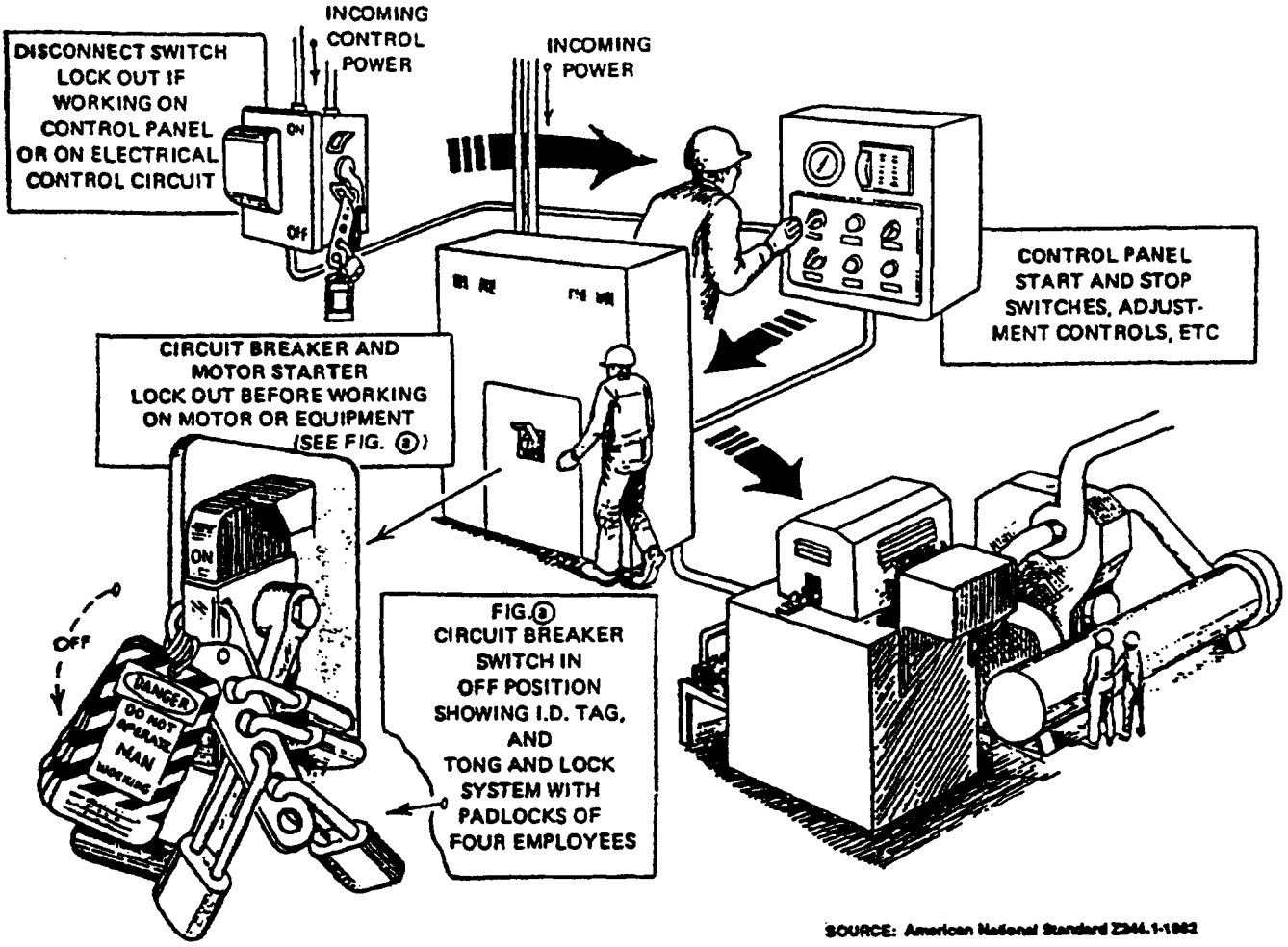


Figure 1. Lockout/Tagout Procedure for Electrical Energy Source

11. Some equipment, because of its nature or function, cannot be locked out in the preceding manner. Such equipment shall be de-energized in accordance with References A and B and agreed upon by all parties involved.

12. Before energy is restored to the equipment/process, an authorized individual shall:

    a. Visually inspect the work area to ensure that tools and equipment have been removed and the unit is ready to operated.

    b. Conduct a head count or otherwise ensure that all personnel are in the clear.

    c. See that each individual lock be removed from each energy isolating device by the person who applied the lock. Exceptions are allowed only as described in Paragraph 9.

B. Mechanical Lockouts

1. All nonelectrical equipment that requires lockout will be locked out in a manner appropriate for that piece of equipment. For example, gate valves shall be chained and locked in a manner that will prevent them from being opened or closed, depending on the requirements (see Figure 2).

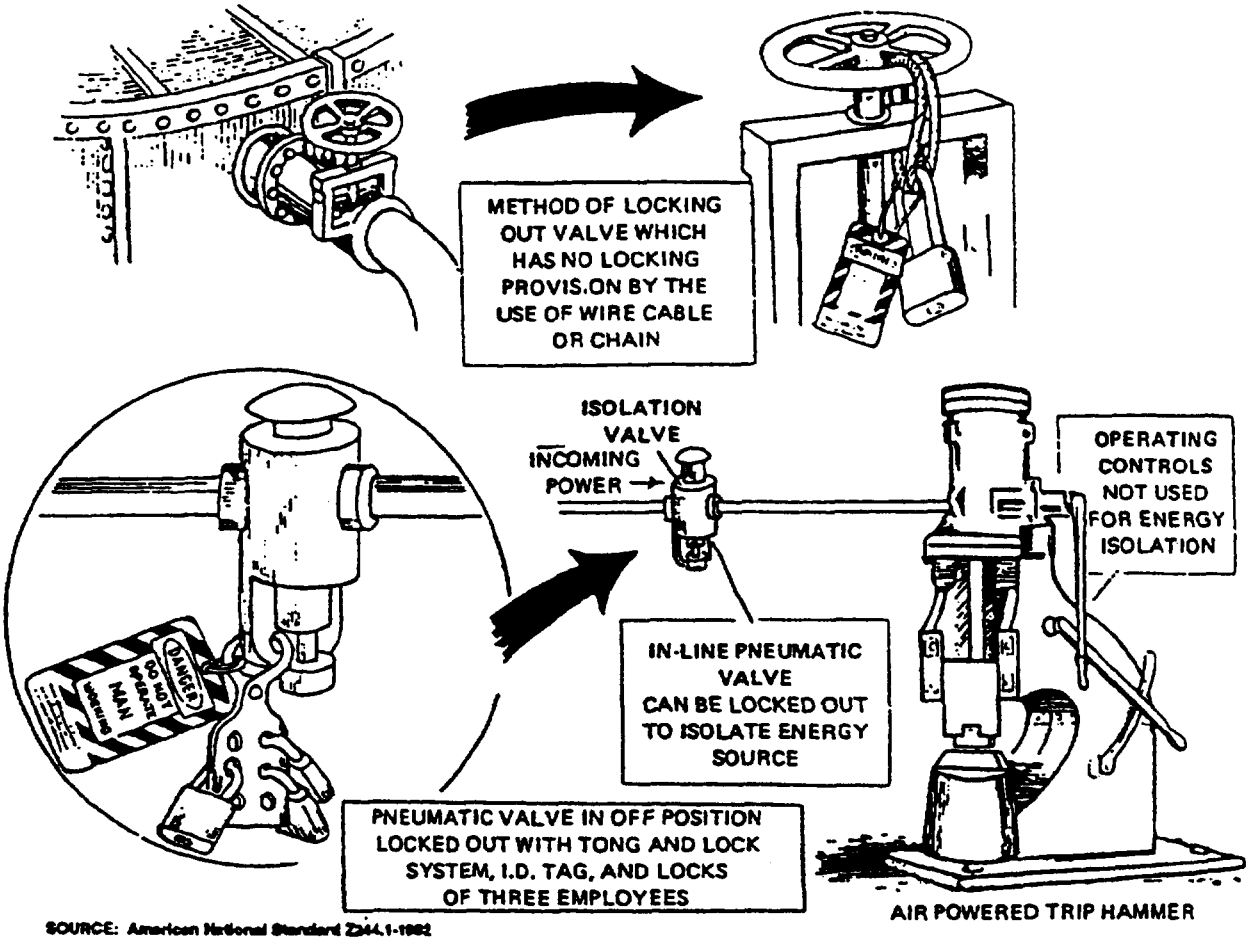
2. When entry into tanks or vessels is required, lines into that vessel shall be secured as follows:

    a. All lines to vessel shall be disconnected, blanked, or blind-flanged.

    b. A list of blanks, disconnections, and/or blind flanges shall be maintained as part of the vessel entry permit.

    Note: A confined-space entry permit must be obtained, and all requirements of the confined-space entry procedure shall be met.

3. Where double block-and-billed systems have been installed (see Figure 3), these valves shall be used and posted with DANGER tags, as stated in Section IV.A.7. Where some question exists regarding the integrity of tagged valves, locks shall be employed to ensure the inoperatability of these valves.



SOURCE: American National Standard Z244.1-1982

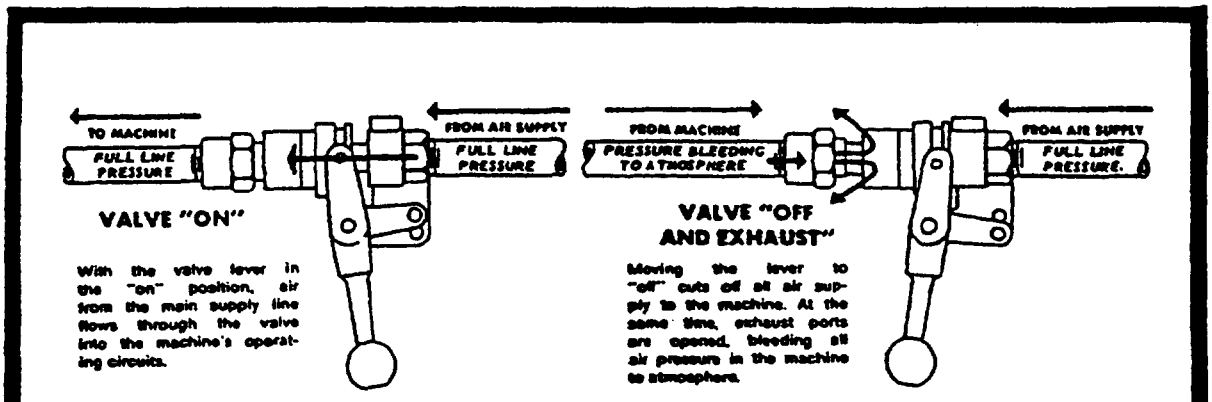


FIG. 25-35.—One type of automatic bleeder valve that helps prevent an accidental stroke by bleeding off residual pressure. Valve can be locked in either "on" or "off" position.

SOURCE: National Safety Council Accident Prevention Manual for Industrial Operations-1988

Figure 2. Lockout/Tagout Procedure for Hydraulic-Pneumatic Energy Source

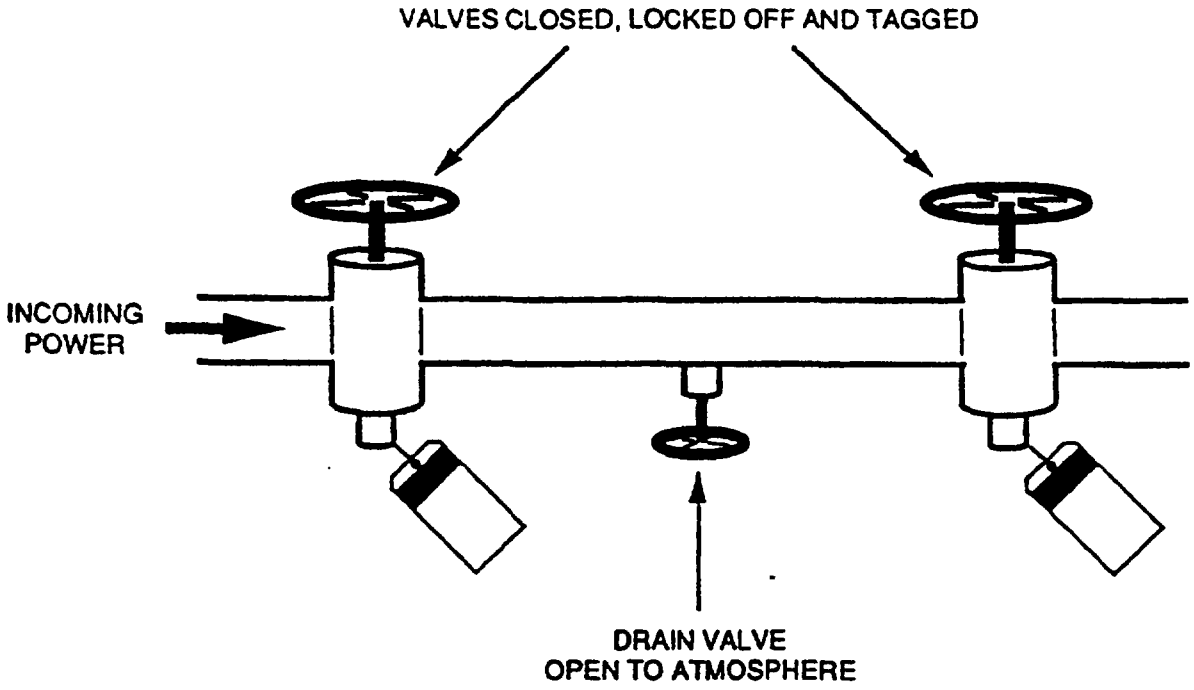


Figure 3. Double Block and Bleed System

4. If necessary, mechanical devices such as agitators, types, and pumps shall be mechanically disconnected from the system to ensure the safety of individuals working on the equipment.

C. Procedure Involving More Than One Person

1. In the preceding sections, if more than one individual is required to lock out equipment, each shall place his or her own personal lock on the energy-isolating device(s).

2. One designated person of a work crew, or a supervisor with the knowledge of the crew, may lock out equipment for the whole crew. It is the responsibility of the designated person to carry out all steps of the lockout procedure and to inform the crew when it is safe to work on the equipment. In addition, this designated person shall not remove a crew lock until it has been verified that all individuals and tools are in the clear. Refer to Section IV.A.12.

3. If equipment will be locked out for more than one shift, the individual or work crew leader from the preceding shift shall notify the individual or work crew leader on the following shift, of the work status and lockout requirements of the job before removing the preceding shifts' padlock. The following shift's personnel shall be responsible for applying necessary lockouts for the shift.

D. Outside Contractors

Whenever outside personnel may be affected by, or perform activities covered by this procedure, these personnel shall be notified of this Lockout Procedure. In addition, Lockout procedures used by other contractors shall be compatible with the Lockout Procedure contained herein. The Project Manager is responsible for notifying outside contractors of these requirements.

E. The opening of motor control center (MCC) panels, disconnect switches, line starters, or any other electrical enclosures by anyone other than qualified personnel is prohibited. The Project Manger will determine those individuals qualified to open electrical enclosures.

F. Training - All employees, supervisors, and management whose job activities may include or be affected by the use of a lockout to control hazardous energy sources shall receive initial training on proper implementation of this procedure. Followup training in all aspects of the lockout procedure will be administered by foremen on an annual basis.

Written training records, which includes employee's name and training date, shall be maintained by the Health, Safety and Training Department.

5. REVIEW AND REVISION

This procedure will be reviewed triannually and revised as needed.

ATTACHMENT JJ
WELDING/CUTTING/GRINDING

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

STANDARD PROCEDURE	PROCEDURE NO. 30 DATE 9/17/93 PAGE 1 OF 9
SUBJECT Welding/Cutting/Grinding	SUPERCEDES APPROVED

USE OF MECHANICAL AND FLAME CUTTING EQUIPMENT

Hot work (i.e., welding, metal cutting, etc.) can be hazardous as an ignition source and as a source of airborne contaminants. The latter is especially true when cutting on painted and/or contaminated metal. Any hot work that would take place near flammable materials in tanks or in a confined space can present an explosion hazard. Cutting equipment and compressed gas cylinders present potential physical, electrical, tripping, and flammable hazards such as welding flash and welding burns.

CONTROLS:

- All hot work shall be performed in accordance with Hot Work Procedure.
- No hot work shall be performed without a Hot Work Permit.
- The area where hot work shall be performed shall be inspected by a qualified person recognized by EQ. This qualified person shall issue a Hot Work Permit.
- Cutting, welding, or other operations that produce excessive heat, open sparks, or flames will not be permitted within 100 feet of a potential liquid fuel source.
- Sacrificial anodes, if used, will be attached using a cold method.
- Two 10-pound or more ABC multipurpose dry chemical fire extinguishers will be available in the immediate vicinity of hot work.

1 SCOPE

1.1 This specification defines the minimum requirements for welders, welding operators, welding procedure qualification, production welding and inspection thereof associated with the welding of structural steel for process tanks, vessels, stacks, skids, access platforms, supports and other such structures produced in EQ shops, at a supplier's fabrication facility, a contractor's facility, or at the installation site. This specification also governs the welding of piping for non-pressure applications (i.e., drains, etc.) not otherwise covered. It does not cover code stamped pressure vessels.

2. CODES AND STANDARDS

The following codes (latest edition) shall be considered as part of this specification. In the event of conflicting statements, this specification shall govern.

2.1 American Institute of Steel Construction (AISC):

- Specification for the design, fabrication, and erection of structural steel for buildings.

2.2 American Welding Society (AWS)

D1.1 Structural Welding Code - Steel
A2.4 Symbols for Welding and Nondestructive Testing

2.3 American Society for Testing Materials (ASTM):

E114 Recommended Practice for Ultrasonic Testing by the Reflection Method Using Longitudinal Waves Induced by Direct Contact

E164 Ultrasonic Contract Inspection of Weldments

E274 Ultrasonic Inspection of Longitudinal and Spiral Welds of Welded Pipe and Tubing

2.4 American Society of Nondestructive Testing (SNT):

TC-1A Nondestructive Testing Personnel Qualification and Certification

3. MATERIAL

3.1 Electrodes, Welding Wire, and Flux

3.1.1 Welding materials shall conform with Section 4 of ASW

D1.1, Paragraph 1.4.5 of the AISC Specification, and shall be certified by the manufacturer as meeting the requirements of the classification.

3.1.2 Welding material shall be selected in accordance with the cited criteria as appropriate to the steel alloys, positions, methods and conditions prevailing for the intended use. All welding materials shall be such as will best develop the full stresses and equivalent characteristics of the respective steel sections being worked.

3.1.3 Manual arc-welding electrodes shall conform to AWS-ASTM Classifications E-XX10, E-XX11, E-XX15, E-XX18 and shall be suitable for the position and conditions of their intended use. In general, root and stringer pass welds shall be deposited with E-60XX electrodes and all other passes shall be made with E-70XX electrodes.

3.1.4 Welding electrodes which are not readily identifiable or on which the flux has been damaged, or which are otherwise of questionable acceptability shall not be used.

3.1.5 Flux for submerged arc welding shall be the neutral type in accordance with the manufacturer's recommendations regarding temperature and humidity limitations. Flux shall be screened and filtered before reuse.

3.1.6 Welding materials shall be handled, shipped and stored in a manner that will prevent contamination or other damage. The temperature and humidity conditions of storage shall comply with the manufacturer's recommendations.

3.1.7 Welding materials shall be identifiable by means of its original color coding or factory labeling until the time of use.

3.2 Inspection of Welding Materials

3.2.1 All welding materials provided shall be subject to inspection by an EQ Representative either at the mill, shop, and/or other work sites.

3.2.2 Inspection at the mill, shop, and/or fabrication sites will not relieve the EQ shop or the Contractor of the responsibility of furnishing welding materials which satisfy specification requirements. In the

event materials do not conform to the requirements of these specifications, such materials shall not be used on this project. Regardless, non-conforming materials may be rejected at any time.

4. QUALIFICATION

4.1 Procedure

4.1.1 It shall be the responsibility of the EQ shop or the Contractor to formulate and physically qualify welding procedures for each of the welding processes to be used for structural purposes. Welding preparation, procedures and practices shall be qualified in accordance with AWS D1.1, Section 5 except as modified by this specification.

4.1.2 In the event the EQ shop or the Contractor have specified welding procedures previously qualified by testing, then such test material and test results may be evaluated in relation to materials and welding processes for this work and if satisfactory, may be accepted as qualified to the requirements of this specification.

4.1.3 Prior to commencing welding work, Contractors shall submit proposed welding procedures to EQ for approval. The documentation for each procedure shall contain, but not be limited to, welding process, material classification and thickness, filler material, machine settings (voltage and amperage), applicable positions, precleaning, joint preparation and fitup, preheating, back gouging, and standard test results.

4.1.4 It shall be clearly understood that approval of welding procedures, prequalified or otherwise, shall not relieve the Contractor of his responsibility to produce the quality of welding necessary to satisfy all aspects of this specification.

4.2. Welders and Welding Operators

4.2.1. All welders and welding operators for this work shall be tested and qualified in accordance with AWS D1.1, Section 5, Parts C and D (except as modified by these specifications), for the welding of the respective steel forms and alloys or types and classifications specified for use in the project. Welders and welding operators shall be considered qualified by satisfactorily completing the appropriate test delineated by AWS D1.1, Section 5 for the type of weldment and grade of steel they are employed to weld except

that previous qualification in the required classifications in accordance with AWS D1.1, Section 5 will be acceptable as required qualification. Welders qualified to weld only part of materials utilized shall be restricted to welding only that portion of the work for which they are qualified. Welders not passing the tests are disqualified as welders on the project.

4.2.2 The contract shall provide equipment and materials for the welder qualification tests and shall bear all costs for the cutting, machining, and testing of test specimens.

4.2.3 Material for use in testing shall be of the same type and grade as that to be used on the project for which the welder is being qualified.

4.2.4 Welder and welding operator qualification tests shall be conducted prior to the performance of any production welding which will be a permanent part of the work. Qualification test records shall be submitted to EQ for approval before the welder is permitted to work on the project.

4.2.5 The decision of the EQ Representative regarding the qualification of any welder shall be final. EQ retains the right to require retesting of any welder or welding operator at anytime.

4.2.6 Each qualified welder shall be assigned a symbol, and a record shall be kept of these symbols by the Contractor. A copy of the symbol record shall be submitted to the EQ representative. For non-pressure applications, each welder shall stamp his weld on this symbol.

5. PRODUCTION WELDING

Production welding encompasses all welding which is to form a permanent part of the work and shall conform to both the AISC and AWS D1.1 Specifications except that this specification shall complement and/or govern in the event of a conflict.

5.1 Welders

5.1.1 Production welding shall be performed by qualified welders. Each welder shall identify his weld with his symbol and shall place his symbol on the weld preferably by the ending crater.

5.1.2 Welders found to be producing unsatisfactory work even though having passed qualification tests shall be immediately recertified or replace with a qualified welder.

5.2 Materials and Equipment

5.2.1 Welding electrodes and rods shall be suitable for the position and conditions of their intended use and shall be dispensed for use in small quantities.

5.2.2 All arc-welding shall be accomplished with welding machines capable of developing a minimum current at the electrode of 300 amperes. All welding equipment shall be in good condition and subject to inspection and approval by EQ. Any equipment found defective or in need of repairs shall be rejected until corrective measures have been taken.

5.3 Welding

5.3.1 Welds shall conform to the symbols shown on the project drawings.

5.3.2 Shearing, flame cutting, beveling and chipping shall be done carefully and accurately. Whenever possible, this work shall be done with automated or mechanically guided tools. All edges shall be left free of slag and deep scars and gouges. Any beveled edge that has been damaged shall be restored to the minimum acceptable tolerance prior to its incorporation into the structure.

5.3.3 Preheating of base metal prior to welding shall be in accordance with AWS D1.1, Section 4. Such heating should be accomplished by devices which produce uniform heating of all the critical zones around the entire weld area.

5.3.4 Welds shall not be cooled by quenching or by any means other than natural convection by air.

5.3.5 Welds shall not be coated before they have been inspected and accepted.

6. INSPECTION OF PRODUCTION WELDING

6.1 Contractor's Responsibilities

6.1.1 The mandatory inspections specified herein shall be made at the Contractor's expense using personnel, equipment and facilities provided by the Contractor.,

6.1.2 Prior to the inspection of the work, the Contractor shall clean the working area sufficiently to allow proper access to the work. The Contractor shall furnish, install and maintain in a safe operating condition, the necessary scaffolding, ladders, walkways, lighting, etc., to allow for a safe and thorough inspection.

6.1.3 The Contractor shall adequately clean all major welds of slag, spatter, dirt, grease, oil and loose scale to aid in the visual inspection of those welds. If ultrasonic testing is required, the welds shall be brush blasted. The surface condition for properly applied welds should be adequate for proper interpretation of test results; therefore, any additional preparation of surfaces necessary, prior to instituting specific non-destructive mediums, will be provided by the Contractor at his expense.

6.1.4 Technicians engaged in non-destructive test activities shall have reasonable access to the fabricating facility in general and area of testing in particular. The Contractor shall not intentionally interfere with testing activities and shall allow adequate time for proper inspection.

6.1.5 EQ shop and supervisory personnel are responsible for complying with the intent of this section. EQ will cover the costs associated with complying with this section for work performed by EQ employees in EQ shops.

6.2 Weld Inspection

6.2.1 All welding shall be visually inspected. Visual inspection shall be made while the operators are making the welds and again after the work is completed. After the welding is completed and the welds thoroughly cleaned, the welds shall be inspected with magnifiers under strong adequate light for surface cracking, porosity, entrapped slag, excessive roughness, unfilled craters, gas pockets, undercuts, overlaps, insufficient weld size and excessive concavity or convexity.

6.2.2 All welds vital to the strength and integrity of the structure are defined as "critical welds" and shall be subject to further examination by means other than visual. Welds designated as critical shall include the following:

- Splices in primary structural members.
- Primarily structural joints shown with full penetration welds on the project drawings.
- Lifting eyes.

6.2.3 Critical welds shall be spot tested over twenty percent of their length using ultrasonic methods and rejection criteria outlined in AWS D1.1. When spot testing reveals indication of flaws requiring repair, additional testing shall be done in accordance with paragraph 6.14.4 of the AWS Specification. An EQ Representative may require confirmation of welds in question using radiographic methods.

6.2.4 Inspection records shall be maintained by the EQ shop, Contractors must submit their inspection records to an EQ Representative for review. EQ retains the right to determine the acceptability of any weld. Interpretation of test results will be in accordance with the guidelines set forth in the referenced standards.

6.2.5 EQ shall have the right to examine the work at any time.

6.2.6 The EQ Representative shall have the right to require inspection of any weld (not previously accepted) by either non-destructive or destructive methods to verify the structural integrity of any welded portion of the structure. This optional inspection can be for the purpose of routine quality control or to further investigate apparent defects detected visually. Defective welds found during optional inspections shall be at the Contractor's expense. Welds found to be satisfactory shall be repaired and the cost of removal and repairs be at EQ expense under the provisions of "Extra Work" clause in the contract. EQ shall not be held liable for loss of time during these tests.

6.2.7 It shall be clearly understood that acceptance of welds shall not relieve the Contractor of the responsibility for satisfactory construction of all work in accordance with the contract requirements.

6.3. Inspection Standards

Welds shall be inspected in accordance with the weld quality and standards of acceptance as follows:

6.3.1 Radiographic film shall be made and interpreted under the rules of AWS D1.1, Sections 6 and 10.

6.3.2 The ultrasonic testing shall conform to AWS D1.1, Sections 6 and 8, ASTM E11, E1164, and E273. (Note: This statement supersedes the second sentence of Paragraph 6.13.1 of AWS D1.1).

6.3.3 Visual or gauge checked welds shall conform to AWS D1.1 Paragraph 8.15.

7. DEFECTIVE WELDS

7.1 Corrective Action

7.1.1 Weld areas containing defects exceeding the standard of acceptance in AWS D1.1, Sections 6 and 10 as revealed by radiographs of the repaired areas shall be repaired at Contractor's expense. If 20 percent or more of the radiographs of welds made by a given welder contain defects requiring repair, 100 percent radiographic inspection of that welders work shall be required at Contractor's expense.

7.1.2 Weld areas containing defects exceeding the standards of acceptance in AWS D1.1, Sections 6 and 8 as revealed by ultrasonic testing shall be repaired.

7.1.3 Weld areas containing defects defined by the standards of acceptance for visual inspection in AWS D1.1, Section 8.15 shall be repaired unless otherwise advised by EQ's Representative.

7.1.4 Repairs defects shall be inspected by the same criterion used for the original inspection.

7.2 Notification

The EQ Representative shall be notified before repairs are made on defective material and/or welds. Repairs made without reasonable notice shall be subject to any form of testing (both destructive and nondestructive) to assure adequate repair and all removal, repair, and retesting deemed necessary by EQ shall be at the Contractor's expense.

7.3 EQ shop and supervisory personnel are responsible for complying with the intent of this section for all work performed in EQ shop by EQ employees.

EQ

No. _____

HOT WORK PERMIT

This permit must be completed and authorized prior to commencing hot work in any area not specifically designated for hot work. This permit must be displayed in the permitted work area while hot work is performed and is void 30 minutes after work ceases or at shift's end, which ever comes first. Once this permit is expired it must be returned to the Safety Representative or Safety Files.

Permit issued to: _____, Start time: _____AM/PM, for this date only: _____ 19 _____

Project site/location: _____

Work to be performed: ___ welding; ___ cutting;___ grinding; ___ hot equipment operation; describe - _____

_____

PRE-WORK CHECKLIST

	Yes	or N/A
1. Operations/site personnel are informed of work to be performed.	___	___
2. Project personnel are trained/debriefed in work to be performed.	___	___
3. All required PPE (i.e. flame retardant clothing, tinted eye protection, etc.) is available (Type: _____).	___	___
4. All necessary portable fire extinguishers are provided (Type: _____).	___	___
5. All existing fire suppression systems are operable (Type: _____).	___	___
6. A Fire Watch, which will remain for 30 minutes after hot work ends, is established.	___	___
7. Surrounding equipment and operations are safe for hot work.	___	___
8. Manholes, basins, and other floor/wall openings are covered.	___	___
9. Combustible items within 35 feet of hot work area have been removed or are otherwise covered with wetted tarpaulins or fire curtains.	___	___
10. Open vessels or lines within 35 feet of hot work are protected.	___	___
11. All necessary grounding/bonding wire is in place.	___	___
12. Energized utilities are locked and tagged out.	___	___
13. All tanks/lines/valves are disconnected, blanked, or locked out.	___	___
14. Equipment and all attached piping has been cleaned and purged (with: Water, Steam, Inert Gas, or Air).	___	___
15. Flammable dusts, vapors, liquids, and residues have been removed.	___	___
16. Flammable gases ≥ 10% of LEL have been purged.	___	___
17. All requirements for Confined Space Entry have been met.	___	___

Completed by: _____ Date: _____

ATMOSPHERIC TESTING RESULTS

Testing frequency: initial and ___ continuous, or ___ periodic (every _____ min.); ___ Atmospheric testing is not required.

Exact Test Location:	Time	% LEL	% Oxygen	OTHERS		Tester's Initials

(Space is provided on the back of this form for additional results)

Special Instructions: _____

_____

Local Emergency Response/Fire Department Phone Number: _____

Work Area Inspected
d Permit Issued by: _____ Date: _____
(Signature)

Safety Rep.
Authorization: _____ Date: _____
(Signature)

EQ Form HWP 12/94

ATMOSPHERIC TESTING RESULTS (CONTINUED)

Exact Test Location:	Time	% LEL	% Oxygen	OTHERS		Tester's Initials

ATTACHMENT KK
ASBESTOS SAMPLING, AIR AND BULK

Environmental Quality Management

Standard Operating Procedure

Title: Asbestos Air Sampling		**Document No. AAS-01**
Date of Issue: April 17, 1995	**Revision No. 00**	**Page 1 of 10**
Approval J. Kominsky	**Approval** JA Fields	

1.0 OVERVIEW

1.1 The purpose of this procedure is describe the method for the collection of personal and area air samples for asbestos analysis.

1.2 This SOP is applicable for (1) occupational exposure measurements; (2) abatement clearance testing; (3) abatement surveillance; (4) building surveillance; and (5) ambient outdoor air measurements.

1.3 This SOP provides information on the proper equipment and techniques for completing the subject procedure.

1.4 Review of this information contained within facilitates the collection of air samples for asbestos analysis. This is accomplished by providing reference documents, general information, definitions, responsibilities, standard procedures, equipment and supporting data.

2.0 RELATED DOCUMENTS

2.1 For rules and regulations regarding asbestos air monitoring in schools, refer to the Asbestos Hazard Emergency Response Act (EPA 40 CFR Part 763, Vol. 52, No. 210, October 30, 1987). For detailed information on current occupational exposure standards, refer to 59 FR 40964, August 10, 1994, Occupational Safety and Health Administration's Final Rules for Asbestos Exposure in General Industry (29 CFR Part 1910) and Construction (29 CFR Part 1915), and Shipyard Employment (29 CFR Part 1926). For general information on asbestos air monitoring in buildings, refer to "A Guide to Monitoring Airborne Asbestos in Buildings" (D.L. Keyes, J. Chesson, 1989, Environmental Sciences, Inc., 105 East Speedway Blvd., Tucson, AZ 85705). For guidance intended for use in

the Superfund Removal Program, refer to EPA's "Compendium of ERT Air Sampling Procedures" (PB92-963406, Publication 9360.4-05, May 1992).

3.0 GENERAL INFORMATION

3.1 Air is sampled by drawing a measured volume of air through a filter designed to collect asbestos fibers. The fibers are detected and counted by viewing a portion of the filter through a microscope - either a light microscope or an electron microscope.

3.2 Phase contrast microscopy (PCM) and transmission electron microscopy (TEM) are the recommended (or required) microscopy methods.

3.3 PCM analysis does not distinguish between asbestos and nonasbestos fibers and only detects fibers that are longer than 5 micrometers (µm) in length and that have an aspect ratio of at least 3:1.

3.4 TEM analysis distinguishes between asbestos and nonasbestos fibers and can detect fibers as small as 0.0125 µm in length and 0.0025 µm in diameter.

3.5 The Occupational Health and Safety Administration (OSHA) standard for and 8-hour, time-weighted average (TWA) is 0.1 fibers per cubic centimeter (f/cm^3) of air sampled. This standard pertains to fibers with an aspect ratio of 3:1 with a fiber length greater than 5 µm. Samples collected to compare to the OSHA standard must be analyzed by PCM.

3.6 The AHERA Rule is the only Federal regulation that specifies a TEM analytical protocol.

4.0 DEFINITIONS

4.1 **Asbestos** - includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos.

4.2 **Aspect Ratio** - The ratio of a particle's length to its width.

4.3 **8-hr TWA** - The time-weighted average concentration for a normal 8-hour workday.

4.4 **Open Field Blank** - Filter cassettes that have been transported to the sampling site, opened for a short time (<30 sec) without air having passed through the filter, and then sent to the laboratory for analysis.

4.5 **Closed Field Blank** - Filter cassettes that have been transported to the sampling site and sent to the laboratory for analysis without being opened.

4.6 **Lot Blank** - Filter cassettes randomly selected from a new lot of filters and sent to the laboratory for analysis.

5.0 RESPONSIBILITIES

5.1 A trained industrial hygienist or field technician should collect the air samples.

5.2 Asbestos air monitoring during an asbestos abatement project should be conducted by a "competent person" as defined in the OSHA Standard 1926.1101(b) and certified under applicable state or local asbestos regulations.

5.3 For asbestos air monitoring other than that associated with an asbestos abatement project, sampling personnel require no formal state or federal certifications to collect air samples for asbestos.

6.0 PROCEDURE

6.1 Sample Media

6.1.1 Occupational Exposure Measurements

6.1.1.1 25-mm diameter, 0.8-µm to 1.2-µm poresize mixed cellulose ester (MCE) membrane filter and cellulose support pad contained in a three-piece cassette with a 50-mm conductive extension cowl.

6.1.2 Abatement Clearance Testing; Abatement Surveillance; Building Surveillance; and Ambient Outdoor Air Measurements

6.1.2.1 25-mm diameter, 0.45-µm pore-size, MCE filter with a 5-µm pore-size MCE diffusing filter and cellulose support pad contained in a three-piece cassette.

6.2 Sampling Strategy

6.2.1 Occupational Exposure Measurements

6.2.2 Air monitoring must be conducted for each type of

operation and for each type of asbestos-containing material.

6.2.3 Personal air monitors should be worn by representative workers for each job type.

6.2.4 Workers should be selected because they are likely to be exposed to the highest levels of airborne asbestos, or selected at random assuming all workers are similar in terms of potential exposure.

6.2.5 PCM analysis should be used to analyze the samples for comparison with OSHA standards.

6.2.2 Abatement Clearance Testing

6.2.2.1 For clearance by PCM (in schools, only small projects may be cleared by PCM - see AHERA Final Rule), at least five samples should be collected inside the work site, plus two field blanks (or 10 percent of the total number of samples, whichever is greater).

6.2.2.2 For clearance by TEM, at least five samples should be collected inside the work site, and at least five samples should be collected outside the work site (either outdoors or inside the building but outside of the containment). In addition, three field blanks should be collected (two open and one closed).

6.2.3 Abatement Surveillance

6.2.3.1 Surveillance outside of the containment area during the abatement should be conducted to detect release of fibers from the work site due to improper work practices or leaks in the containment barriers.

6.2.3.2 The number of samples depends on the degree of assurance the building owner requires. The more samples and the more frequently they are collected, the greater the assurance.

6.2.3.3 PCM analysis can be used to analyze abatement surveillance samples. When measured levels exceed EPA and/or OSHA action levels, TEM analysis should be used to determine whether the elevated levels are due to

asbestos particles.

6.2.4 Building Surveillance

6.2.4.1 Samples should be collected in the most heavily trafficked areas (i.e., representative rooms or common areas where most people work or move about).

6.2.4.2 The number of samples collected from different parts of the building will depend on the complexity of the building. A minimum of five samples should be collected.

6.2.4.3 PCM analysis can be used to analyze building surveillance samples. When measured levels exceed EPA and/or OSHA action levels, TEM analysis should be used to determine whether the elevated levels are due to asbestos particles.

6.2.5 Ambient Outdoor Air Measurements

6.2.5.1 Collect a minimum of three simultaneous upwind samples (i.e., upwind from the suspected source) 30 degrees apart from the prevailing wind directions to determine background fiber levels.

6.2.5.2 Collect a minimum of three samples in a 180-degree arc downwind from the suspected source to measure fugitive emissions from the site.

6.2.5.3 Collect a minimum of three representative samples at the suspected source site.

6.2.5.4 PCM analysis can be used to analyze outdoor ambient samples. When measured levels exceed EPA and/or OSHA action levels, TEM analysis should be used to determine whether the elevated levels are due to asbestos particles.

6.3 Flow Rates and Sample Volumes

6.3.1 For occupational exposure monitoring, OSHA recommends a sampling rate of 0.5 to 5.0 liters of air per minute (L/min). OSHA recommended air volumes range from 25 liters to 2400 liters of air.

pump numb

6.4.1.7 Turn the cas
replace face
from the sar

6.4.1.8 Record the s
start time).

4.2 Area Air Monitoring

6.4.2.1 Attach 25-m
with a 5-µm
support pad
volume elect

6.4.2.2 Position sam
the filter faci
horizontal.

6.4.2.3 Turn pump o
calibrate the
rotameter.

6.4.2.4 Record the s
pump numbe

6.4.2.5 Remove the

6.4.2.6 At the end of
the sampling

6.4.2.7 Post-calibrate
precision rota

6.4.2.8 Record the r
time (stop tim

6.4.2.9 Remove sam
pump off.

ality Assurance/Quality C

.1 Follow all QA/QC req

/ C

Pag

6.3.2 Outdoor sampling usually requires flow rates betwe
L/min and sample volumes ranging from 1000 to 5(

6.3.2 AHERA requires flow rates between 1 to 10 L/min.
volumes can vary provided that an analytical sensit
asbestos structures per cubic centimeter (s/cm^3) of
better, is achieved.

6.3.3 NIOSH Method 7400 (PCM) and 7402 (TEM) recor
sampling flow rates between 0.5 to 16 L/min. See s
methods for allowable sampling volumes.

6.4 *Procedure*

6.4.1 Personal Breathing Zone Air Monitoring

6.4.1.1 Pre-calibrate the battery-powered personal s
using an electric bubble calibrator or a rotar
previously calibrated to a primary standard.
calibrated flow rate.

6.4.1.2 Position 25-mm diameter, 0.8-µm to 1.2-µm
mixed cellulose ester (MCE) membrane filte
support pad contained in a three-piece cass
mm conductive extension cowl in the breath
the worker.

6.4.1.3 Position the cassette so that the filter faces
prevent dust from settling in it.

6.4.1.4 Attach the filter cassette to a calibrated, batt
personal sampling pump via plastic tubing.

6.4.1.5 A flow rate of 2.0 - 3.5 L/min is recommende
samples.

6.4.1.6 Remove cap from filter cassette (i.e., collect
sample open-faced).

6.4.1.7 Post calibrate the sampling pump. Record tl
rate.

6.4.1.6 Record the average flow rate (average of the
calibration flow rates), start time, date, samp

analytical method and/or project-specific quality assurance project plan.

6.5.2 Generally, open and closed field blanks are required for each set of samples or 10% of the total samples, whichever is greater.

6.5.3 The laboratory analyzing the samples should determine the lot blank requirements. No less than 1 lot blank per sample lot should be analyzed. The lot blanks should be analyzed prior to sampling.

6.5.4 Use chain-of-custody procedures for sample handling and transport.

6.6 Laboratory Analysis

6.6.1 Analytical laboratories should be selected from a list of laboratories participating in EPA's quality assurance (round robin) program and/or is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST).

6.6.2 Analytical protocols for occupational exposure monitoring and abatement clearance testing in schools are specified in the OSHA and AHERA regulations, respectively.

6.6.3 PCM analysis is recommended for abatement surveillance sampling.

6.6.4 PCM analysis can be used to analyze abatement surveillance samples. When measured levels exceed EPA and/or OSHA action levels, TEM analysis should be used to determine whether the elevated levels are due to asbestos particles.

6.6.5 PCM analysis can be used to analyze outdoor ambient samples. When measured levels exceed EPA and/or OSHA action levels, TEM analysis should be used to determine whether the elevated levels are due to asbestos particles.

7.0 EQUIPMENT

7.1 The materials needed to collect air samples for asbestos may include the following:

7.1.1 Personal Air Monitoring

- belts to hang sampling pumps on worker
- battery-powered sampling pump and battery charger
- inert plastic tubing
- lapel clips to attach sample cassette in worker's breathing zone
- 25-mm diameter, 0.8-µm to 1.2-µm poresize MCE membrane filter and cellulose support pad contained in a three-piece cassette with a 50-mm conductive extension cowl.
- precision rotameter or Gilibrator (electric bubble calibrator)
- small screw driver (Phillips and flathead)
- sample labels
- asbestos warning labels to send with samples
- sampling data sheets
- sample shipment container - to keep samples upright
- chain of custody/request for analysis forms
- Indelible ink pens
- shipment labels (overnight delivery)
- carrying case for supplies, samples, waste
- clipboard
- cassette opening tool
- ziplock bags to hold sample caps
- filter luers

7.1.2 Area Air Monitoring

- electric-powered, high-flow sampling pump
- generator, if no power source is available
- sample stands (tripods) approximately 5 ft high
- extension cords
- multiple outlet plugs
- inert plastic tubing
- 25-mm diameter, 0.45-µm pore-size, MCE filter with a 5-µm pore-size MCE diffusing filter and cellulose support pad contained in a three-piece cassette.
- precision rotameter
- sample labels

- sampling data sheets
- sample shipment container - to keep samples upright
- asbestos warning labels to send with samples
- chain of custody/request for analysis forms
- Indelible ink pens
- shipment labels (overnight delivery)
- cassette opener
- ziplock bags to hold sample caps
- carrying case for supplies, samples, waste
- clipboard
- wheeled cart to transport sampling pumps

8.0 ATTACHMENTS

None.

Environmental Quality Management

Standard Operating Procedure

Title: Asbestos Bulk Sampling		**Document No. ABS-01**
Date of Issue: April 13, 1995	**Revision No. 00**	**Page 1 of 7**
Approval J. Kominsky	**Approval** Julie A. Fields	

1.0 OVERVIEW

1.1 The purpose of this procedure is describe the method for the collection of bulk material for asbestos analysis.

1.2 This SOP is applicable for a wide variety of material including, but not limited to, thermal system insulation, spray-applied or trowelled-on surfacing material, and miscellaneous materials.

1.3 This SOP provides information on the proper equipment and techniques for completing the subject procedure.

1.4 Review of this information contained within facilitates the collection of bulk samples for asbestos analysis. This is accomplished by providing reference documents, general information, definitions, responsibilities, standard procedures, equipment and supporting data.

2.0 RELATED DOCUMENTS

2.1 For detailed information describing a procedure for sampling friable sprayed-on or trowelled-on materials on ceilings, walls, and other surfaces, refer to Asbestos in Buildings: Simplified Sampling Scheme for Friable Surfacing Materials, (EPA 560/5-85-030a). For revised training requirements for asbestos-related work, refer to Asbestos Model Accreditation Plan: Interim Final Rule (EPA 40 CFR Part 763, Vol. 59, No. 23, February 3, 1994). For rules and regulations regarding asbestos-related work in schools, refer to the Asbestos Hazard Emergency Response Act (EPA 40 CFR Part 763, Vol. 52, No. 210, October 30, 1987). For detailed information on current occupational

exposure standards, refer to 59 FR 40964, August 10, 1994, Occupational Safety and Health Administration's Final Rules for Asbestos Exposure in General Industry (29 CFR Part 1910) and Construction (29 CFR Part 1915), and Shipyard Employment (29 CFR Part 1926). For information on EPA's rules concerning the application, removal, and disposal of asbestos-containing material, and concerning manufacturing, spraying, and fabricating asbestos-containing material, refer to the National Emission Standards for Hazardous for Hazardous Air Pollutants (NESHAPS) (40 CFR 61, Part M).

3.0 GENERAL INFORMATION

3.1 Group friable material into "homogeneous" sampling areas.

3.2 For surfacing material, nine samples per homogeneous sampling area are recommended. If nine samples cannot be collected, use the following table to determine the minimum number of samples as required by AHERA:

Size of Sampling Area	Recommended Number of Samples to be Collected	Minimum Number of Samples to be Collected
Less than 1000 ft^2	9	3
1000 - 5000 ft^2	9	5
Greater than 5000 ft^2	9	7

3.4 For thermal system insulation, a minimum of three samples should be collected.

3.5 For miscellaneous materials, a minimum of one sample per homogeneous area should be collected.

3.6 Sample locations should be selected so that they are representative of the sampling area. A random sampling scheme should be employed.

4.0 DEFINITIONS

4.1 **Surfacing Material** - Asbestos-containing material (ACM) sprayed or trowelled on surfaces (walls, ceilings, structural members) for acoustical, decorative, or fireproofing purposes. This includes plaster and fireproofing insulation.

4.2 **Thermal System Insulation (TSI)** - Insulation used to inhibit heat transfer or prevent condensation on pipes, boilers, tanks, ducts, and

various other components of hot and cold water systems and heating, ventilation, and air conditioning systems. This includes pipe lagging; pipe wrap; block, batt, and blanket insulation; cements and "muds"; and a variety of other products such as gaskets and ropes.

4.3 **Miscellaneous Materials** - other, mostly nonfriable products and materials such as floor tile, ceiling tile, roofing felt, concrete pipe, outdoor siding, and fabrics.

4.4 **Friable ACM** - Any material containing more than 1 percent asbestos which when dry, may be crumbled, pulverized, or reduced to powder by hand pressure.

4.5 **Homogenous Area** - An area containing friable material that is uniform in texture and color and appears identical in every other respect.

5.0 RESPONSIBILITIES

5.1 All persons who inspect and/or sample for asbestos containing material in schools or in public and commercial buildings in Ohio must be accredited by passing the AHERA Asbestos Abatement Building Inspector Training Course and the AHERA Asbestos Abatement Management Planner Training Course.

5.2 Other states may have different requirements than Ohio. Specific state requirements should be determined prior to sampling.

6.0 PROCEDURE

6.1 Preliminary Visual Inspection

6.1.1 Record locations of similar materials. The visual evaluation should also include the type of material, likelihood of friability, condition of the material, existence of water damage or abrasion, and approximate amount of exposed material.

6.2 Personal Protective Equipment

6.2.1 Sampling personnel should wear, at a minimum, either a full-face or half-face mask-type respirator equipped with high-efficiency disposable filter cartridges.

6.2.2 Disposable clothing, including Tyvek coveralls and disposable latex rubber gloves, should be worn during sampling if the

sampling operation is likely to dislodge pieces of suspect material or if the environment is extremely dusty.

6.3 Preparation

6.3.1 Assemble equipment (e.g., ladder). Spread plastic drop cloth under area to be sampled.

6.3.2 Locate an inconspicuous, relatively inaccessible area of material to be sampled. Look for exposed/damaged areas, if possible. However, random sampling will require sampling of intact material.

6.3.3 Don personal protective equipment.

6.3.4 Label container with sample identification number and record sample number, sample location, and type of material sampled on a sampling data form.

6.3.5 Mark the location of the sample on the sampling diagram and record the sample identification number on the plan diagram.

6.4 Sampling Procedure

6.4.1 Wet the surface with a spray of amended water.

6.4.2 Extract the sample using a clean knife to cut or scrape a small piece of material. Penetrate all layers of material and take care not to disturb adjacent material. For cementitious material or floor tile, use a chisel to break off a piece of the material.

6.4.3 Place sample in a container and seal tightly.

6.4.4 Wet-wipe the exterior of the sample container/bag.

6.4.5 Clean tools with wet-wipes and wet-wipe and/or vacuum area with a HEPA vacuum.

6.4.6 Fill hole with caulking compound and/or spray with encapsulant to seal any fibers the area where the sample was collected and minimize the potential for subsequent fiber release.

6.4.7 Double bag the sample container.

6.4.8 Repeat above steps at each sample location.

6.4.9 Discard personal protective equipment and clothing, wet wipes, and drop cloths into a labelled plastic bag. The label should read "Danger - Contains Asbestos Fibers - Avoid Creating Dust - Cancer and Lung Disease Hazard."

6.5 QA Requirements

6.5.1 Collect at least 1 QA sample per building or 1 QA sample per 20 samples, whichever is larger.

6.5.2 The QA sample should be collected immediately adjacent to a random field sample (i.e., side-by-side) and labelled and handled in the same way as an ordinary sample.

6.5.3 The QA sample should be analyzed by the same laboratory as the other field samples to determine the variability within a laboratory, or alternately by a second lab to measure variability between labs (using a second laboratory is only appropriate for large studies).

6.5.4 Laboratory Analysis

6.5.4.1 Analytical laboratories should be selected from a list of laboratories participating in EPA's quality assurance (round robin) program and/or is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST).

6.5.4.2 The samples should be analyzed by polarized light microscopy with dispersion staining in accordance with the EPA Method "Determination of Asbestos in Bulk Insulation Samples" (EPA 600/M4-82-020, 1980).

6.5.4.3 A competent analytical laboratory should provide a detailed bulk sample analysis report that includes the following information:

- Client Sample ID#
- Laboratory Sample ID#
- Analytical technique used
- Laboratory QA/QC procedures used
- Physical description of sample, as received
- Type(s) and estimate percentage of asbestos
- Type(s) and estimate percentage of

nonasbestos fibers
- Type(s) and estimate percentage of other components, if known
- Date of analysis
- Analyst's signature

7.0 EQUIPMENT

7.1 The materials needed to collect bulk samples for asbestos may include the following:

- Small hammer
- 1-inch or 1½-inch chisel edge scraper
- 3-inch or 4-inch chisel edge scraper
- 20- or 50-foot tape measure
- Linoleum/flooring knife
- Regular slotted screwdriver
- Phillips screwdriver
- Slip joint pliers or tweezers
- Set of cork borers
- Roll of cellophane tape
- Spray acrylic, spray adhesive or other encapsulant
- Airtight, rigid, sample containers
- Zip-lock bags with labels
- Paper towels
- Sprayer bottle with amended water
- Plastic drop cloths
- Caulking gun and compound
- HEPA-filtered vacuum cleaner
- Camera
- Duct tape
- Flashlight
- Step ladder
- Sample data sheets
- Chain of custody/Request for analysis forms
- Indelible ink pens
- Floor plans to identify sample locations
- Labelled plastic bag for contaminated PPE/C, wet wipes, drop cloths, etc.
- Pre-moistened cloths (wet wipes)
- Labels for sample containers
- Box for sample shipment
- Shipment labels (overnight delivery)
- Carrying case for supplies, samples, waste

- Packing enclosure warnings and forms for sample shipment
- Clipboard
- Pushcart

8.0 ATTACHMENTS

None.

ATTACHMENT PP
REAL TIME PARTICULATE SAMPLING

Environmental Quality Management

Standard Operating Procedure

Title:	**Real-Time Particulate Sampling**	**Document No.**	**MS-11**
Date of Issue:	**June 20, 1995**	**Revision No.**	**00** **Page 1 of 7**
Approval	John R. Kominsky	**Approval**	Jacquelyn R. Doe

1.0 OVERVIEW

1.1 The purpose of this procedure is to describe the method for real-time air sampling of total particulates using a light-scattering aerosol monitor (i.e., MINIRAM™ aerosol monitor).

1.2 This SOP is applicable for: 1) occupational exposure measurements, and 2) stationary (indoor or outdoor) ambient air measurements.

1.3 This SOP provides information on the proper equipment and techniques for completing the subject procedure.

1.4 Review of the information contained within facilitates real-time monitoring of total particulates. This is accomplished by providing reference documents, general information, definitions, responsibilities, standard procedures, an equipment list and supporting data.

2.0 RELATED DOCUMENTS

2.1 MINIRAM Personal Monitor-Model PDM-3 Operations Manual, MIE, Inc., Billerica, MA, March 1990.

2.2 Air Sampling Instruments for Evaluation of Atmospheric Contaminants, the American Conference of Governmental Industrial Hygienists, 7th Edition, Cincinnati, Ohio, 1989.

3.0 GENERAL INFORMATION

3.1 The MINIRAM (Miniature Real-Time Monitor) Model PDM-3 is a portable, hand-held airborne particulate monitor. This light-scattering aerosol monitor operates by illuminating aerosol particles (both solid and liquid) passing through a defined volume and detecting the total light scattered by all the particles within its sensing volume of one cubic centimeter. The MINIRAM's liquid crystal display indicates the aerosol concentration in the units of milligrams per cubic meter of air, which is updated every 10 seconds.

3.2 The operating ranges of the MINIRAM are: 1) 0.01 to 10 mg/m^3 with a 0.02 mg/m^3 resolution or 0.1 to 100 mg/m^3 with a resolution of 0.1 mg/m^3.

3.3 The MINIRAM satisfies the requirements for intrinsically safe operation in methane-air mixtures. Mine Safety and Health Administration (MSHA) 2G-3532-0 approval has been granted to the MINIRAM Model PDM-3 monitor.

3.4 This SOP pertains only to the operation of the MINIRAM personal monitor Model PDM-3.

3.5 The MINIRAM cannot be used to discriminate between different types of aerosols or particulates. The instrument will respond to all types of aerosol present simultaneously in the detection volume. Therefore, measurement of a small amount of specific aerosol (i.e., lead fume) in the presence of a large amount of interfering dust (welding fumes) is not possible with this instrument. However, if lead fume were the major aerosol component, the MINIRAM would be the appropriate instrument to use.

3.6 High humidity or use of the MINIRAM near water sprays, heated water baths or other sources of airborne water vapor may result in a positive interference, i.e., the measured aerosol concentration may reflect water aerosol in addition to the contaminant of interest. In these situations care should be exercised when interpreting the results. Alternatively, non-real time sampling methods incorporating filter media should be used.

3.7 The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for total particulate is 15 mg/m^3, as an 8 hour time-weighted average. The American Conference of Governmental Industrial Hygienists, Inc. (ACGIH) Threshold Limit Value (TLV) for total particulate is 10 mg/m^3, as an 8 hour TWA. In both cases, the particulate represents nuisance dust, i.e., contain < 1% asbestos and < 1% crystalline silica.

4.0 DEFINITIONS

4.1 mg/m^3 - milligram of particulate per cubic meter of air.

4.2 PEL - permissible exposure limit

4.3 TLV - threshold limit value

4.4 8 hour TWA - time weighted average concentration for a normal 8 hour workday.

5.0 RESPONSIBILITIES

5.1 The project manager should ensure that adequate resources are available to conduct subject monitoring, i.e., implementation of this SOP.

5.2 The monitoring should be conducted by a trained industrial hygienist or field technician. These individuals are responsible for the following:

5.2.1 Reading and implementing project or site-specific health and safety plan and sampling plan(s).

5.2.2 Ensuring that the MINIRAM is available to accomplish the sampling objectives.

5.2.3 Reading and understanding the manufacturer's operations manual.

5.2.4 For area sampling; locating and marking sampling locations. For personal sampling; selecting individuals to monitor.

5.2.5 Decontaminating the instrument (if necessary) in accordance with the procedures outlined in the site-specific health and safety plan.

5.2.6 Conducting a performance check of the monitor prior to use.

5.2.7 Calibrating the monitor in the field prior before and after sampling.

5.2.8 Maintaining sampling records, sampling logs, data sheets, and maps.

6.0 PROCEDURE

6.1 Air Monitoring

6.1.1 Charge the batteries of the MINIRAM for a minimum of 8.33 hours before using the instrument without a charger. The MINIRAM can be used for extended periods (i.e., greater than 8 hours on a continuous basis) at a fixed location with charger connected to AC source.

6.1.2 Calibration is not required prior to use; the MINIRAM is factory-calibrated.

6.1.3 Zero the MINIRAM using the Z-Bag kit in accordance with manufacturers instructions. The Z-Bag kit consists of a one-way flow rubber bulb for manual air pumping, a filter cartridge, a zippered plastic bag, and connecting hardware. The procedure is as follows:

6.1.3.1 Remove the rubber bulb filter assembly from the Z-Bag. Place the Z-Bag on flat surface with the red flow fitting facing up. Flatten bag. Remove the small plastic cap from the flow fitting on the bag.

6.1.3.2 Insert the ribbed elbow connector (attached to filter cartridge) into the red flow fitting of the plastic bag, until the connector is flush with the bottom of the red flow fitting.

6.1.3.3 The MINIRAM should be in its OFF condition (observe display). If the display is blanked, or if the MINIRAM is in the MEAS mode, key OFF.

6.1.3.4 Open the Z-Bag and place the MINIRAM inside, approximately at its center.

6.1.3.5 Key ZERO through the open end of the Z-Bag. Immediately zip closed the Z-Bag and begin to pump the hand bulb.

6.1.3.6 The Z-Bag should inflate as hand pumping continues, up to a height of about five inches (12 cm). Continue pumping gently to maintain bag interior pressure, until the MINIRAM displays OFF again.

6.1.3.7 Unzip the Z-Bag and remove the MINIRAM. MINIRAM is now ready for monitoring.

6.1.3.8 Place the rubber bulb/filter assembly inside the Z-Bag, and plug the small plastic cap into the flow fitting to close it. Zip close while flattening the Z-Bag to store it to ensure cleanliness of the bag interior.

6.1.4 To start measuring airborne total aerosol concentrations, press the MEAS button on the panel. After about 36 second has elapsed since pressing the MEAS button, the first 10 second averaged concentration (in mg/m^3) will be displayed on the LCD readout. All subsequent readings are updated every 10 seconds. The instrument will operate continuous for up to 500 minutes after which it will automatically stop, displaying the OFF reading.

6.1.5 Record real-time airborne aerosol concentrations by manually transcribing levels on a Real Time Monitoring Log (Attachment 1) sampling data sheet or by outputting data stored in RAM on a printer. Section 10 of the operations manual should be reviewed prior to use of a printer.

6.2 Quality Assurance/Quality Control

6.2.1 Follow QA/QC requirements specified in the associated project-specific quality assurance plan.

6.3 Health and Safety requirements for performing real-time aerosol monitoring aerosol should be identified in a project or site-specific health and safety plan.

6.4 Equipment Decontamination

In the event that the monitor becomes contaminated during its use, the decontamination procedure outlined in the site-specific health and safety plan should be followed.

7.0 EQUIPMENT

7.1 Aside from the MINIRAM monitor, the following accessories are necessary for implementation of all aspects of this SOP:

- Z-Bag calibration kit
- battery charger
- printer

8.0 ATTACHMENTS

8.1 Real Time Monitoring Log

REAL TIME MONITORING LOG

Site Name: _____ Project No.: _____

DATE/TIME	SAMPLING LOCATION	INSTRUMENT (Mfg./Model)	MEASURED AGENT	RESULTS ( )	SAMPLED BY	COMMENTS/ ACTIVITIES

methods remove greater than 99.99 percent of the mercury.

13.1 *Disposal of Mercury-Containing Solutions.*

13.2 *Method for Forming an Amalgam.*

1. Place the waste solution in an uncapped vessel in a hood.

2. For each liter of waste solution, add approximately 10 g of sodium carbonate until neutralization has occurred (NaOH may have to be used).

3. Following neutralization, add 10 g of granular zinc or magnesium.

4. Stir the solution in a hood for 24 hours. Caution must be exercised as hydrogen gas is evolved by this treatment process.

5. After 24 hours, allow the solution to stand without stirring to allow the mercury amalgam (solid black material) to settle to the bottom of the waste receptacle.

6. Upon settling, decant and discard the supernatant liquid.

7. Quantitatively transfer the solid material to a container and allow to dry.

8. The solid material can be sent to a mercury reclaiming plant. It must not be discarded.

13.3 *Method Using Aluminum Foil Strips.*

1. Place the waste solution in an uncapped vessel in a hood.

2. For each liter of waste solution, add approximately 10 g of aluminum foil strips. If all the aluminum is consumed and no gas is evolved, add an additional 10 g of foil. Repeat until the foil is no longer consumed and allow the gas to evolve for 24 hours.

3. Decant the supernatant liquid and discard.

4. Transfer the elemental mercury that has settled to the bottom of the vessel to a storage container.

5. The mercury can be sent to a mercury reclaiming plant. It must not be discarded.

14.0 *References for SO_2 Method.*

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[Appendix A added at 47 FR 54899, Dec. 6, 1982; amended at 48 FR 17355, April 22, 1983]

APPENDIX B—REFERENCE METHOD FOR THE DETERMINATION OF SUSPENDED PARTICULATE MATTER IN THE ATMOSPHERE (HIGH-VOLUME METHOD)

1.0 *Applicability.*

1.1 This method provides a measurement of the mass concentration of total

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suspended particulate matter (TSP) in ambient air for determining compliance with the primary and secondary national ambient air quality standards for particulate matter as specified in §50.6 and §50.7 of this chapter. The measurement process is nondestructive, and the size of the sample collected is usually adequate for subsequent chemical analysis. Quality assurance procedures and guidance are provided in Part 58, Appendixes A and B, of this chapter and in References 1 and 2.

2.0 *Principle.*

2.1 An air sampler, properly located at the measurement site, draws a measured quantity of ambient air into a covered housing and through a filter during a 24-hr (nominal) sampling period. The sampler flow rate and the geometry of the shelter favor the collection of particles up to 25-50 μm (aerodynamic diameter), depending on wind speed and direction.(*3*) The filters used are specified to have a minimum collection efficiency of 99 percent for 0.3 μm (DOP) particles (see Section 7.1.4).

2.2 The filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain. The total volume of air sampled, corrected to EPA standard conditions (25°C, 760 mm Hg [101 kPa]), is determined from the measured flow rate and the sampling time. The concentration of total suspended particulate matter in the ambient air is computed as the mass of collected particles divided by the volume of air sampled, corrected to standard conditions, and is expressed in micrograms per standard cubic meter (μg/std m^3). For samples collected at temperatures and pressures significantly different than standard conditions, these corrected concentrations may differ substantially from actual concentrations (micrograms per actual cubic meter), particularly at high elevations. The actual particulate matter concentration can be calculated from the corrected concentration using the actual temperature and pressure during the sampling period.

3.0 *Range.*

3.1 The approximate concentration range of the method is 2 to 750 μg/std m^3. The upper limit is determined by the point at which the sampler can no longer maintain the specified flow rate due to the increased pressure drop of the loaded filter. This point is affected by particle size distribution, moisture content of the collected particles, and variability from filter to filter, among other things. The lower limit is determined by the sensitivity of the balance (see Section 7.10) and by inherent sources of error (see Section 6).

3.2 At wind speeds between 1.3 and 4.5 m/sec (3 and 10 mph), the high-volume air sampler has been found to collect particles up to 25 to 50 μm, depending on wind speed and direction.(*3*) For the filter specified in Section 7.1, there is effectively no lower limit on the particle size collected.

4.0 *Precision.*

4.1 Based upon collaborative testing, the relative standard deviation (coefficient of variation) for single analyst precision (repeatability) of the method is 3.0 percent. The corresponding value for interlaboratory precision (reproducibility) is 3.7 percent.(*4*)

5.0 *Accuracy.*

5.1 The absolute accuracy of the method is undefined because of the complex nature of atmospheric particulate matter and the difficulty in determining the "true" particulate matter concentration. This method provides a measure of particulate matter concentration suitable for the purpose specified under Section 1.0, Applicability.

6.0 *Inherent Sources of Error.*

6.1 *Airflow variation.* The weight of material collected on the filter represents the (integrated) sum of the product of the instantaneous flow rate times the instantaneous particle concentration. Therefore, dividing this weight by the average flow rate over the sampling period yields the true particulate matter concentration only when the flow rate is constant over the period. The error resulting from a nonconstant flow rate depends on the magnitude of the instantaneous changes in the flow rate and in the particulate matter concentration. Normally, such errors are not large, but they can be greatly reduced by equipping the sampler with an automatic flow controlling mechanism that maintains constant flow during the sampling period. Use of a contant flow controller is recommended.*

6.2 *Air volume measurement.* If the flow rate changes substantially or nonuniformly during the sampling period, appreciable error in the estimated air volume may result from using the average of the presampling and postsampling flow rates. Greater air volume measurement accuracy may be achieved by (1) equipping the sampler with a flow controlling mechanism that maintains constant air flow during the sampling period,* (2) using a calibrated, continuous flow rate recording device to record the actual flow rate during the samping period and integrating the flow rate over the period, or (3) any other means that will accurately measure the total air volume sampled during the sampling period. Use of a continuous flow recorder is recommended, particularly if the sampler is not equipped with a constant flow controller.

6.3 *Loss of volatiles.* Volatile particles collected on the filter may be lost during subsequent sampling or during shipment and/or storage of the filter prior to the postsampling weighing.(*5*) Although such losses are largely unavoidable, the filter should be reweighed as soon after sampling as practical.

6.4 *Artifact particulate matter.* Artifact particulate matter can be formed on the surface of alkaline glass fiber filters by oxidation of acid gases in the sample air, resulting in a higher than true TSP determination.(*6 7*) This effect usually occurs early in the sample period and is a function of the filter pH and the presence of acid gases. It is generally believed to account for only a small percentage of the filter weight gain, but the effect may become more significant where relatively small particulate weights are collected.

6.5 *Humidity.* Glass fiber filters are comparatively insensitive to changes in relative humidity, but collected particulate matter can be hygroscopic.(*8*) The moisture conditioning procedure minimizes but may not completely eliminate error due to moisture.

6.6 *Filter handling.* Careful handling of the filter between the presampling and postsampling weighings is necessary to avoid errors due to loss of fibers or particles from the filter. A filter paper cartridge or cassette used to protect the filter can minimize handling errors. (See Reference 2, Section 2).

6.7 *Nonsampled particulate matter.* Particulate matter may be deposited on the filter by wind during periods when the sampler is inoperative. (*9*) It is recommended that errors from this source be minimized by an automatic mechanical device that keeps the filter covered during nonsampling periods, or by timely installa-

*At elevated altitudes, the effectiveness of automatic flow controllers may be reduced because of a reduction in the maximum sampler flow.

tion and retrieval of filters to minimize the nonsampling periods prior to and following operation.

6.8 *Timing errors.* Samplers are normally controlled by clock timers set to start and stop the sampler at midnight. Errors in the nominal 1,440-min sampling period may result from a power interruption during the sampling period or from a discrepancy between the start or stop time recorded on the filter information record and the actual start or stop time of the sampler. Such discrepancies may be caused by (1) poor resolution of the timer set-points, (2) timer error due to power interruption, (3) missetting of the timer, or (4) timer malfunction. In general, digital electronic timers have much better set-point resolution than mechanical timers, but require a battery backup system to maintain continuity of operation after a power interruption. A continuous flow recorder or elapsed time meter provides an indication of the sampler run-time, as well as indication of any power interruption during the sampling period and is therefore recommended.

6.9 *Recirculation of sampler exhaust.* Under stagnant wind conditions, sampler exhaust air can be resampled. This effect does not appear to affect the TSP measurement substantially, but may result in increased carbon and copper in the collected sample. (*10*) This problem can be reduced by ducting the exhaust air well away, preferably downwind, from the sampler.

7.0 *Apparatus.*

(See References 1 and 2 for quality assurance information.)

NOTE: Samplers purchased prior to the effective date of this amendment are not subject to specifications preceded by (†).

7.1 *Filter.* (Filters supplied by the Environmental Protection Agency can be assumed to meet the following criteria. Additional specifications are required if the sample is to be analyzed chemically.)

7.1.1 *Size:* 20.3±0.2×25.4 ± 0.2 cm (nominal 8×10 in).

7.1.2 *Nominal exposed area:* 406.5 cm^2 (63 in^2).

7.1.3. *Material:* Glass fiber or other relatively inert, nonhygroscopic material. (*8*)

7.1.4 *Collection efficiency:* 99 percent minimum as measured by the DOP test (ASTM-2986) for particles of 0.3 μm diameter.

7.1.5 *Recommended pressure drop range:* 42-54 mm Hg (5.6-7.2 kPa) at a flow rate of 1.5 std m^3/min through the nominal exposed area.

7.1.6 *pH:* 6 to 10. (*11*)

7.1.7 *Integrity:* 2.4 mg maximum weight loss. (*11*)

7.1.8 *Pinholes:* None.

7.1.9 *Tear strength:* 500 g minimum for 20 mm wide strip cut from filter in weakest dimension. (See ASTM Test D828-60).

7.1.10 *Brittleness:* No cracks or material separations after single lengthwise crease.

7.2 *Sampler.* The air sampler shall provide means for drawing the air sample, via reduced pressure, through the filter at a uniform face velocity.

7.2.1 The sampler shall have suitable means to:

a. Hold and seal the filter to the sampler housing.

b. Allow the filter to be changed conveniently.

c. Preclude leaks that would cause error in the measurement of the air volume passing through the filter.

d. † Manually adjust the flow rate to accommodate variations in filter pressure drop and site line voltage and altitude. The adjustment may be accomplished by an automatic flow controller or by a manual flow adjustment device. Any manual adjustment device must be designed with positive detents or other means to avoid unintentional changes in the setting.

7.2.2 *Minimum sample flow rate, heavily loaded filter:* 1.1 m^3/min (39 ft^3/min).††

7.2.3 *Maximum sample flow rate, clean filter:* 1.7 m^3/min (60 ft^3/min).††

7.2.4 *Blower Motor:* The motor must be capable of continuous operation for 24-hr periods.

7.3 *Sampler shelter.*

7.3.1 The sampler shelter shall:

a. Maintain the filter in a horizontal position at least 1 m above the sampler supporting surface so that sample air is drawn downward through the filter.

†See note at beginning of Section 7 of this appendix.

††These specifications are in actual air volume units; to convert to EPA standard air volume units, multiply the specifications by $(P_b/P_{std})(298/T)$ where P_b and T are the barometric pressure in mm Hg (or kPa) and the temperature in K at the sampler, and P_{std} is 760 mm Hg (or 101 kPa).

b. Be rectangular in shape with a gable roof, similar to the design shown in Figur 1.

c. Cover and protect the filter and san pler from precipitation and other weathe

d. Discharge exhaust air at least 40 c from the sample air inlet.

e. Be designed to minimize the colle tion of dust from the supporting surface b incorporating a baffle between the exhau outlet and the supporting surface.

7.3.2 The sampler cover or roof sha overhang the sampler housing somewha as shown in Figure 1, and shall be moun ed so as to form an air inlet gap betwee the cover and the sampler housing wall †This sample air inlet should be approx mately uniform on all sides of the sample †The area of the sample air inlet must b sized to provide an effective particle ca ture air velocity of between 20 and 3 cm/sec at the recommended operation flow rate. The capture velocity is the sam ple air flow rate divided by the inlet are measured in a horizontal plane at the lo er edge of the cover. †Ideally, the inl area and operational flow rate should b selected to obtain a capture air velocity 25 ± cm/sec.

7.4 *Flow rate measurement devices.*

7.4.1 The sampler shall incorporate flow rate measurement device capable indicating the total sampler flow rate. Tw common types of flow indicators covere in the calibration procedure are (1) a electronic mass flowmeter and (2) an or fice or orifices located in the sample a stream together with a suitable pressur indicator such as a manometer, or aneroi pressure gauge. A pressure recorder ma be used with an orifice to provide a contin uous record of the flow. Other types o flow indicators (including rotameters) ha ing comparable precision and accuracy ar also acceptable.

7.4.2 † The flow rate measurement d vice must be capable of being calibrate and read in units corresponding to a flo rate which is readable to the nearest 0.0 std m^3/min over the range 1.0 to 1.8 st m^3/min.

7.5 *Thermometer,* to indicate the a proximate air temperature at the flow rat measurement orifice, when temperatur corrections are used.

7.5.1 *Range:* -40° to +50°C (223-32 K).

†See note at beginning of Section 7 of this appendix

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7.5.2 *Resolution:* 2°C (2 K).

7.6 *Barometer,* to indicate barometric pressure at the flow rate measurement orifice, when pressure corrections are used.

7.6.1 *Range:* 500 to 800 mm Hg (66-106 kPa).

7.6.2 *Resolution:* ± *mm Hg (0.67 kPa).*

7.7 *Timing/control device.*

7.7.1 The timing device must be capable of starting and stopping the sampler to obtain an elapsed run-time of 24 hr ±11 hr (1,440 ±60 min).

7.7.2 *Accuracy of time setting:* ±30 min, or better. (See Section 6.8).

7.8 *Flow rate transfer standard,* traceable to a primary standard. (See Section 9.2.)

7.8.1 *Approximate range:* 1.0 to 1.8 m^3/min.

7.8.2 *Resolution:* 0.02 m^3/min.

7.8.3 *Reproducibility:* ±2 percent (2 times coefficient of variation) over normal ranges of ambient temperature and pressure for the stated flow rate range. (See Reference 2, Section 2.)

7.8.4 *Maximum pressure drop at 1.7 std* m^3/min; 50 cm H_2O (5 kPa).

7.8.5 The flow rate transfer standard must connect without leaks to the inlet of the sampler and measure the flow rate of the total air sample.

7.8.6 The flow rate transfer standard must include a means to vary the sampler flow rate over the range of 1.0 to 1.8 m^3/min (35-64 ft^3/min) by introducing various levels of flow resistance between the sampler and the transfer standard inlet.

7.8.7 The conventional type of flow transfer standard consists of: An orifice unit with adapter that connects to the inlet of the sampler, a manometer or other device to measure orifice pressure drop, a means to vary the flow through the sampler unit, a thermometer to measure the ambient temperature, and a barometer to measure ambient pressure. Two such devices are shown in Figures 2a and 2b. Figure 2a shows multiple fixed resistance plates, which necessitate disassembly of the unit each time the flow resistance is changed. A preferable design, illustrated in Figure 2b, has a variable flow restriction that can be adjusted externally without disassembly of the unit. Use of a conventional, orifice-type transfer standard is assumed in the calibration procedure (Section 9). However, the use of other types of transfer standards meeting the above specifications, such as the one shown in Figure 2c, may be approved; see the note following Section 9.1.

7.9 *Filter conditioning environment*

7.9.1 *Controlled temperature:* between 15° and 30°C with less than ±°C variation during equilibration period.

7.9.2 *Controlled humidity:* Less than 50 percent relative humidity, constant within ±5 percent.

7.10 *Analytical balance.*

7.10.1 *Sensitivity:* 0.1 mg.

7.10.2 Weighing chamber designed to accept an unfolded 20.3 x 25.4 cm (8 x 10 in) filter.

7.11 *Area light source,* similar to X-ray film viewer, to backlight filters for visual inspection.

7.12 *Numbering device,* capable of printing identification numbers on the filters before they are placed in the filter conditioning environment, if not numbered by the supplier.

8.0 *Procedure.*

(See References 1 and 2 for quality assurance information.)

8.1 Number each filter, if not already numbered, near its edge with a unique identification number.

8.2 Backlight each filter and inspect for pinholes, particles, and other imperfections; filters with visible imperfections must not be used.

8.3 Equilibrate each filter in the conditioning environment for at least 24-hr.

8.4 Following equilibration, weigh each filter to the nearest milligram and record this tare weight (W_i) with the filter identification number.

8.5 Do not bend or fold the filter before collection of the sample.

8.6 Open the shelter and install a numbered, preweighed filter in the sampler, following the sampler manufacturer's instructions. During inclement weather, precautions must be taken while changing filters to prevent damage to the clean filter and loss of sample from or damage to the exposed filter. Filter cassettes that can be loaded and unloaded in the laboratory may be used to minimize this problem (See Section 6.6).

8.7 Close the shelter and run the sampler for at least 5 min to establish run-temperature conditions.

8.8 Record the flow indicator reading and, if needed, the barometric pressure (P_3) and the ambient temperature (T_3) see NOTE following step 8.12). Stop the sampler. Determine the sampler flow rate (see Section 10.1); if it is outside the acceptable range (1.1 to 1.7 m^3/min [39-60 ft^3/min]), use a different filter, or adjust the sampler flow rate. Warning: Substantial flow adjustments may affect the calibration of the orifice-type flow indicators and may necessitate recalibration.

8.9 Record the sampler identification information (filter number, site location or identification number, sample date, and starting time).

8.10 Set the timer to start and stop the sampler such that the sampler runs 24-hrs, from midnight to midnight (local time).

8.11 As soon as practical following the sampling period, run the sampler for at least 5 min to again establish run-temperature conditions.

8.12 Record the flow indicator reading and, if needed, the barometric pressure (P_3) and the ambient temperature (T_3).

NOTE: No onsite pressure or temperature measurements are necessary if the sampler flow indicator does not require pressure or temperature corrections (e.g., a mass flowmeter) or if average barometric pressure and seasonal average temperature for the site are incorporated into the sampler calibration (see step 9.3.9). For individual pressure and temperature corrections, the ambient pressure and temperature can be obtained by onsite measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampler site and the airport. For samplers having flow recorders but not constant flow controllers, the average temperature and pressure at the site *during the sampling period* should be estimated from weather bureau or other available data.

8.13 Stop the sampler and carefully remove the filter, following the sampler manufacturer's instructions. Touch only the outer edges of the filter. See the precautions in step 8.6.

8.14 Fold the filter in half lengthwise so that only surfaces with collected particulate matter are in contact and place it in the filter holder (glassine envelope or manila folder).

8.15 Record the ending time or elapsed time on the filter information record, either from the stop set-point time, from an elapsed time indicator, or from a continuous flow record. The sample period must be 1,440 ± 60 min. for a valid sample.

8.16 Record on the filter information record any other factors, such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement. If the sam-

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ple is known to be defective, void it at this time.

8.17 Equilibrate the exposed filter in the conditioning environment for at least 24-hrs.

8.18 Immediately after equilibration, reweigh the filter to the nearest milligram and record the gross weight with the filter identification number. See Section 10 for TSP concentration calculations.

9.0 *Calibration.*

9.1 Calibration of the high volume sampler's flow indicating or control device is necessary to establish traceability of the field measurement to a primary standard via a flow rate transfer standard. Figure 3a illustrates the certification of the flow rate transfer standard and Figure 3b illustrates its use in calibrating a sampler flow indicator. Determination of the corrected flow rate from the sampler flow indicator, illustrated in Figure 3c, is addressed in Section 10.1

NOTE: The following calibration procedure applies to a conventional orifice-type flow transfer standard and an orifice-type flow indicator in the sampler (the most common types). For samplers using a pressure recorder having a square-root scale, 3 other acceptable calibration procedures are provided in Reference 12. Other types of transfer standards may be used if the manufacturer or user provides an appropriately modified calibration procedure that has been approved by EPA under Section 2.8 of Appendix C to Part 58 of this chapter.

9.2 *Certification of the flow rate transfer standard.*

9.2.1 *Equipment required:* Positive displacement standard volume meter traceable to the National Bureau of Standards (such as a Roots meter or equivalent), stop-watch, manometer, thermometer, and barometer.

9.2.2 Connect the flow rate transfer standard to the inlet of the standard volume meter. Connect the manometer to measure the pressure at the inlet of the standard volume meter. Connect the orifice manometer to the pressure tap on the transfer standard. Connect a high-volume air pump (such as a high-volume sampler blower) to the outlet side of the standard volume meter. See Figure 3a.

9.2.3 Check for leaks by temporarily clamping both manometer lines (to avoid fluid loss) and blocking the orifice with a large-diameter rubber stopper, wide cellophane tape, or other suitable means. Start the high-volume air pump and note any change in the standard volume meter reading. The reading should remain constant. If the reading changes, locate any leaks by listening for a whistling sound and/or retightening all connections, making sure that all gaskets are properly installed.

9.2.4 After satisfactorily completing the leak check as described above, unclamp both manometer lines and zero both manometers.

9.2.5 Achieve the appropriate flow rate through the system, either by means of the variable flow resistance in the transfer standard or by varying the voltage to the air pump. (Use of resistance plates as shown in Figure 1a is discouraged because the above leak check must be repeated each time a new resistance plate is installed.) At least five different but constant flow rates, evenly distributed, with at least three in the specified flow rate interval (1.1 to 1.7 m^3/min [39-60 ft^3/min]), are required.

9.2.6 Measure and record the certification data on a form similar to the one illustrated in Figure 4 according to the following steps.

9.2.7 Observe the barometric pressure and record as P_1 (item 8 in Figure 4).

9.2.8 Read the ambient temperature in the vicinity of the standard volume meter and record it as T_1 (item 9 in Figure 4).

9.2.9 Start the blower motor, adjust the flow, and allow the system to run for at least 1 min for a constant motor speed to be attained.

9.2.10 Observe the standard volume meter reading and simultaneously start a stopwatch. Record the initial meter reading (V_i) in column 1 of Figure 4.

9.2.11 Maintain this constant flow rate until at least 3 m^3 of air have passed through the standard volume meter. Record the standard volume meter inlet pressure manometer reading as ΔP (column 5 in Figure 4), and the orifice manometer reading as ΔH (column 7 in Figure 4). Be sure to indicate the correct units of measurement.

9.2.12 After at least 3 m^3 of air have passed through the system, observe the standard volume meter reading while simultaneously stopping the stopwatch. Record the final meter reading (V_f) in column 2 and the elapsed time (t) in column 3 of Figure 4.

9.2.13 Calculate the volume measured by the standard volume meter at meter conditions of temperature and pressures as $V_m = V_f - V_i$. Record in column 4 of Figure 4.

9.2.14 Correct this volume to standard volume (std m_3) as follows:

$$V_{std} = V_m \frac{P_1 - \Delta P}{P_{std}} \frac{T_{std}}{T_1}$$

where:

V_{std}=standard volume, std m^3;

V_m=actual volume measured by the standard volume meter;

P_1=barometric pressure during calibration, mm Hg or kPa;

ΔP=differential pressure at inlet to volume meter, mm Hg or kPa;

P_{std}=760 mm Hg or 101 kPa;

T_{std}=298 K;

T_1=ambient temperature during calibration, K.

Calculate the standard flow rate (std m^3/min) as follows:

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$$Q_{std} = \frac{V_{std}}{t}$$

where:

Q_{std}=standard volumetric flow rate, std m^3/min

t=elapsed time, minutes.

Record Q_{std} to the nearest 0.01 std m^3/min in column 6 of Figure 4.

9.2.15 Repeat steps 9.2.9 through 9.2.14 for at least four additional constant flow rates, evenly spaced over the approximate range of 1.0 to 1.8 std m^3/min (35-64 ft^3/min).

9.2.16 For each flow, compute

$\sqrt{\Delta H}\ (P_1/P_{std})(298/T_1)$

(column 7a of Figure 4) and plot these value against Q_{std} as shown in Figure 3a. Be sure to use consistent units (mm Hg or kPa) for barometric pressure. Draw the orifice transfer standard certification curve or calculate the linear least squares slope (m) and intercept (b) of the certification curve:

$\sqrt{\Delta H}\ (P_1/P_{std})(298/T_1)$

$=mQ_{std}+b$. See Figures 3 and 4. A certification graph should be readable to 0.02 std m^3/min.

9.2.17 Recalibrate the transfer standard annually or as required by applicable quality control procedures. (See Reference 2.)

9.3 *Calibration of sampler flow indicator.*

NOTE: For samplers equipped with a flow controlling device, the flow controller must be disabled to allow flow changes during calibration of the sampler's flow indicator, or the alternate calibration of the flow controller given in 9.4 may be used. For samplers using an orifice-type flow indicator downstream of the motor, do not vary the flow rate by adjusting the voltage or power supplied to the sampler.

9.3.1 A form similar to the one illustrated in Figure 5 should be used to record the calibration data.

9.3.2 Connect the transfer standard to the inlet of the sampler. Connect the orifice manometer to the orifice pressure tap, as illustrated in Figure 3b. Make sure there are no leaks between the orifice unit and the sampler.

9.3.3 Operate the sampler for at least 5 minutes to establish thermal equilibrium prior to the calibration.

9.3.4 Measure and record the ambient temperature, T_2, and the barometric pressure, P_2, during calibration.

9.3.5 Adjust the variable resistance or, if applicable, insert the appropriate resistance plate (or no plate) to achieve the desired flow rate.

9.3.6 Let the sampler run for at least 2 min to re-establish the run-temperature conditions. Read and record the pressure drop across the orifice (ΔH) and the sampler flow rate indication (I) in the appropriate columns of Figure 5.

9.3.7 Calculate $\sqrt{\Delta H}\ (P_2/P_{std})(298/T_2)$ and determine the flow rate at standard conditions (Q_{std}) either graphically from the certification curve or by calculating Q_{std} from the least square slope and intercept of the transfer standard's transposed certification curve:

$Q_{std}=1/m\ \sqrt{\Delta H}\ (P_2/P_{std})(298/T_2)-b$

Record the value of Q_{std} on Figure 5.

9.3.8 Repeat steps 9.3.5, 9.3.6, and 9.3.7 for several additional flow rates distributed over a range that includes 1.1 to 1.7 std m^3/min.

9.3.9 Determine the calibration curve by plotting values of the appropriate expression involving I, selected from Table 1, against Q_{std}. The choice of expression from Table 1 depends on the flow rate measurement device used (see Section 7.4.1) and also on whether the calibration curve is to incorporate geographic average barometric pressure (P_a) and seasonal average temperature (T_a) for the site to approximate actual pressure and temperature. Where P_a and T_a can be determined for a site for a seasonal period such that the actual barometric pressure and temperature at the site do not vary by more than ±60 mm Hg (8 kPa) from P_a or ±15°C from T_a, respectively, then using P_a and T_a avoids the need for subsequent pressure and temperature calculation when the sampler is used. The geographic average barometric pressure (P_a) may be estimated from an altitude-pressure table or by making an (approximate) elevation correction of -26 mm Hg (-3.46 kPa) for each 305 m (1,000 ft) above sea level (760 mm Hg or 101 kPa). The seasonal average temperature (T_a) may be estimated from weather station or other records. Be sure to use consistent units (mm Hg or kPa) for barometric pressure.

9.3.10 Draw the sampler calibration curve or calculate the linear least squares slope (m), intercept (b), and correlation coefficient of the calibration curve: [Expression from Table 1]= $mQ_{std}+b$. See Figures 3 and 5. Calibration curves should be readable to 0.02 std m^3/min.

9.3.11 For a sampler equipped with a flow controller, the flow controlling mechanism should be re-enabled and set to a flow near the lower flow limit to allow maximum control range. The sample flow rate should be verified at this time with a clean filter installed. Then add two or more filters to the sampler to see if the flow controller maintains a constant flow; this is particularly important at high altitudes where the range of the flow controller may be reduced.

9.4 Alternate calibration of flow-controlled samplers. A flow-controlled sampler may be calibrated solely at its controlled flow rate, provided that previous operating history of the sampler demonstrates that the flow rate is stable and reliable. In this case, the flow indicator may remain uncalibrated but should be used to indicate any relative change between initial and final flows, and the sampler should be recalibrated more often to minimize potential loss of samples because of controller malfunction.

9.4.1 Set the flow controller for a flow near the lower limit of the flow range to allow maximum control range.

9.4.2 Install a clean filter in the sampler and carry out steps 9.3.2, 9.3.3, 9.3.4, 9.3.6, and 9.3.7.

9.4.3 Following calibration, add one or two additional clean filters to the sampler, reconnect the transfer standard, and operate the sampler to verify that the controller maintains the same calibrated flow rate; this is particularly important at high altitudes where the flow control range may be reduced.

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TABLE 1. EXPRESSIONS FOR PLOTTING SAMPLER CALIBRATION CURVES

Type of sampler flow rate measuring device	Expression: For actual pressure and temperature corrections	Expression: For incorporation of geographic average pressure and seasonal average temperature
Mass flowmeter	I	I
Orifice and pressure indicator	$\sqrt{I\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$	$\sqrt{I\left(\frac{P_2}{P_a}\right)\left(\frac{T_a}{T_2}\right)}$
Rotameter, or orifice and pressure recorder having square root scale*	$I\sqrt{\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$	$I\sqrt{\left(\frac{P_2}{P_a}\right)\left(\frac{T_a}{T_2}\right)}$

*This scale is recognizable by its nonuniform divisions and is the most commonly available for high-volume samplers.

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TABLE 2. EXPRESSIONS FOR DETERMINING FLOW RATE DURING SAMPLER OPERATION

Type of sampler flow rate measuring device	Expression: For actual pressure and temperature corrections	Expression: For use when geographic average pressure and seasonal average temperature have been incorporated into the sampler calibration
Mass flowmeter	I	I
Orifice and pressure indicator	$\sqrt{I\left(\frac{P_3}{P_{std}}\right)\left(\frac{298}{T_3}\right)}$	$\sqrt{I}$
Rotameter, or orifice and pressure recorder having square root scale*	$I\sqrt{\left(\frac{P_3}{P_{std}}\right)\left(\frac{298}{T_3}\right)}$	I

*This scale is recognizable by its nonuniform divisions and is the most commonly available for high-volume samplers.

10.0 *Calculations of TSP Concentration.*

10.1 Determine the average sampler flow rate during the sampling period according to either 10.1.1 or 10.1.2 below.

10.1.1 For a sampler without a continuous flow recorder, determine the appropriate expression to be used from Table 2 corresponding to the one from Table 1 used in step 9.3.9. Using this appropriate expression, determine Q_{std} for the initial flow rate from the sampler calibration curve, either graphically or from the transposed regression equation:

Q_{std}=
1/m ([Appropriate expression from Table 2] - b)

Similarly, determine Q_{std} from the final flow reading, and calculate the average flow Q_{std} as one-half the sum of the initial and final flow rates.

10.1.2 For a sampler with a continuous flow recorder, determine the average flow rate device reading, I, for the period. Determine the appropriate expression from Table 2 corresponding to the one from Table 1 used in step 9.3.9. Then using this expression and the average flow rate reading, determine Q_{std} from the sampler calibration curve, either graphically or from the transposed regression equation:

Q_{std}=
1/m ([Appropriate expression from Table 2] - b)

If the trace shows substantial flow change during the sampling period, greater accuracy may be achieved by dividing the sampling period into intervals and calculating an average reading before determining Q_{std}.

10.2 Calculate the total air volume sampled as:

$V—Q_{std}Xt$

where:

V = total air volume sampled, in standard volume units, std m^3/;

Q_{std}=average standard flow rate, std m^3/min;

t = sampling time, min.

10.3 Calculate and report the particulate matter concentration as:

$$TSP = \frac{(W_f—W_i)\times 10^6}{V}$$

where:

TSP=mass concentration of total suspended particulate matter, μg/std m^3;

W_i=initial weight of clean filter, g;

W_f=final weight of exposed filter, g;

V=air volume sampled, converted to standard conditions, std m^3,

10^6=conversion of g to μg.

10.4 If desired, the actual particulate matter concentration (see Section 2.2) can be calculated as follows:

$(TSP)_a$=TSP $(P_3/P_{std})(298/T_3)$

where:

$(TSP)_a$=actual concentration at field conditions, μg/m^3;

TSP=concentration at standard conditions, μg/std m^3;

P_3=average barometric pressure during sampling period, mm Hg;

P_{std}=760 mn Hg (or 101 kPa);

T_3=average ambient temperature during sampling period, K.

11.0 *References.*

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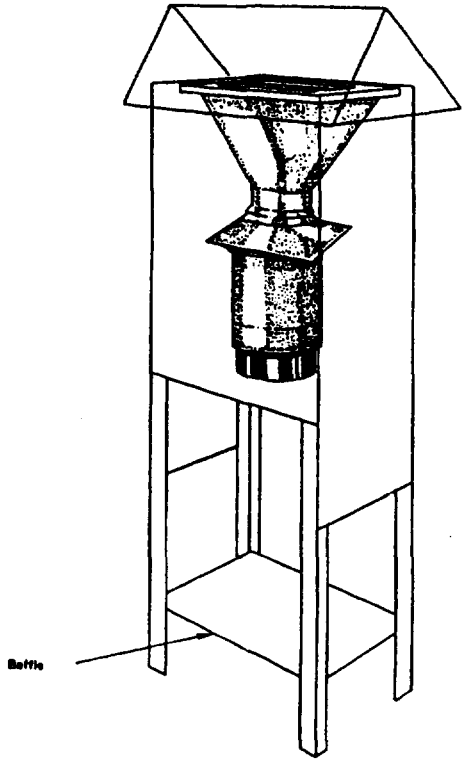

Figure 1. High-volume sampler in shelter.

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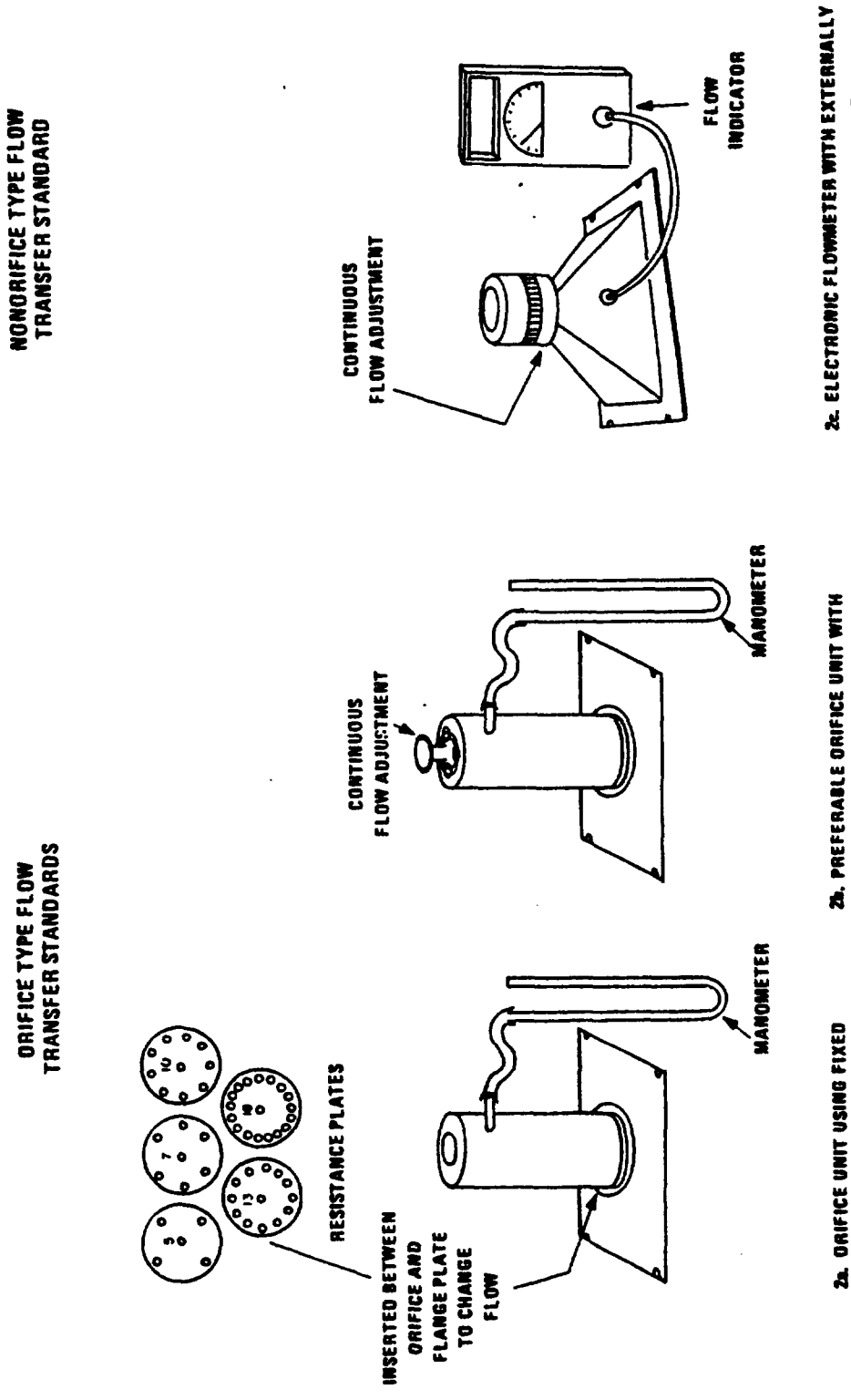

Figure 2. Various types of flow transfer standards. Note that all devices are designed to mount to the filter inlet area of the sampler.

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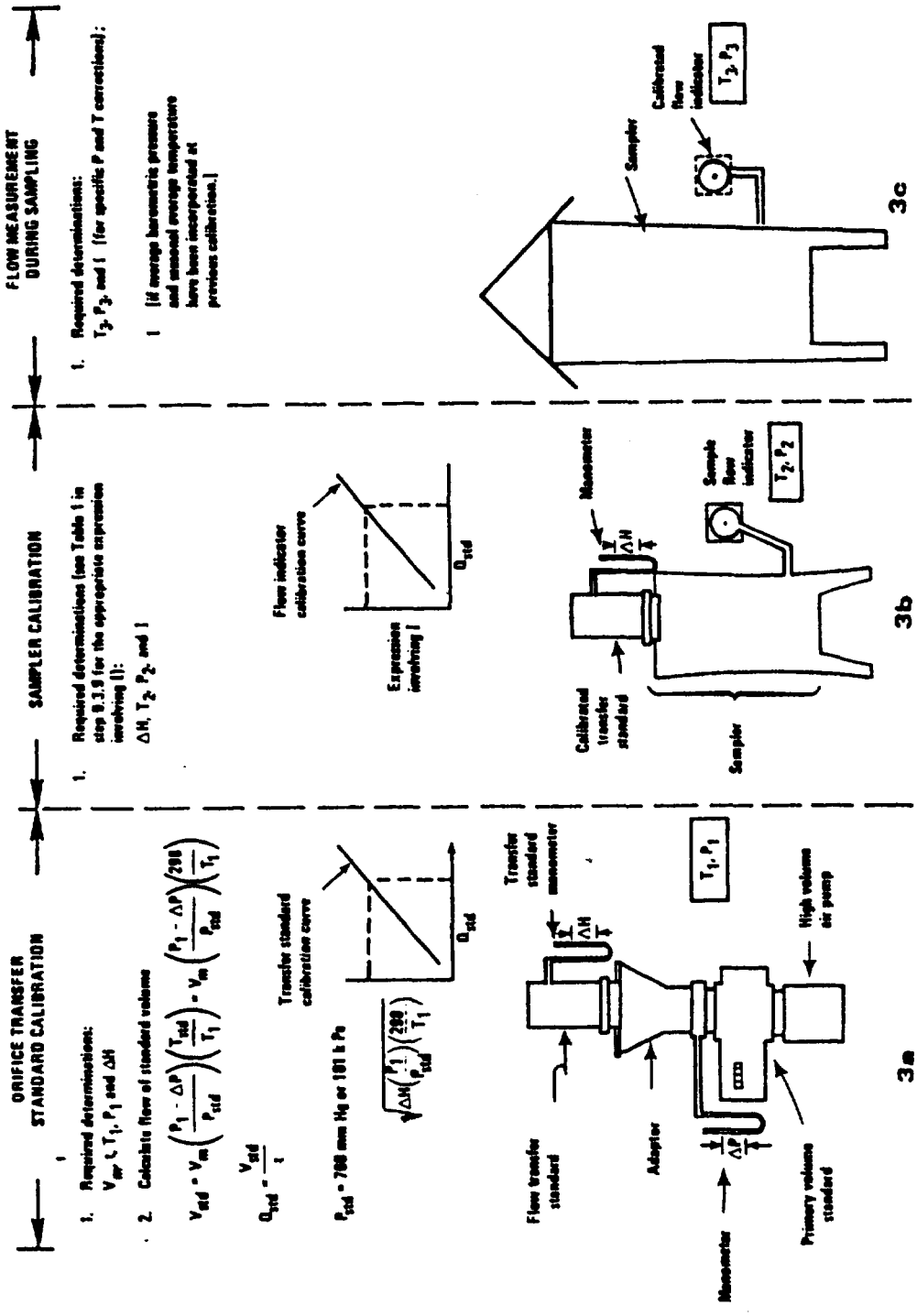

Figure 3. Illustration of the 3 steps in the flow measurement process.

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ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET

Run No.	(1) Meter reading start V_i (m^3)	(2) Meter reading stop V_f (m^3)	(3) Sampling time t (min)	(4) Volume measured V_m (m^3)	(5) Differential pressure (at inlet to volume meter) ΔP (mm Hg or kPa)	(6) (X) Flow rate Q_{std} (std m^3/min)	(7) Pressure drop across orifice ΔH ☐ (in) or ☐ (cm) of water	(7a) (Y) $\sqrt{\Delta H\left(\frac{P_1}{P_{std}}\right)\left(\frac{298}{T_1}\right)}$
1								
2								
3								
4								
5								
6								

RECORDED CALIBRATION DATA

Standard volume meter no. _____

Transfer standard type: ☐ orifice ☐ other

Model No. _____ Serial No. _____

(8) P_1: _____ mm Hg (or kPa) (10) P_{std}: 760 mm Hg (or 101 kPa)

(9) T_1: _____ K (11) T_{std}: 298 K

Calibration performed by: _____

Date: _____

CALCULATION EQUATIONS

(1) $V_m = V_f - V_i$

(2) $V_{std} = V_m\left(\frac{P_1 - \Delta P}{P_{std}}\right)\left(\frac{T_{std}}{T_1}\right)$

(3) $Q_{std} = \frac{V_{std}}{t}$

LEAST SQUARES CALCULATIONS

Linear ($Y = mX + b$) regression equation of $Y = \sqrt{\Delta H(P_1/P_{std})(298/T_1)}$ on $X = Q_{std}$ for Orifice Calibration Unit (i.e., $\sqrt{\Delta H(P_1/P_{std})(298/T_1)} = mQ_{std} + b$)

Slope (m) = _____ Intercept (b) = _____ Correlation coefficient (r) = _____

To use for subsequent calibration: $X = \frac{1}{m}(Y-b)$; $\boxed{Q_{std} = \frac{1}{m}\left(\sqrt{\Delta H\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)} - b\right)}$

Figure 4. Example of orifice transfer standard certification worksheet.

[Appendix B added at 47 FR 54912, Dec. 6, 1982; 48 FR 17355, April 22, 1983]

HIGH-VOLUME AIR SAMPLER CALIBRATION WORKSHEET

Site Location: _____

Date: _____ Barometric Pressure, P_2 mm Hg (or kPa) _____

Calibrated By: _____ Temperature, T_2 (K) _____

Sampler No. _____ Serial No. _____

Transfer std. type: _____ Serial No. _____

					(Y) For specific pressure and temperature corrections (see Table 1)	(Y) For incorporation of average pressure and seasonal average temperature (see Table 1)
P_{std} = 760 mm Hg (or 101 kPa) Optional: Average barometric pressure: P_a = _____ Seasonal average temperature: T_a = _____					☐ I or ☐ $\sqrt{I\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$ or ☐ $I\sqrt{\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$	☐ I. or ☐ $\sqrt{I\left(\frac{P_2}{P_a}\right)\left(\frac{T_a}{T_2}\right)}$ or ☐ $I\sqrt{\left(\frac{P_2}{P_a}\right)\left(\frac{T_a}{T_2}\right)}$
No.	ΔH Pressure drop across orifice ☐(in) or ☐(cm) of water	$\sqrt{\Delta H\left(\frac{P_2}{P_{std}}\right)\left(\frac{298}{T_2}\right)}$	(X) Q_{std} (from orifice certification) std m^3/min	I Sampler flow rate indication (arbitrary)		
1						
2						
3						
4						
5						
6						

LEAST SQUARES CALCULATIONS

Linear regression of Y on X: $Y = mX + b$; Y = appropriate expression from Table 1; $X = Q_{std}$.

Slope (m) = ____ Intercept (b) = ____ Correlation Coeff. (r) = _____

To determine subsequent flow rate during use: $X = \frac{1}{m}(Y-b)$; $Q_{std} = \frac{1}{m}$ ([appropriate expression from Table 2] - b)

Figure 5. Example of high-volume air sampler calibration worksheet.

[47 FR 54912, Dec. 6, 1982; 48 FR 17355, Apr. 22, 1983]

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APPENDIX C—MEASUREMENT PRINCIPLE AND CALIBRATION PROCEDURE FOR THE MEASUREMENT OF CARBON MONOXIDE IN THE ATMOSPHERE (NON-DISPERSIVE INFRARED PHOTOMETRY)

Measurement Principle

1. Measurements are based on the absorption of infrared radiation by carbon monoxide (CO) in a non-dispersive photometer. Infrared energy from a source is passed through a cell containing the gas sample to be analyzed, and the quantitative absorption of energy by CO in the sample cell is measured by a suitable detector. The photometer is sensitized to CO by employing CO gas in either the detector or in a filter cell in the optical path, thereby limiting the measured absorption to one or more of the characteristic wavelengths at which CO strongly absorbs. Optical filters or other means may also be used to limit sensitivity of the photometer to a narrow band of interest. Various schemes may be used to provide a suitable zero reference for the photometer. The measured absorption is converted to an electrical output signal, which is related to the concentration of CO in the measurement cell.

2. An analyzer based on this principle will be considered a reference method only if it has been designated as a reference method in accordance with Part 53 of this chapter.

3. Sampling considerations.

The use of a particle filter on the sample inlet line of an NDIR CO analyzer is optional and left to the discretion of the user or the manufacturer. Use of filter should depend on the analyzer's susceptibility to interference, malfunction, or damage due to particles.

Calibration Procedure

1. *Principle.* Either of two methods may be used for dynamic multipoint calibration of CO analyzers:

(1) One method uses a single certified standard cylinder of CO, diluted as necessary with zero air, to obtain the various calibration concentrations needed.

(2) The other method uses individual certified standard cylinders of CO for each concentration needed. Additional information on calibration may be found in Section 2.0.9 of Reference 1.

2. *Apparatus.* The major components and typical configurations of the calibration systems for the two calibration methods are shown in Figures 1 and 2.

2.1 Flow controller(s). Device capable of adjusting and regulating flow rates. Flow rates for the dilution method (Figure 1) must be regulated to ±1%.

2.2 Flow meter(s). Calibrated flow meter capable of measuring and monitoring flow rates. Flow rates for the dilution method (Figure 1) must be measured with an accuracy of ±2% of the measured value.

2.3 Pressure regulator(s) for standard CO cylinder(s). Regulator must have nonreactive diaphragm and internal parts and a suitable delivery pressure.

2.4 Mixing chamber. A chamber designed to provide thorough mixing of CO and diluent air for the dilution method.

2.5 Output manifold. The output manifold should be of sufficient diameter to insure an insignificant pressure drop at the analyzer connection. The system must have a vent designed to insure atmospheric pressure at the manifold and to prevent ambient air from entering the manifold.

3. *Reagents.*

3.1 CO concentration standard(s). Cylinder(s) of CO in air containing appropriate concentrations(s) of CO suitable for the selected operating range of the analyzer under calibration; CO standards for the dilution method may be contained in a nitrogen matrix if the zero air dilution ratio is not less than 100:1. The assay of the cylinder(s) must be traceable either to a National Bureau of Standards (NBS) CO in air Standard Reference Material (SRM) or to an NBS/EPA-approved commercially available Certified Reference Material (CRM). CRM's are described in Reference 2, and a list of CRM sources is available from the address shown for Reference 2. A recommended protocol for certifying CO gas cylinders against either a CO SRM or a CRM is given in Reference 1. CO gas cylinders should be recertified on a regular basis as determined by the local quality control program.

3.2 Dilution gas (zero air). Air, free of contaminants which will cause a detectable response on the CO analyzer. The zero air should contain <0.1 ppm CO. A procedure for generating zero air is given in Reference 1.

4. *Procedure Using Dynamic Dilution Method.*

4.1 Assemble a dynamic calibration system such as the one shown in Figure 1. All calibration gases including zero air must be introduced into the sample inlet of the analyzer system. For specific operating instructions refer to the manufacturer's manual.

4.2 Insure that all flowmeters are properly calibrated, under the conditions of use, if appropriate, against an authoritative standard such as a soap-bubble meter or wet-test meter. All volumetric flowrates should be corrected to 25°C and 760 mm Hg (101 kPa). A discussion on calibration of flowmeters is given in Reference 1.

4.3 Select the operating range of the CO analyzer to be calibrated.

4.4 Connect the signal output of the CO analyzer to the input of the strip chart recorder or other data collection device. All adjustments to the analyzer should be based on the appropriate strip chart or data device readings. References to analyzer responses in the procedure given below refer to recorder or data device responses.

4.5 Adjust the calibration system to deliver zero air to the output manifold. The total air flow must exceed the total demand of the analyzer(s) connected to the output manifold to insure that no ambient air is pulled into the manifold vent. Allow the analyzer to sample zero air until a stable respose is obtained. After the response has stabilized, adjust the analyzer zero control. Offsetting the analyzer zero adjustments to +5 percent of scale is recommended to facilitate observing negative zero drift. Record the stable zero air response as Z_{CO}.

4.6 Adjust the zero air flow and the CO flow from the standard CO cylinder to provide a diluted CO concentration of approximately 80 percent of the upper range limit (URL) of the operating range of the analyzer. The total air flow must exceed the total demand of the analyzer(s) connected to the output manifold to insure that no ambient air is pulled into the manifold vent. The exact CO concentration is calculated from:

$$[CO]_{OUT} = \frac{[CO]_{STD} \times F_{CO}}{F_D + F_{CO}} \quad (1)$$

Where:

$[CO]_{OUT}$=diluted CO concentration at the output manifold, ppm;

[Part 50, Appendix C]

each year, the number of days with maximum hourly concentrations above 0.12 ppm is determined and this number is averaged with the results of previous years. As long as this average remains "less than or equal to 1," the area is in compliance.

3. *Estimating the Number of Exceedances for a Year*

In general, a valid daily maximum hourly average value may not be available for each day of the year, and it will be necessary to account for these missing values when estimating the number of exceedances for a particular calendar year. The purpose of these computations is to determine if the expected number of exceedances per year is less than or equal to 1. Thus, if a site has two or more observed exceedances each year, the standard is not met and it is not necessary to use the procedures of this section to account for incomplete sampling.

The term "missing value" is used here in the general sense to describe all days that do not have an associated ozone measurement. In some cases, a measurement might actually have been missed but in other cases no measurement may have been scheduled for that day. A daily maximum ozone value is defined to be the highest hourly ozone value recorded for the day. This daily maximum value is considered to be valid if 75 percent of the hours from 9:01 a.m. to 9:00 p.m. (LST) were measured or if the highest hour is greater than the level of the standard.

In some areas, the seasonal pattern of ozone is so pronounced that entire months need not be sampled because it is extremely unlikely that the standard would be exceeded. Any such waiver of the ozone monitoring requirement would be handled under provisions of 40 CFR Part 58. Some allowance should also be made for days for which valid daily maximum hourly values were not obtained but which would quite likely have been below the standard. Such an allowance introduces a complication in that it becomes necessary to define under what conditions a missing value may be assumed to have been less than the level of the standard. The following criterion may be used for ozone:

A missing daily maximum ozone value may be assumed to be less than the level of the standard if the valid daily maxima on both the preceding day and the following day do not exceed 75 percent of the level of the standard.

Let z denote the number of missing daily maximum values that may be assumed to be less than the standard. Then the following formula shall be used to estimate the expected number of exceedances for the year:

$$e = v + [(v/n)8(N-n-z)] \quad (1)$$

(*Indicates multiplication.)

where:

e=the estimated number of exceedances for the year,

N=the number of required monitoring days in the year,

n=the number of valid daily maxima,

v=the number of daily values above the level of the standard, and

z=the number of days assumed to be less than the standard level.

This estimated number of exceedances shall be rounded to one decimal place (fractional parts equal to 0.05 round up).

It should be noted that N will be the total number of days in the year unless the appropriate Regional Administrator has granted a waiver under the provisions of 40 CFR Part 58.

The above equation may be interpreted intuitively in the following manner. The estimated number of exceedances is equal to the observed number of exceedances (v) plus an increment that accounts for incomplete sampling. There were (N-n) missing values for the year but a certain number of these, namely z, were assumed to be less than the standard. Therefore, (N-n-z) missing values are considered to include possible exceedances. The fraction of measured values that are above the level of the standard is v/n. It is assumed that this same fraction applies to the (N-n-z) missing values and that (v/n)*(N-n-z) of these values would also have exceeded the level of the standard.

[Appendix H added at 44 FR 8220, Feb. 8, 1979]

APPENDIX I—[Reserved]

APPENDIX J TO PART 50—REFERENCE METHOD FOR THE DETERMINATION OF PARTICULATE MATTER AS PM_{10} IN THE ATMOSPHERE

1.0 *Applicability.*

1.1 This method provides for the measurement of the mass concentration of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) in ambient air over a 24-hour period for purposes of determining attainment and maintenance of the primary and secondary national ambient air quality standards for particulate matter specified in §50.6 of this chapter. The measurement process is nondestructive, and the PM_{10} sample can be subjected to subsequent physical or chemical analyses. Quality assurance procedures and guidance are provided in part 58, appendices A and B, of this chapter and in References 1 and 2.

2.0 *Principle.*

2.1 An air sampler draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within the PM_{10} size range. Each size fraction in the PM_{10} size range is then collected on a separate filter over the specified sampling period. The particle size discrimination characteristics (sampling effectiveness and 50 percent cutpoint) of the sampler inlet are prescribed as performance specifications in part 53 of this chapter.

2.2 Each filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain due to collected PM_{10}. The total volume of air sampled, corrected to EPA reference conditions (25°C, 101.3 kPa), is determined from the measured flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is computed as the total mass of collected particles in the PM_{10} size range divided by the volume of air sampled, and is expressed in micrograms per standard cubic meter ($\mu g/std\ m^3$). For PM_{10} samples collected at temperatures and pressures significantly different from EPA reference conditions, these corrected concentrations sometimes differ substantially from actual concentrations (in micrograms per actual cubic meter), particularly at high elevations. Although not required, the actual PM_{10} concentration can be calculated from the corrected concentration, using the average ambient temperature and barometric pressure during the sampling period.

2.3 A method based on this principle will be considered a reference method only if (a) the associated sampler meets the requirements specified in this appendix and the requirements in part 53 of this

chapter, and (b) the method has been designated as a reference method in accordance with part 53 of this chapter.

3.0 *Range.*

3.1 The lower limit of the mass concentration range is determined by the repeatability of filter tare weights, assuming the nominal air sample volume for the sampler. For samplers having an automatic filter-changing mechanism, there may be no upper limit. For samplers that do not have an automatic filter-changing mechanism, the upper limit is determined by the filter mass loading beyond which the sampler no longer maintains the operating flow rate within specified limits due to increased pressure drop across the loaded filter. This upper limit cannot be specified precisely because it is a complex function of the ambient particle size distribution and type, humidity, filter type, and perhaps other factors. Nevertheless, all samplers should be capable of measuring 24-hour PM_{10} mass concentrations of at least 300 $\mu g/std\ m^3$ while maintaining the operating flow rate within the specified limits.

4.0 *Precision.*

4.1 The precision of PM_{10} samplers must be 5 $\mu g/m^3$ for PM_{10} concentrations below 80 $\mu g/m^3$ and 7 percent for PM_{10}concentrations above 80 $\mu g/m^3$, as required by Part 53 of this chapter, which prescribes a test procedure that determines the variation in the PM_{10} concentration measurements of identical samplers under typical sampling conditions. Continual assessment of precision via collocated samplers is required by Part 58 of this chapter for PM_{10} samplers used in certain monitoring networks.

5.0 *Accuracy.*

5.1 Because the size of the particles making up ambient particulate matter varies over a wide range and the concentration of particles varies with particle size, it is difficult to define the absolute accuracy of PM_{10} samplers. Part 53 of this chapter provides a specification for the sampling effectiveness of PM_{10} samplers. This specification requires that the expected mass concentration calculated for a candidate PM_{10} sampler, when sampling a specified particle size distribution, be within ± 10 percent of that calculated for an ideal sampler whose sampling effectiveness is explicitly specified. Also, the particle size for 50 percent sampling effectivensss is required to be 10 ± 0.5 micrometers. Other specifications related to accuracy apply to flow measurement and calibration, filter media, analytical (weighing) procedures, and artifact. The flow rate accuracy of PM_{10} samplers used in certain monitoring networks is required by Part 58 of this chapter to be assessed periodically via flow rate audits.

6.0 *Potential Sources of Error.*

6.1 *Volatile Particles.* Volatile particles collected on filters are often lost during shipment and/or storage of the filters prior to the post-sampling weighing[3]. Although shipment or storage of loaded filters is sometimes unavoidable, filters should be reweighed as soon as practical to minimize these losses.

6.2 *Artifacts.* Positive errors in PM_{10} concentration measurements may result from retention of gaseous species on filters[4, 5]. Such errors include the retention of sulfur dioxide and nitric acid. Retention of sulfur dioxide on filters, followed by oxidation to sulfate, is referred to as artifact sulfate formation, a phenomenon which increases with increasing filter alkalinity[6]. Little or no artifact sulfate formation should occur using filters that meet the alkalinity specification in section 7.2.4. Artifact nitrate formation, resulting primarily from retention of nitric acid, occurs to varying degrees on many filter types, including glass fiber, cellulose ester, and many quartz fiber filters[5, 7, 8, 9, 10]. Loss of true atmospheric particulate nitrate during or following sampling may also occur due to dissociation or chemical reaction. This phenomenon has been observed on Teflon® filters[8] and inferred for quartz fiber filters[11, 12]. The magnitude of nitrate artifact errors in PM_{10} mass concentration measurements will vary with location and ambient temperature; however, for most sampling locations, these errors are expected to be small.

6.3 *Humidity.* The effects of ambient humidity on the sample are unavoidable. The filter equilibration procedure in section 9.0 is designed to minimize the effects of moisture on the filter medium.

6.4 *Filter Handling.* Careful handling of filters between presampling and post-sampling weighings is necessary to avoid errors due to damaged filters or loss of collected particles from the filters. Use of a filter cartridge or cassette may reduce the magnitude of these errors. Filters must also meet the integrity specification in section 7.2.3.

6.5 *Flow Rate Variation.* Variations in the sampler's operating flow rate may alter the particle size discrimination characteristics of the sampler inlet. The magnitude of this error will depend on the sensitivity of the inlet to variations in flow rate and on the particle distribution in the atmosphere during the sampling period. The use of a flow control device (section 7.1.3) is required to minimize this error.

6.6 *Air Volume Determination.* Errors in the air volume determination may result from errors in the flow rate and/or sampling time measurements. The flow control device serves to minimize errors in the flow rate determination, and an elapsed time meter (section 7.1.5) is required to minimize the error in the sampling time measurement.

7.0 *Apparatus.*

7.1 *PM_{10} Sampler.*

7.1.1 The sampler shall be designed to:

a. Draw the air sample into the sampler inlet and through the particle collection filter at a uniform face velocity.

b. Hold and seal the filter in a horizontal position so that sample air is drawn downward through the filter.

c. Allow the filter to be installed and removed conveniently.

d. Protect the filter and sampler from precipitation and prevent insects and other debris from being sampled.

e. Minimize air leaks that would cause error in the measurement of the air volume passing through the filter.

f. Discharge exhaust air at a sufficient distance from the sampler inlet to minimize the sampling of exhaust air.

g. Minimize the collection of dust from the supporting surface.

7.1.2 The sampler shall have a sample air inlet system that, when operated within a specified flow rate range, provides particle size discrimination characteristics meeting all of the applicable performance specifications prescribed in part 53 of this chapter. The sampler inlet shall show no significant wind direction dependence. The latter requirement can generally be satisfied by an inlet shape that is circularly symmetrical about a vertical axis.

7.1.3 The sampler shall have a flow control device capable of maintaining the sampler's operating flow rate within the flow rate limits specified for the sampler inlet over normal variations in line voltage and filter pressure drop.

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7.1.4 The sampler shall provide a means to measure the total flow rate during the sampling period. A continuous flow recorder is recommended but not required. The flow measurement device shall be accurate to ±2 percent.

7.1.5 A timing/control device capable of starting and stopping the sampler shall be used to obtain a sample collection period of 24 ± 1 hr (1,440 ± 60 min). An elapsed time meter, accurate to within ± 15 minutes, shall be used to measure sampling time. This meter is optional for samplers with continuous flow recorders if the sampling time measurement obtained by means of the recorder meets the ± 15 minute accuracy specification.

7.1.6 The sampler shall have an associated operation or instruction manual as required by part 53 of this chapter which includes detailed instructions on the calibration, operation, and maintenance of the sampler.

7.2 *Filters.*

7.2.1 *Filter Medium.* No commercially available filter medium is ideal in all respects for all samplers. The user's goals in sampling determine the relative importance of various filter characteristics (e.g., cost, ease of handling, physical and chemical characteristics, etc.) and, consequently, determine the choice among acceptable filters. Furthermore, certain types of filters may not be suitable for use with some samplers, particularly under heavy loading conditions (high mass concentrations), because of high or rapid increase in the filter flow resistance that would exceed the capability of the sampler's flow control device. However, samplers equipped with automatic filter-changing mechanisms may allow use of these types of filters. The specifications given below are minimum requirements to ensure acceptability of the filter medium for measurement of PM_{10} mass concentrations. Other filter evaluation criteria should be considered to meet individual sampling and analysis objectives.

7.2.2 *Collection Efficiency.* ± 99 percent, as measured by the DOP test (ASTM-2986) with 0.3 μm particles at the sampler's operating face velocity.

7.2.3 *Integrity.* ±5 $\mu g/m^3$ (assuming sampler's nominal 24-hour air sample volume). Integrity is measured as the PM_{10} concentration equivalent corresponding to the average difference between the initial and the final weights of a random sample of test filters that are weighed and handled under actual or simulated sampling conditions, but have no air sample passed through them (i.e., filter blanks). As a minimum, the test procedure must include initial equilibration and weighing, installation on an inoperative sampler, removal from the sampler, and final equilibration and weighing.

7.2.4 *Alkalinity.* <25 microequivalents/gram of filter, as measured by the procedure given in Reference 13 following at least two months storage in a clean environment (free from contamination by acidic gases) at room temperature and humidity.

7.3 *Flow Rate Transfer Standard.* The flow rate transfer standard must be suitable for the sampler's operating flow rate and must be calibrated against a primary flow or volume standard that is traceable to the National Bureau of Standards (NBS). The flow rate transfer standard must be capable of measuring the sampler's operating flow rate with an accuracy of ± 2 percent.

7.4 *Filter Conditioning Environment.*

7.4.1 Temperature range: 15° to 30°C.

7.4.2 Temperature control: ±3°C.

7.4.3 Humidity range: 20% to 45% RH.

7.4.4 Humidity control: ± 5% RH.

7.5 *Analytical Balance.* The analytical balance must be suitable for weighing the type and size of filters required by the sampler. The range and sensitivity required will depend on the filter tare weights and mass loadings. Typically, an analytical balance with a sensitivity of 0.1 mg is required for high volume samplers (flow rates >0.5 m^3/min). Lower volume samplers (flow rates > 0.5 m^3/min) will require a more sensitive balance.

8.0 *Calibration.*

8.1 *General Requirements.*

8.1.1 Calibration of the sampler's flow measurement device is required to establish traceability of subsequent flow measurements to a primary standard. A flow rate transfer standard calibrated against a primary flow or volume standard shall be used to calibrate or verify the accuracy of the sampler's flow measurement device.

8.1.2 Particle size discrimination by inertial separation requires that specific air velocities be maintained in the sampler's air inlet system. Therefore, the flow rate through the sampler's inlet must be maintained throughout the sampling period within the design flow rate range specified by the manufacturer. Design flow rates are specified as actual volumetric flow rates, measured at existing conditions of temperature and pressure (Q_a). In contrast, mass concentrations of PM_{10} are computed using flow rates corrected to EPA reference conditions of temperature and pressure (Q_{std}).

8.2 *Flow Rate Calibration Procedure.*

8.2.1 PM_{10} samplers employ various types of flow control and flow measurement devices. The specific procedure used for flow rate calibration or verification will vary depending on the type of flow controller and flow indicator employed. Calibration in terms of actual volumetric flow rates (Q_a) is generally recommended, but other measures of flow rate (e.g., Q_{std}) may be used provided the requirements of section 8.1 are met. The general procedure given here is based on actual volumetric flow units (Q_a) and serves to illustrate the steps involved in the calibration of a PM_{10} sampler. Consult the sampler manufacturer's instruction manual and Reference 2 for specific guidance on calibration. Reference 14 provides additional information on the use of the commonly used measures of flow rate and their interrelationships.

8.2.2 Calibrate the flow rate transfer standard against a primary flow or volume standard traceable to NBS. Establish a calibration relationship (e.g., an equation or family of curves) such that traceability to the primary standard is accurate to within 2 percent over the expected range of ambient conditions (i.e., temperatures and pressures) under which the transfer standard will be used. Recalibrate the transfer standard periodically.

8.2.3 Following the sampler manufacturer's instruction manual, remove the sampler inlet and connect the flow rate transfer standard to the sampler such that the transfer standard accurately measures the sampler's flow rate. Make sure there are no leaks between the transfer standard and the sampler.

8.2.4 Choose a minimum of three flow rates (actual m^3/min), spaced over the acceptable flow rate range specified for the inlet (see 7.1.2) that can be obtained by suitable adjustment of the sampler flow rate. In accordance with the sampler manufacturer's instruction manual, obtain or verify the calibration relationship between the flow rate (actual m^3/min) as

[Part 50, Appendix J]

indicated by the transfer standard and the sampler's flow indicator response. Record the ambient temperature and barometric pressure. Temperature and pressure corrections to subsequent flow indicator readings may be required for certain types of flow measurement devices. When such corrections are necessary, correction on an individual or daily basis is preferable. However, seasonal average temperature and average barometric pressure for the sampling site may be incorporated into the sampler calibration to avoid daily corrections. Consult the sampler manufacturer's instruction manual and Reference 2 for additional guidance.

8.2.5 Following calibration, verify that the sampler is operating at its design flow rate (actual m^3/min) with a clean filter in place.

8.2.6 Replace the sampler inlet.

9.0 *Procedure.*

9.1 The sampler shall be operated in accordance with the specific guidance provided in the sampler manufacturer's instruction manual and in Reference 2. The general procedure given here assumes that the sampler's flow rate calibration is based on flow rates at ambient conditions (Q_a) and serves to illustrate the steps involved in the operation of a PM_{10} sampler.

9.2 Inspect each filter for pinholes, particles, and other imperfections. Establish a filter information record and assign an identification number to each filter.

9.3 Equilibrate each filter in the conditioning environment (see 7.4) for at least 24 hours.

9.4 Following equilibration, weigh each filter and record the presampling weight with the filter identification number.

9.5 Install a preweighed filter in the sampler following the instructions provided in the sampler manufacturer's instruction manual.

9.6 Turn on the sampler and allow it to establish run-temperature conditions. Record the flow indicator reading and, if needed, the ambient temperature and barometric pressure. Determine the sampler flow rate (actual m^3/min) in accordance with the instructions provided in the sampler manufacturer's instruction manual. NOTE.—No onsite temperature or pressure measurements are necessary if the sampler's flow indicator does not require temperature or pressure corrections or if seasonal average temperature and average barometric pressure for the sampling site are incorporated into the sampler calibration (see step 8.2.4). If individual or daily temperature and pressure corrections are required, ambient temperature and barometric pressure can be obtained by on-site measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampling site and the airport.

9.7 If the flow rate is outside the acceptable range specified by the manufacturer, check for leaks, and if necessary, adjust the flow rate to the specified setpoint. Stop the sampler.

9.8 Set the timer to start and stop the sampler at appropriate times. Set the elapsed time meter to zero or record the initial meter reading.

9.9 Record the sample information (site location or identification number, sample date, filter identification number, and sampler model and serial number).

9.10 Sample for 24 ± 1 hours.

9.11 Determine and record the average flow rate (Q_a) in actual m^3/min for the sampling period in accordance with the instructions provided in the sampler manufacturer's instruction manual. Record the elapsed time meter final reading and, if needed, the average ambient temperature and barometric pressure for the sampling period (see note following step 9.6).

9.12 Carefully remove the filter from the sampler, following the sampler manufacturer's instruction manual. Touch only the outer edges of the filter.

9.13 Place the filter in a protective holder or container (e.g., petri dish, glassine envelope, or manila folder).

9.14 Record any factors such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement on the filter information record.

9.15 Transport the exposed sample filter to the filter conditioning environment as soon as possible for equilibration and subsequent weighing.

9.16 Equilibrate the exposed filter in the conditioning environment for at least 24 hours under the same temperature and humidity conditions used for presampling filter equilibration (see 9.3).

9.17 Immediately after equilibration, reweigh the filter and record the post-sampling weight with the filter identification number.

10.0 *Sampler Maintenance.*

10.1 The PM_{10} sampler shall be maintained in strict accordance with the maintenance procedures specified in the sampler manufacturer's instruction manual.

11.0 *Calculations.*

11.1 Calculate the average flow rate over the sampling period corrected to EPA reference conditions as Q_{std}. When the sampler's flow indicator is calibrated in actual volumetric units (Q_a), Q_{std} is calculated as:

$$\overline{Q}_{std} = \overline{Q}_a \times (P_{av}/T_{av})(T_{std}/P_{std})$$

where

$\overline{Q}_{std}$=average flow rate at EPA reference conditions, std m^3/min;

$\overline{Q}_a$=average flow rate at ambient conditions, m^3/min;

P_{av}=average barometric pressure during the sampling period or average barometric pressure for the sampling site, kPa (or mm Hg);

T_{av}=average ambient temperature during the sampling period or seasonal average ambient temperature for the sampling site, K;

T_{std}=standard temperature, defined as 298 K;

P_{std}=standard pressure, defined as 101.3 kPa (or 760 mm Hg).

11.2 Calculate the total volume of air sampled as:

$$V_{std} = \overline{Q}_{std} t$$

where

V_{std}=total air sampled in standard volume units, std m^3;

t=sampling time, min.

11.3 Calculate the PM_{10} concentration as:

$$PM_{10} = (W_f - W_i) \times 10^6/V_{std}$$

where

PM_{10} =mass concentration of PM_{10}, μg/std m^3;

W_f, W_i=final and initial weights of filter collecting PM_{10}particles, g;

10^6=conversion of g to μg.

NOTE: If more than one size fraction in the PM_{10} size range is collected by the sampler, the sum of the net weight gain by each collection filter [$\Sigma S(W_f - W_i)$] is used to calculate the PM_{10} mass concentration.

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[Appendix J added at 52 FR 24663, July 1, 1987; amended at 52 FR 29467, Aug. 7, 1987]

APPENDIX K TO PART 50—INTERPRETATION OF THE NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER

1.0 *General.*

This appendix explains the computations necessary for analyzing particulate matter data to determine attainment of the 24-hour and annual standards specified in 40 CFR 50.6. For the primary and secondary standards, particulate matter is measured in the ambient air as PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers) by a reference method based on Appendix J of this part and designated in accordance with part 53 of this chapter, or by an equivalent method designated in accordance with part 53 of this chapter. The required frequency of measurements is specified in part 58 of this chapter.

Several terms used throughout this appendix must be defined. A "daily value" for PM_{10} refers to the 24-hour average concentration of PM_{10} calculated or measured from midnight to midnight (local time). The term "exceedance" means a daily value that is above the level of the 24-hour standard after rounding to the nearest 10 $\mu g/m^3$ (i.e., values ending in 5 or greater are to be rounded up). The term "average" refers to an arithmetic mean. All particulate matter standards are expressed in terms of expected annual values: expected number of exceedances per year for the 24-hour standards and expected annual arithmetic mean for the annual standards. The "expected annual value" is the number approached when the annual values from an increasing number of years are averaged, in the absence of long-term trends in emissions or meteorological conditions. The term "year" refers to a calendar year.

Although the discussion in this appendix focuses on monitored data, the same principles apply to modeling data, subject to EPA modeling guidelines.

2.0 *Attainment Determinations.*

2.1 *24-Hour Primary and Secondary Standards.*

Under 40 CFR 50.6(a) the 24-hour primary and secondary standards are attained when the expected number of exceedances per year at each monitoring site is less than or equal to one. In the simplest case, the number of expected exceedances at a site is determined by recording the number of exceedances in each calendar year and then averaging them over the past 3 calendar years. Situations in which 3 years of data are not available and possible adjustments for unusual events or trends are discussed in Sections 2.3 and 2.4. Further, when data for a year are incomplete, it is necessary to compute an estimated number of exceedances for that year by adjusting the observed number of exceedances. This procedure, performed by calendar quarter, is described in Section 3. The expected number of exceedances is then estimated by averaging the individual annual estimates for the past 3 years.

The comparison with the allowable expected exceedance rate of one per year is made in terms of a number rounded to the nearest tenth (fractional values equal to or greater than 0.05 are to be rounded up; e.g., an exceedance rate of 1.05 would be rounded to 1.1, which is the lowest rate for nonattainment).

2.2 *Annual Primary and Secondary Standards.*

Under 40 CFR 50.6(b), the annual primary and secondary standards are attained when the expected annual arithmetic mean PM_{10} concentration is less than or equal to the level of the standard. In the simplest case, the expected annual arithmetic mean is determined by averaging the annual arithmetic mean PM_{10} concentrations for the past 3 calendar years. Because of the potential for incomplete data and the possible seasonality in PM_{10} concentrations, the annual mean shall be calculated by averaging the four quarterly means of PM_{10} concentrations within the calendar year. The formulas for calculating the annual arithmetic mean are given in Section 4. Situations in which 3 years of data are not available and possible adjustments for unusual events or trends are discussed in Sections 2.3 and 2.4. The expected annual arith-

ATTACHMENT QQ
NUISANCE DUST

NUISANCE DUST, RESPIRABLE

FORMULA: The respirable fraction of the dust mass, as specified by the American Conference of Governmental Industrial Hygienists [1]

METHOD: 0600
ISSUED: 2/15/84

OSHA: 5 mg/m³
NIOSH: no standard
ACGIH: 5 mg/m³

PROPERTIES: Penetrates the non-ciliated portions of the lung; quartz less than 1%

SYNONYMS: boron oxide (CAS #1303-86-2) and nuisance dusts [2], including alumina (CAS #1344-28-1), calcium carbonate (CAS #1317-65-3), cellulose (paper fiber; CAS #9004-34-6), glycerin mist (CAS #56-81-5), limestone (CAS #1317-65-3), etc.

SAMPLING

SAMPLER: CYCLONE + FILTER (10-mm Dorr-Oliver cyclone + tared 5-µm PVC membrane)

FLOW RATE: 1.7 L/min

VOL-MIN: 75 L @ 5 mg/m³
-MAX: 1000 L @ 5 mg/m³

SHIPMENT: routine

SAMPLE STABILITY: indefinitely

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: 0.5 to 10 mg/m³ (lab and field)

BIAS: depends on dust size distributions [3]

OVERALL PRECISION (s_r): 0.043 to 0.145 (lab); 0.144 to 0.227 (field) [4]

MEASUREMENT

TECHNIQUE: GRAVIMETRIC (FILTER WEIGHING)

ANALYTE: mass of respirable dust fraction

BALANCE: 0.01 mg sensitivity or better; use same balance before and after sample collection

CALIBRATION: National Bureau of Standards Class M weights

RANGE: 0.3 to 2 mg per sample

ESTIMATED LOD: 0.2 mg per sample

PRECISION: 68 µg with 0.01-mg sensitivity balance [5]

APPLICABILITY: The method measures the mass concentration of any non-volatile respirable dust. Besides inert dusts [1], the method is recommended for respirable coal dust, which has an OSHA PEL = 2.4 mg/m³. The method may be biased where the respirable fraction is defined by the British Medical Research Council's criteria or the MRE horizontal elutriator [4].

INTERFERENCES: Larger than respirable particles (over 10 µm) have been found in some cases by microscopic analysis of cyclone filters. Over-sized particles in the sample are known to be caused by inverting the cyclone assembly. Heavy dust loadings, charged particles, fibers and water-saturated dusts also interfere with the cyclone's size-selective properties.

OTHER METHODS: This method is based on and replaces Sampling Data Sheet #29.02 [6].

EQUIPMENT:

1. Sampler:
   a. Filter: 37-mm diameter, 5.0-μm pore size, polyvinyl chloride filter or equivalent hydrophobic membrane filter supported with backup pad in a two-piece, 37-mm cassette filter holder held together by tape or cellulose shrink band.
   b. Cyclone: 10-mm Dorr-Oliver nylon cyclone.
   c. Sampling head holder: this holder must keep the cassette, cyclone and coupler together rigidly so that air enters only at the cyclone inlet.
2. Personal sampling pump, 1.7 L/min ± 5%, with flexible connecting tubing.
   NOTE: Pulsation in the pump flow must be within ± 20% of the mean flow.
3. Balance, analytical, with sensitivity of at least 0.01 mg. A more sensitive balance will be necessary for substances with PEL's below 1 mg/m³.
4. Static neutralizer, e.g., Po-210; replace nine months after the production date.
5. Environmental chamber for balance, e.g., 20 °C ± 0.3 °C and 50% ± 5% RH.
6. Vacuum desiccator.

SPECIAL PRECAUTIONS: None.

PREPARATION OF SAMPLERS BEFORE SAMPLING:

1. Dry filters and backup pads under vacuum in the vacuum desiccator for at least 15 min.
2. Release the vacuum, remove the desiccator cover, and equilibrate the filters in the environmental chamber for at least 1 hr.
3. Number the backup pads with a ballpoint pen and place them, numbered side down, in filter cassette bottom sections.
4. Weigh the filters in the environmental chamber. Record the filter tare weight, W_1 (mg).
   a. Zero the balance before each weighing;
   b. Handle the filter with forceps (nylon forceps if further analyses will be done); and
   c. Pass the filter over an antistatic radiation source. Repeat this step if filter does not release easily from the forceps or if filter attracts balance pan. Static electricity can cause erroneous weight readings.
5. Place the weighed filters on top of the backup pads in the filter cassette bottom sections and allow to stand an additional 8 to 16 hrs in the environmental chamber.
6. Reweigh the filters. If this tare weight differs by more than 0.01 mg from the first tare weight obtained in step 4 above, discard the filter.
   NOTE: Insert a rod through the outlet hole of the filter cassette bottom section to raise the backup pad and filter so that the filter can be grasped with forceps.
7. Assemble the filters in the filter cassettes and close firmly so that leakage around the filter will not occur. Place a plug in each opening of the filter cassette. Place a cellulose shrink band around the filter cassette, allow to dry, and mark with the same number as the backup pad.
8. Remove the cyclone's grit cap and vortex finder before use and inspect the cyclone interior. If the inside is visibly scored, discard this cyclone since the dust separation characteristics of the cyclone might be altered. Clean the interior of the cyclone to prevent reentrainment of large particles.
9. Assemble the sampler head. Check alignment of filter holder and cyclone in the sampling head to prevent leakage.

SAMPLING:

10. Calibrate each personal sampling pump to 1.7 L/min with a representative sampler in line.
11. Sample at 1.7 L/min for 45 min to 8 hrs (76 to 816 L). Do not exceed 5 mg dust loading on the filter.

    NOTE: Do not allow the sampler assembly to be inverted at any time. Turning the cyclone to anything more than a horizontal orientation may deposit over-sized material from the cyclone body onto the filter.

SAMPLE PREPARATION:

12. Wipe dust from the external surface of the filter cassette with a moist paper towel to minimize contamination. Discard the paper towel.
13. Remove the top and bottom plugs from the filter cassette. Place the filter cassettes in a vacuum desiccator under vacuum for at least 15 min, followed by equilibration for at least 1 hr in the environmental chamber.
14. Remove the filter cassette band, pry open the filter cassette, and remove the filter by inserting a rod in the outlet hole of the filter cassette. Handle the filters very gently by the edge to avoid loss of dust.

    NOTE: If the filter sticks to the underside of the cassette top, very gently lift away by using the dull side of a scalpel blade. This must be done carefully or the filter will tear.

CALIBRATION AND QUALITY CONTROL:

15. Zero the microbalance before all weighings. Use the same microbalance for weighing filters before and after sample collection. Calibrate the balance with National Bureau of Standards Class M weights.
16. Take two to four replicate samples for every batch of field samples for quality assurance on the sampling procedures. The set of replicate samples should be exposed to the same dust environment, either in a laboratory dust chamber [7] or in the field [8]. The quality control samples must be taken with the same equipment, procedures and personnel used in the routine field samples. Calculate precision from these replicates and record s_r on control charts. Take corrective action when the precision is out of control [7].

MEASUREMENT:

17. Weigh each filter, including field blanks. Record this post-sampling weight, W_2 (mg), beside its corresponding tare weight. Record anything remarkable about a filter (e.g., visible particles, overloaded, leakage, wet, torn, etc.).

CALCULATIONS:

18. Calculate the concentration of respirable nuisance dust, C (mg/m³), in the air volume sampled, V (L):

$$C = \frac{(W_2 - W_1) + B}{V} \cdot 10^3, \text{ mg/m}^3$$

where: W_1 = tare weight of filter before sampling (mg)
W_2 = post-sampling weight of sample-containing filter (mg)
B = mean change in field blank filter weights between tare and post-sampling (mg) (+ or -).

EVALUATION OF METHOD:

1. Bias. In respirable dust measurements, the bias in a sample is calculated relative to the appropriate respirable dust criterion. The theory for calculating bias is developed by Bartley and Breuer [3]. For this method, the bias, therefore, depends on the ACGIH criterion for respirable dust, the cyclone's penetration curve at 1.7 L/min flow rate, and the size distribution of the ambient dust. Based on the cyclone's penetration curves for non-pulsating flow measured with a monodisperse aerosol by Caplan, Doemeny and Sorenson [9], the bias in this method is shown in Figure 1.

   For dust size distributions in the shaded region, the bias in this method lies within the ± 0.10 criterion established by NIOSH for method validation. Bias larger than ± 0.10 would, therefore, be expected for many workplace aerosols, especially those with small mass median diameters. However, bias within ± 0.20 would be expected for dusts with geometric standard deviations greater than 2.0, which is the case in most workplaces.

   Bias can also be caused in a cyclone by the pulsation of the personal sampling pump. Bartley, et al. [10] showed that cyclone samples with pulsating flow can have negative bias as large as -0.22 relative to samples with steady flow. The magnitude of the bias depends on the amplitude of the pulsation at the cyclone aperture and the dust size distribution. For pumps with instantaneous flow rates within 20% of the mean, the pulsation bias is less than -0.02 for most dust size distributions encountered in the workplace.

   Electric charges on the dust and the cyclone will also cause bias. Briant and Moss [11] have found electrostatic biases as large as -50%, and show that cyclones made with graphite-filled nylon eliminate the problem.

2. Precision. In a recent review [4], the overall cyclone precision is shown to be most sensitive to two factors: the analytical precision and the sampling procedures, particularly the quality control system used in the maintenance and calibration of samplers. Theoretically, the variance for the overall precision is the sum of the variances from the sampling and analysis. The analytical variance depends on the dust loading on the filter. For the dust loading in an 8-hr sample above 1.5 mg/m^3, Bowman, et al. [4] find that the empirically determined sampling error dominates this analytical error.

   Because of the effects of the environment, precision estimates for dust samplers are much more variable than those reported for gas and vapor sampling. In laboratory tests with 0.01 mg sensitivity balances, the overall precision of a single respirable dust sample has relative standard deviations (s_r) from 0.043 to 0.145 over concentrations ranging from 0.5 to 5 mg/m^3. In the laboratory studies where the dust concentrations in the test chamber are more carefully controlled, the estimated s_r is less than 0.091, which is the target precision value for a bias equal to ± 0.10 in the NIOSH validation criteria.

   In the field tests with 0.01 mg sensitivity balances, precision estimates range from 0.144 to 0.227 over concentrations ranging from 1 to 10 mg/m^3. Whether the larger s_r values in field tests are due to sampler performance or to more inhomogeneous dust concentrations in the field tests cannot be determined from existing data.

REFERENCES:

[1] TLVs - Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment with Intended Changes for 1983-84, 38, ACGIH, Cincinnati, OH (1983).

[2] Ibid, Appendix D, 52.

[3] Bartley, D. L. and G. M. Breuer. Analysis and Optimization of the Performance of the 10-mm Cyclone, Am. Ind. Hyg. Assoc. J., 43, 520-528 (1982).

[4] Bowman, J. D., D. L. Bartley, G. M. Breuer and S. A. Shulman. The Accuracy of Sampling Respirable Coal Mine Dust, Draft NIOSH report (1983).

[5] Parobeck, P., T. F. Tomb, H. Ku and J. Cameron. Measurement Assurance Program for the Weighings of Respirable Coal Mine Dust Samples, J. Qual. Tech., 13, 157 (1981).

[6] NIOSH Manual of Sampling Data Sheets, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-159 (1977).

[7] Bowman, J. D., D. L. Bartley, G. M. Breuer, L. J. Doemeny and D. J. Murdock. Accuracy Criteria Recommended for the Certification of Gravimetric Coal Mine Dust Personal Samplers, NIOSH report (in press, 1983).

[8] Breslin, J. A., S. J. Page and R. A. Jankowski. Precision of Personal Sampling of Respirable Dust in Coal Mines, U.S. Bureau of Mines Report of Investigations #8740 (1983).

[9] Caplan, K. J., L. J. Doemeny and S. Sorenson. Evaluation of Coal Mine Dust Personal Sampler Performance, Final Report, NIOSH Contract No. PH CPE-r-70-0036 (1973).

[10] Bartley, D. L., G. M. Breuer, P. A. Baron and J. D. Bowman. Pump Fluctuations and Their Effect on Cyclone Performance, submitted to the Am. Ind. Hyg. Assoc. J. (1983).

[11] Briant, J. K. and O. R. Moss. The Influence of Electrostatic Charge on the Performance of 10-mm Nylon Cyclones, American Industrial Hygiene Conference (1983).

METHOD WRITTEN BY: Joseph Bowman, Ph.D., CIH, NIOSH/DPSE.

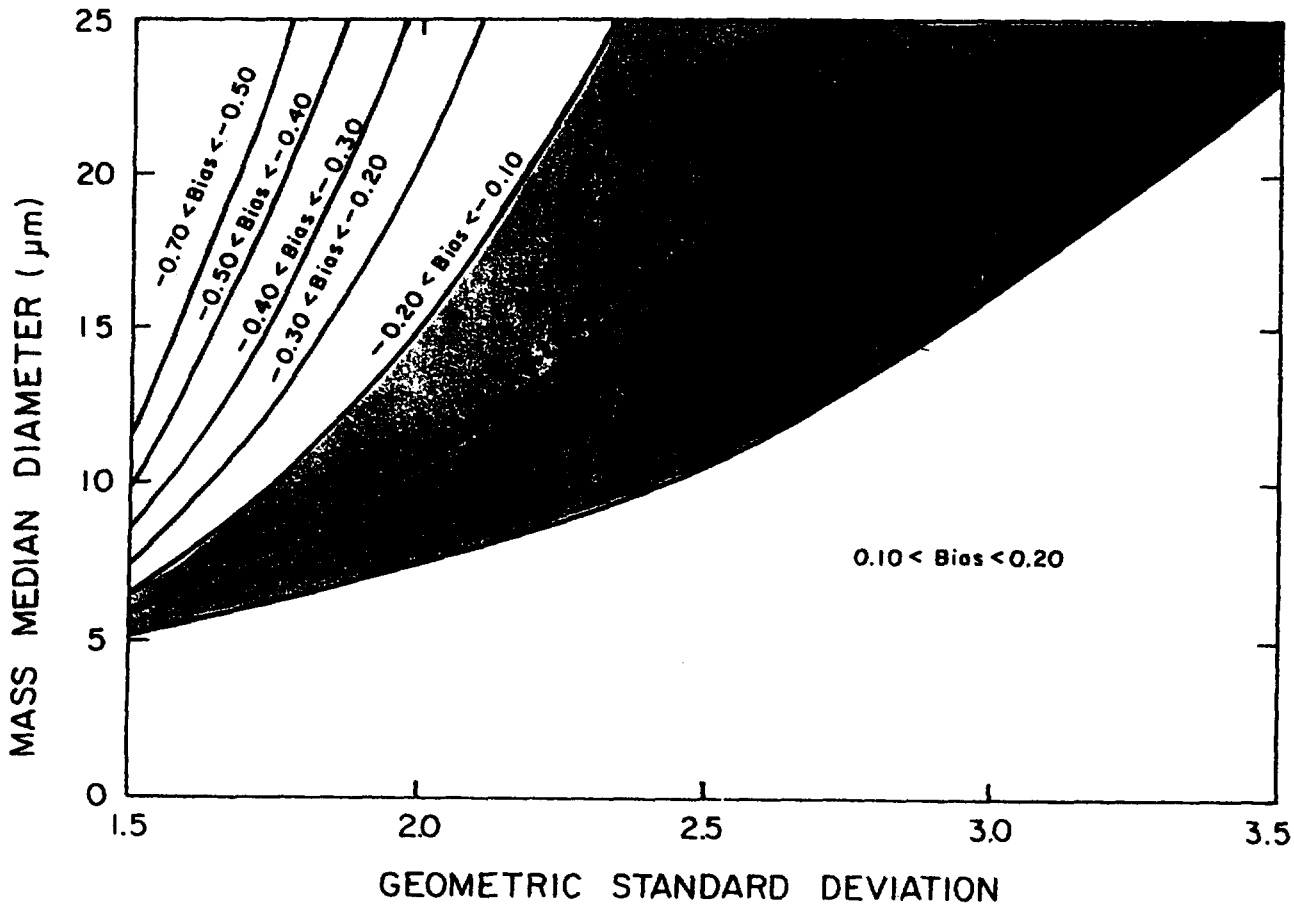

Figure 1. Bias in respirable dust determination.

DEFINITION: Total aerosol mass

NUISANCE DUST, TOTAL

METHOD: 0500
ISSUED: 2/15/84

OSHA: 15 mg/m³
NIOSH: no standard
ACGIH: 10 mg/m³, total dust less than 1% quartz

PROPERTIES: quartz less than 1% [1]

SYNONYMS: boron oxide (CAS #1303-86-2) and nuisance dusts [1] including alumina (CAS #1344-28-1), calcium carbonate (CAS #1317-65-3), cellulose (paper fiber; CAS #9004-34-6), glycerin mist (CAS #56-81-5), limestone (CAS #1317-65-3), etc.

SAMPLING

SAMPLER: FILTER
(tared 37-mm, 5-µm PVC filter)

FLOW RATE: 1.5 to 2 L/min

VOL-MIN: 25 L @ 15 mg/m³
-MAX: 133 L @ 15 mg/m³

SHIPMENT: routine

SAMPLE STABILITY: indefinitely

BLANKS: 2 field blanks per 10 samples

BULK SAMPLE: none required

ACCURACY

RANGE STUDIED: 8 to 28 mg/m³

BIAS: not significant

OVERALL PRECISION (s_r): 0.056 [2]

MEASUREMENT

TECHNIQUE: GRAVIMETRIC (FILTER WEIGHT)

ANALYTE: airborne particulate material

BALANCE: 0.01 mg sensitivity or better; use same balance before and after sample collection

CALIBRATION: National Bureau of Standards Class M weights

RANGE: 0.3 to 2 mg per sample

ESTIMATED LOD: 0.2 mg per sample

PRECISION: 0.08 mg per sample [3]

APPLICABILITY: The working range is 3 to 20 mg/m³ for a 100-L air sample. This method is nonspecific and determines the total dust concentration to which a worker is exposed. It may be applied, e.g., to gravimetric determination of fibrous glass [4] in addition to the other ACGIH nuisance dusts [1].

INTERFERENCES: Organic and volatile particulate matter may be removed by dry ashing [4].

OTHER METHODS: This method is similar to the criteria document method for fibrous glass [4] and Method 5000 for carbon black. This method replaces Method S349 [5]. Impingers and direct-reading instruments may be used to collect total dust samples, but these have limitations for personal sampling.

EQUIPMENT:

1. Environmental chamber at constant temperature and humidity (e.g., 20 °C ± 0.3 °C and 50% ± 5% RH).
2. Sampler: 37-mm PVC, 2- to 5-µm pore size membrane or equivalent hydrophobic filter and cellulose supporting pad in 37-mm cassette filter holder.
3. Personal sampling pump, 1.5 to 2 L/min, with flexible connecting tubing.
4. Microbalance, capable of weighing to 0.01 mg.
5. Vacuum desiccator.
6. Static neutralizer: e.g., Po-210; replace nine months after the production date.

SPECIAL PRECAUTIONS: None.

PREPARATION OF FILTERS BEFORE SAMPLING:

1. Dry filters and backup pads under vacuum in the vacuum desiccator for at least 15 min.
2. Release the vacuum, remove the desiccator cover and equilibrate the filters in the environmental chamber for at least 1 hr.
3. Number the backup pads with a ballpoint pen and place them, numbered side down, in filter cassette bottom sections.
4. Weigh the filters in the environmental chamber. Record the filter tare weight, W_1 (mg).
   a. Zero the balance before each weighing.
   b. Handle the filter with forceps (nylon forceps if further analyses will be done).
   c. Pass the filter over an antistatic radiation source. Repeat this step if filter does not release easily from the forceps or if filter attracts balance pan. Static electricity can cause erroneous weight readings.
5. Place the weighed filters on top of the backup pads in the filter cassette bottom sections and allow to stand an additional 8 to 16 hrs in the environmental chamber.
6. Reweigh the filters. If this tare weight differs by more than 0.01 mg from the first tare weight obtained in step 4 above, discard the filter.
   NOTE: Insert a rod through the outlet hole of the filter cassette bottom section to raise the backup pad and filter so that the filter can be grasped with forceps.
7. Assemble the filter in the filter cassettes and close firmly so that leakage around the filter will not occur. Place a plug in each opening of the filter cassette. Place a cellulose shrink band around the filter cassette, allow to dry and mark with the same number as the backup pad.

SAMPLING:

8. Calibrate each personal sampling pump with a representative sampler in line.
9. Sample at 1.5 to 2 L/min. Do not exceed a total filter loading of approximately 2 mg total dust.

SAMPLE PREPARATION:

10. Wipe dust from the external surface of the filter cassette with a moist paper towel to minimize contamination. Discard the paper towel.
11. Remove the top and bottom plugs from the filter cassette. Place the filter cassettes in a vacuum desiccator under vacuum for at least 15 min, followed by equilibration for at least 1 hr in the environmental chamber.
12. Remove the cassette band, pry open the cassette and remove the filter. Handle the filters very gently by the edge to avoid loss of dust.

NOTE: If the filter sticks to the underside of the cassette top, very gently lift away by using the dull side of a scalpel blade. This must be done carefully or the filter will tear.

CALIBRATION AND QUALITY CONTROL:

13. Zero the microbalance before all weighings. Use the same microbalance for weighing filters before and after sample collection. Maintain and calibrate the balance with National Bureau of Standards Class M weights.
14. Take two to four replicate samples for every batch of field samples for quality assurance on the sampling procedures. The set of replicate samples should be exposed to the same dust environment, either in a laboratory dust chamber [6] or in the field. The quality control samples must be taken with the same equipment, procedures and personnel used in the routine field samples. The relative standard deviation calculated from these replicates should be recorded on control charts and action taken when the precision is out of control.

MEASUREMENT:

15. Weigh each filter, including field blanks. Record this post-sampling weight, W_2 (mg), beside its corresponding tare weight. Record anything remarkable about a filter (e.g., overload, leakage, wet, torn, etc.).

CALCULATIONS:

16. Calculate the concentration of total nuisance dust, C (mg/m^3), in the air volume sampled, V (L):

$$C = \frac{(W_2 - W_1) + B}{V} \cdot 10^3, \text{ mg/m}^3$$

where: W_1 = tare weight of filter before sampling (mg)
W_2 = post-sampling weight of sample-containing filter (mg)
B = mean change in field blank filter weights between tare and post-sampling (mg) (+ or -).

EVALUATION OF METHOD:

Lab testing with blank filters and generated atmospheres of carbon black was done at 8 to 28 mg/m^3 [2,6]. Precision and accuracy data are given on page 0500-1.

REFERENCES:

[1] TLVs - Threshold Limit Values for 1983-84, Appendix D, ACGIH, Cincinnati, OH (1983).
[2] This Manual, Method 5000.
[3] Unpublished data from Non-textile Cotton Study, NIOSH/DRDS/EIB.
[4] NIOSH Criteria for a Recommended Standard ... Occupational Exposure to Fibrous Glass, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-152, 119-142 (1977).
[5] NIOSH Manual of Analytical Methods, 2nd ed., V. 3, S349, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).
[6] Documentation of the NIOSH Validation Tests, S262 and S349, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-185 (1977).

METHOD WRITTEN BY: Kathy Morring, Jerry Clere, and Frank Hearl, P.E., NIOSH/DRDS.

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ROBERT RANDLE

For Completion of
Annual Training (8 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-003
Certificate #

January 6, 1999
Date Awarded

DEBBIE LARAMIE
Instructor

SMITH

ENVIRONMENTAL TECHNOLOGIES CORPORATION

1995

Certificate of Training

Presented To

Bob Randle

For Completion of

Initial Training for Advanced HM181/126F Haz Mat Training

in accordance with DOT in 49 CFR 172.700

95-334

Certificate #

December 28 - 29, 1995

Date Awarded

Dan Wilson

Dan Wilson

Instructor

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Robert Randle

Has Successfully Completed A Course Of Instruction On
NRC Equipment Operation and Maintenance

Friday, September 04, 1998

NRC
NATIONAL RESPONSE CORPORATION

446 Edwards Avenue
Calverton, New York 11933-0609

Archie Cook
Instructor

George Wallace III
Director of Training

urse Number: 98145
rtificate Number: 98145-2887
mpletion Date: 04-Sep-98

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RESULTS OF MEDICAL EXAMINATION

(214242*6*1) BONDLE, ROBERT JOSEPH JR
SSN#: 333-80-7097 D-O-B: 01/05/76
1177001018 ENVIRONMENTAL RESTORATION

SSN: _____ DOB _____

Employer Name _____

Today's Date 6-9-99

☐ Drug Screen Only ☐ Alcohol Only ☐ Drug Screen and Alcohol

☒ Able ☐ Unable to perform job functions as described by:
- ☒ Employee
- ☐ Written job description

If "unable" is checked, the reason is:
- ☐ Delay in job placement pending:
  - ☐ Further tests to be ordered/information to be reviewed
  - ☐ JCA
  - ☐ Personal physician follow-up
  - ☐ Other
  - ☐ Patient has a medical condition not anticipated to interfere with described job functions
- ☐ Review of outstanding results
  - ☒ Lab
  - ☐ Drug screen
  - ☐ X-ray
- ☐ Unable to perform essential job functions safely

Recommended physical restrictions Portacount fit test not performed due to machine malfunction.

☒ Based on the Medical Evaluation for fitness to wear respirator:
- ☒ No restrictions on respirator use
- ☐ Some specific use restrictions

Restrictions _____

- ☐ No respirator use permitted

Time in _____ Physician/Nurse Practitioner [signature] Date 6-9-99
Signature

Time out 21 Employee [signature] Date 6-9-99
Signature

JN 99

071 (7/98)

Environmental Restoration L.L.C.
16333 Westwoods Business Park Drive
St. Louis, Missouri 63021
(314) 227-7477
Fax: (314) 227-6447

RESPIRATORY AND PROTECTIVE EQUIPMENT TRAINING

I have received training in the proper usage of the following respirator and protective equipment and in the company's written respiratory program.

Training has included the following:

1. Written Respiratory Program: BR
2. Respirator Selection: BR
3. Respirator Limitation: BR
4. Fit testing methods: BR
5. Cleaning Techniques: BR
6. Inspection Requirements: BR
7. Maintenance: BR
8. Storage Requirements: BR
9. Medical Exams: BR
10. Qualitative Fit Test Used:
    Irritant Smoke: ~~X~~
    Isoamyl Acetate: ~~X~~
11. Quantitative Fit Test: ~~X~~
    A. Porta-Count Model 8015: ~~X~~
    B. ~~X~~
    C. Overall Fit Factor: ~~X~~

I have been trained and fitted with the following respirators:

MANUFACTURER	TYPE	SIZE	APPROVAL	DATE	INITIAL
MSA	Ultra-Twin Full Face	Medium			
MSA	Gas Mask Type				
MSA	Model 401 Ultralite SCBA				
MSA	Cascade 5 Minute Egress System				

I have been provided with a copy of Environmental Restoration's Respiratory Protection Program:

Date: 9-9-98 Signed: [signature]

I have read and understand the Environmental Restoration Respiratory Protection Procedures and know how to obtain more information.

Signed: [signature] Date: 9-9-98

Environmental Restoration Representative: Signed: _____

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ORVILLE JOHN CRUMP

For Completion of
Initial Training (40 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-068

Certificate #

September 19-22, 1999

Date Awarded

Debbie S. Laramie

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ORVILLE JOHN CRUMP

For Completion of
Forklift Operator Safety Training
in accordance with OSHA in 29 CFR 1910.178

S99-03
Certificate #

SEPTEMBER 22, 1999
Date Awarded

Debbie Laramie
DEBBIE LARAMIE
Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ORVILLE JOHN CRUMP

For Completion of
Review Training for HM 181/126 Haz Mat Training
in accordance with DOT in 49 CFR 172.700.

S99-040
Certificate #

SEPTEMBER 22, 1999
Date Awarded

DEBBIE LARAMIE
Instructor

Claim Number:

Concentra Medical Centers

83 Progress Parkway Maryland Heights, MO 63043
Phone: (314) 434-2233 Fax: (314) 434-8706

Service Date: 09/30/1999

Non-Injury Status Report

Patient: Crump, Orville J.
SSN: 329-74-5862
Address: 124 N. Virginia
BELLEVILLE, IL 62220
Home: (618) 239-6811
Work: ( ) - **Ext.:**

Employer Location: Environmental Restoration
Address: 16333 Westwoods Business
ELLISVILLE, MO 63021
Auth. by:

Contact: Mike Broderick
Role: Safety Manager
Phone: (314) 227-7477 **Ext.:**
Fax: ( ) -

This Visit:

Time In: 08:21 am **Time Out:** 01:05 pm

HazMat Physical - Preplacement

Audiogram
U/A Micro
Pulmonary Fun.Test W/Interp.
Blood Lead
GGT - Gamma Glutyl Transferase
Lipid Panel
CBC w/diff
Hepatic Function
EKG
DOT Pre-Placement
Respitator Fit-Quantative
Chest X-ray 1 view
Hazardous Material Physical (HazMat)
Metabolic Panel

Result Status:

Able to perform essential functions
No medical restrictions
Pending - Results

lab tests, ekg, cxr, drug screen results

Remarks:

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MEDICAL EXAMINER'S CERTIFICATE

I certify that I have examined

C Kville Crump

(Driver's name (Print))

In accordance with the Federal Motor Carrier Safety Regulations (49 CFR 391.41 through 391.49) and with knowledge of his/her duties, I find him/her qualified under the regulations. Expiration date of certificate: 09-30-2001

Qualified only when wearing: ☐ Corrective lenses ☐ Hearing aid

☐ Medically unqualified unless accompanied by a _____ waiver

☐ Medically unqualified unless driving within an exempt intracity zone

☐ Qualified by operation of 49 CFR 391.64

A completed examination form for this person is on file in my office.

314-434-8174 067554 MO

(Area Code/Phone No.) (License/Certificate No.) (State)

M. Warmington, RN CS, ANP M Warmington, RN CS NP

(Medical Examiner: (Print Name and Title)) (Signature)

[signature]

(Signature of Driver)

124 N. VIRGINIA / Belleville, IL. 62220

(Address of Driver)

110-BC

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John Crump

Environmental Restoration L.L.C.
16333 Westwoods Business Park Drive
St. Louis, Missouri 63021
(314) 227-7477
Fax: (314) 227-6447

RESPIRATORY AND PROTECTIVE EQUIPMENT TRAINING

I have received training in the proper usage of the following respirator and protective equipment and in the company's written respiratory program.

Training has included the following:

1. Written Respiratory Program: _____
2. Respirator Selection: _____
3. Respirator Limitation: _____
4. Fit testing methods: _____
5. Cleaning Techniques: _____
6. Inspection Requirements: _____
7. Maintenance: _____
8. Storage Requirements: _____
9. Medical Exams: _____
10. Qualitative Fit Test Used:
    Irritant Smoke: _____
    Isoamyl Acetate: _____
11. ~~Quantitative Fit Test:~~
    ~~A. Porta-Count Model 8015: _____~~
    ~~B. _____~~
    ~~C. Overall Fit Factor: _____~~

I have been trained and fitted with the following respirators:

MANUFACTURER	TYPE	SIZE	APPROVAL	DATE	INITIAL
MSA	Ultra-Twin Full Face	L	DSL	9-22-99	
MSA	Gas Mask Type				
MSA	Model 401 / Ultralite SCBA				
MSA	Cascade 5 Minute Egress System				

I have been provided with a copy of Environmental Restoration's Respiratory Protection Program:

Date: 9/22/99 Signed: _____

I have read and understand the Environmental Restoration Respiratory Protection Procedures and know how to obtain more information.

Signed: 9/22/99 Date: _____

Environmental Restoration Representative: Signed: _____

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

JIM DAVIS

For Completion of
Annual Training (8 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-007
Certificate #

January 22, 1999
Date Awarded

Debbie Laramie
DEBBIE LARAMIE
Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

JIM DAVIS

For Completion of
Review Training for HM 181/126 Haz Mat Training
in accordance with DOT in 49 CFR 172.700.

S99-001
Certificate #

January 22, 1999
Date Awarded

DEBBIE LARAMIE
Instructor

"Imagineering a Cleaner World"

Riedel Environmental Services Inc.

Certificate of Completion

presented to

JIM DAVIS

in recognition of satisfactory completion
of the course of instruction entitled

HAZARDOUS MATERIALS HANDLING & RESPONSE

February 2-6, 1987

Date(s) of Instruction

Instructor

SMITH

The Smith Corporate Health And Safety Department

Affirms That

JIM DAVIS

Has given satisfactory evidence through experience and examination,
and, is hereby authorized to use the designation

SMITH SITE SAFETY OFFICER

As long as the certificate is renewed annually and not revoked.

Certificate #97-397

Date Awarded - May 5, 1997

Greg Rakes
Regional Health & Safety Manager

Corporate Director of Health and Safety

The Institute of Hazardous Materials Management

INSTITUTE OF HAZARDOUS MATERIALS MANAGEMENT 1984 IHMM

Certifies that

James K. Davis

has demonstrated understanding of science, knowledge of regulations, competence in management, and maturity of judgement essential to effectively manage hazardous materials and is hereby designated a

Certified Hazardous Materials Manager

Senior Level

July, 1997	8289	2003	Harold M. Gordon
Date	Number	Expiration Date	Executive Director

International Association

Nitrox & Technical Divers

ENRICHED AIR NITROX DIVER

James Davis

is hereby awarded the Nitrox Diver Certificate
on this 26th day of May, 1994 for completion of
"The Physics and Physiology of Nitrox Diving."

6161
Certification No.

Dick Rutkowski
Instructor

Hyperbarics International
Facility

Key Largo, Florida
Certification Location

Tom Mount
IANTD President

Hyperbarics International, Inc.

Excellence In Undersea Diver Training

Certificate of Training

James Davis

is hereby recognized for successful completion of

Diving Accident Management and Oxygen Adminstration

Dick Rutkowski

PRESIDENT

Jim Patrick

PROGRAM DIRECTOR

May 27, 1994

DATE

Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Scientific Diver Training Program

Certificate of Training

James Davis

Is Hereby Recognized for Successful Completion of

Diving Accident Management / Working Diver

Awarded by US EPA Diver Training Center

Bruce Reynolds
Chairman, Diving Safety Board

May 27, 1994

James M. Patrick
Director, EPA Diver Training

"Imagineering a Cleaner World"

Riedel Environmental Services Inc.

Certificate of Completion

presented to

JIM DAVIS

in recognition of satisfactory completion
of the course of instruction entitled

SITE SAFETY MANAGEMENT

1-14-87
Date(s) of Instruction

Instructor

"Imagineering a Cleaner World"

Riedel Environmental Services Inc.

Certificate of Completion

presented to

JIM DAVIS

in recognition of satisfactory completion
of the course of instruction entitled

EQUIPMENT SAFETY

1/14/87

Date(s) of Instruction

Instructor

PADI

This Is To Certify That

Jim Davis

Has Satisfactorily Completed A Sanctioned Course In

SCUBA DIVING

And Is Hereby Awarded The Rating Of

Open Water Diver

Given This 24 Day Of April 19 94

Instructor

M-12947

Number

President

Certificate of Completion

Awarded to

James K. Davis

FOR COMPLETION OF CLASSROOM STUDY OF BLOODBORNE PATHOGENS

Presented by

U.S. Public Health Service

May 27, 1994

Sandra Keheley R.N. COHN

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

MATT DUKE

For Completion of
Initial Training (40 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-066

Certificate #

September 19-22, 1999

Date Awarded

Debbie S. Laramie

Debbie S. Laramie

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

MATT DUKE

For Completion of
Forklift Operator Safety Training
in accordance with OSHA in 29 CFR 1910.178

S99-07
Certificate #

SEPTEMBER 22, 1999
Date Awarded

DEBBIE LARAMIE
Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

MATT DUKE

For Completion of
Review Training for HM 181/126 Haz Mat Training
in accordance with DOT in 49 CFR 172.700.

S99-037
Certificate #

SEPTEMBER 22, 1999
Date Awarded

DEBBIE LARAMIE
Instructor

Claim Number:

Concentra Medical Centers

83 Progress Parkway Maryland Heights, MO 63043
Phone: (314) 434-2233 Fax: (314) 434-8706

Service Date: 09/29/1999

Non-Injury Status Report

Patient: Duke, Steve M.
SSN: 326-82-7622
Address: 109 Hawthorn
COLUMBIA, IL 62236
Home: (618) 287-0437
Work: **Ext.:**

Employer Location: Environmental Restoration
Address: 16333 Westwoods Business
ELLISVILLE, MO 63021
Auth. by:

Contact: Mike Broderick
Role: Safety Manager
Phone: (314) 227-7477 **Ext.:**
Fax: ( ) -

This Visit:

Time In: 08:50 am **Time Out:** 01:04 pm

HazMat Physical - Preplacement

Lipid Panel
CBC w/diff
Hepatic Function
Metabolic Panel
Respitator Fit-Quantative
EKG
Chest X-ray 1 view
Hazardous Material Physical (HazMat)
U/A Micro
Audiogram
Pulmonary Fun.Test W/Interp.
Blood Lead
DOT Pre-Placement
Regulated UDS/MRO - Pre-Place.
GGT - Gamma Glutyl Transferase

Result Status:

Able to perform essential functions
No medical restrictions

Remarks: Pending drug screen results

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Matt Duke

Environmental Restoration L.L.C.
16333 Westwoods Business Park Drive
St. Louis, Missouri 63021
(314) 227-7477
Fax: (314) 227-6447

RESPIRATORY AND PROTECTIVE EQUIPMENT TRAINING

I have received training in the proper usage of the following respirator and protective equipment and in the company's written respiratory program.

Training has included the following:

1. Written Respiratory Program: MD
2. Respirator Selection: MD
3. Respirator Limitation: MD
4. Fit testing methods: MD
5. Cleaning Techniques: MD
6. Inspection Requirements: MD
7. Maintenance: MD
8. Storage Requirements: MD
9. Medical Exams: MD
10. Qualitative Fit Test Used:
    Irritant Smoke: MD
    Isoamyl Acetate: _____
11. ~~Quantitative Fit Test:~~
    ~~A. Porta-Count Model 8015:~~
    ~~B.~~
    ~~C. Overall Fit Factor:~~

I have been trained and fitted with the following respirators:

MANUFACTURER	TYPE	SIZE	APPROVAL	DATE	INITIAL
MSA	Ultra-Twin Full Face	large M	DSL	9-22-99	MD
MSA	Gas Mask Type				
MSA	Model 401 / Ultralite SCBA				
MSA	Cascade 5 Minute Egress System				

I have been provided with a copy of Environmental Restoration's Respiratory Protection Program:

Date: 9-22-99 Signed: Matt Duke

I have read and understand the Environmental Restoration Respiratory Protection Procedures and know how to obtain more information.

Signed: Matt Duke Date: 9-22-99

Environmental Restoration Representative: Signed: Debbie L. Laramie

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

JOHN C. JOHNSON, JR.

For Completion of
Initial Training (40 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-045
Certificate #

July 16, 1999
Date Awarded

Debbie S. Laramie
Debbie S. Laramie

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

JOHN C. JOHNSON, JR.

For Completion of

Review Training for HM 181/126 Haz Mat Training

in accordance with DOT in 49 CFR 172.700.

S99-012

Certificate #

JULY 14, 1999

Date Awarded

DEBBIE LARAMIE

Instructor

John C Johnson, JR

Environmental Restoration L.L.C.
16333 Westwoods Business Park Drive
St. Louis, Missouri 63021
(314) 227-7477
Fax: (314) 227-6447

RESPIRATORY AND PROTECTIVE EQUIPMENT TRAINING

I have received training in the proper usage of the following respirator and protective equipment and in the company's written respiratory program.

Training has included the following:

1. Written Respiratory Program: JJ
2. Respirator Selection: JJ
3. Respirator Limitation: JJ
4. Fit testing methods: JJ
5. Cleaning Techniques: JJ
6. Inspection Requirements: JJ
7. Maintenance: JJ
8. Storage Requirements: JJ
9. Medical Exams: JJ
10. Qualitative Fit Test Used:
    Irritant Smoke: JJ
    Isoamyl Acetate: _____
11. ~~Quantitative Fit Test: _____~~
    ~~A. Porta-Count Model 8015: _____~~
    ~~B. _____~~
    ~~C Overall Fit Factor: _____~~

I have been trained and fitted with the following respirators:

MANUFACTURER	TYPE	SIZE	APPROVAL	DATE	INITIAL
MSA	Ultra-Twin Full Face	L	DSL	7-16-99	JJ
MSA	Gas Mask Type				
MSA	Model 401 / Ultralite SCBA				
MSA	Cascade 5 Minute Egress System				

I have been provided with a copy of Environmental Restoration's Respiratory Protection Program:

Date: _____ Signed: _____

I have read and understand the Environmental Restoration Respiratory Protection Procedures and know how to obtain more information.

Signed: John C Johnson Jr Date: 7-16-99

Environmental Restoration Representative: Signed: Debbie L. Lorenz

HealthLine®
CORPORATE HEALTH SERVICES METRO ST. LOUIS

☐ Center 1
1212 South Grand
St. Louis, Missouri 63104
(314) 577-8060
Fax (314) 776-2793

☒ Center 2
83 Progress Parkway
Maryland Heights, Missouri 63043
(314) 434-8174
Fax (314) 434-8706

☐ Center 3
2626 North Broadway
St. Louis, Missouri 63102
(314) 241-5804
Fax (314) 241-3558

☐ Center 4
801 Hazelwest Drive
Hazelwood, Missouri 63042
(314) 895-2811
Fax (314) 919-2710

☐ Center 5
1617 South 3rd Street
St. Louis, Missouri 63104
(314) 421-2557
Fax (314) 421-2046

☐ Center 6
1709 Gilsinn Lane
Fenton, Missouri 63026
(314) 349-6850
Fax (314) 349-6641

RESULTS OF MEDICAL EXAMINATION

[illegible] JOHNSON, JOHN C.(JR)
SSN#: 337-52-8575 D-O-B: 02/04/65
1177001010 ENVIRONMENTAL RESTORATION

Patient Name _____ SSN: _____ DOB _____

Employer ID No. _____ Employer Name _____

Today's Date 7-28-99

HAZ MAT EXAM

Baseline

☐ Drug Screen Only ☐ Alcohol Only ☐ Drug Screen and Alcohol

☒ Able ☐ Unable to perform job functions as described by:
- ☒ Employee
- ☐ Written job description

If "unable" is checked, the reason is:
- ☐ Delay in job placement pending:
  - ☐ Further tests to be ordered/information to be reviewed
  - ☐ JCA
  - ☐ Personal physician follow-up
  - ☐ Other
  - ☐ Patient has a medical condition not anticipated to interfere with described job functions
- ☐ Review of outstanding results
  - ☒ Lab
  - ☐ Drug screen
  - ☒ X-ray
- ☐ Unable to perform essential job functions safely

Recommended physical restrictions _____

☒ Based on the Medical Evaluation for fitness to wear respirator:
- ☒ No restrictions on respirator use
- ☐ Some specific use restrictions

Restrictions _____

☐ No respirator use permitted

Time in 9:00 Physician/Nurse Practitioner [signature] Date 7/28/99
Signature

Time out _____ Employee [signature] Date 7-28-99
Signature

91071 (3/99)

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

KEITH L. CALHOUN

For Completion of
Initial Training (40 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-017
Certificate #

February 11, 1999
Date Awarded

Debbie A. Laramie
DEBBIE LARAMIE
Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

KEITH L. CALHOUN

For Completion of
Review Training for HM 181/126 Haz Mat Training
in accordance with DOT in 49 CFR 172.700

S99-012
Certificate #

FEBRUARY 11, 1999
Date Awarded

DEBBIE LARAMIE
Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ORVILLE JOHN CRUMP

For Completion of
Initial Training (40 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-068

Certificate #

September 19-22, 1999

Date Awarded

Debbie S. Laramie

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ORVILLE JOHN CRUMP

For Completion of
Forklift Operator Safety Training
in accordance with OSHA in 29 CFR 1910.178

S99-03
Certificate #

SEPTEMBER 22, 1999
Date Awarded

Debbie Laramie
DEBBIE LARAMIE
Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ORVILLE JOHN CRUMP

For Completion of
Review Training for HM 181/126 Haz Mat Training
in accordance with DOT in 49 CFR 172.700.

S99-040
Certificate #

SEPTEMBER 22, 1999
Date Awarded

DEBBIE LARAMIE
Instructor

HEALTHLINE®

NAME: Keith Calhoun DATE: 2 / 19 / 99

SS#: _____ SEX: _____

BIRTHDATE OR / 10 / 69 LOC#: _____

PHYSICIANS WRITTEN OPINION REGARDING EMPLOYEE EXPOSED TO HAZARDOUS SUBSTANCES

1.0 Results of medical examination?

Satisfactory [✓] Unsatisfactory [ ]

2.0 Has employee any detected medical condition which would place employee at an increased risk due to exposure to hazardous substances?

Yes [ ] No [✓]

3.0 Are there recommended limitations on the employee's exposure to hazardous substances or on the use of protective clothing and equipment such as respirators?

Yes [ ] No [✓]

4.0 Has employee been informed by the physician of the results of the health examination?

Yes [✓] No [ ]

5.0 Are there medical conditions which require further examination or treatment?

Yes [ ] No [✓]

Remarks: _____

DATE: 2 / 19 / 99 SIGNED: [signature] M.D.

The written opinion has been reviewed and explained to me, and a copy provided.

DATE: ___ / ___ / ___ SIGNED: _____ EMPLOYEE

APR 1 0 1991

Keith Calhoun

Environmental Restoration L.L.C.
16333 Westwoods Business Park Drive
St. Louis, Missouri 63021
(314) 227-7477
Fax: (314) 227-6447

RESPIRATORY AND PROTECTIVE EQUIPMENT TRAINING

I have received training in the proper usage of the following respirator and protective equipment and in the company's written respiratory program.

Training has included the following:

1. Written Respiratory Program: X
2. Respirator Selection: X
3. Respirator Limitation: X
4. Fit testing methods: X
5. Cleaning Techniques: X
6. Inspection Requirements: X
7. Maintenance: X
8. Storage Requirements: X
9. Medical Exams: X
10. Qualitative Fit Test Used:
    Irritant Smoke: X
    Isoamyl Acetate: _____
11. Quantitative Fit Test: _____
    A. Porta-Count Model 8015: _____
    B. _____
    C. Overall Fit Factor: _____

I have been trained and fitted with the following respirators:

MANUFACTURER	TYPE	SIZE	APPROVAL	DATE	INITIAL
MSA	Ultra-Twin Full Face	M	DSL	2-11-99	KLC
MSA	Gas Mask Type				
MSA	Model 401 / Ultralite SCBA				
MSA	Cascade 5 Minute Egress System				

I have been provided with a copy of Environmental Restoration's Respiratory Protection Program:

Date: 2-11-99 Signed: Keith L Calhoun

I have read and understand the Environmental Restoration Respiratory Protection Procedures and know how to obtain more information.

Signed: Keith L Calhoun Date: 2-11-99

Environmental Restoration Representative: Signed: D. Lasomie

HealthLine
CORPORATE HEALTH SERVICES METRO ST. LOUIS

☐ Center 1
1212 South Grand
St. Louis, Missouri 63104
(314) 577-8060
Fax (314) 776-2793

☑ Center 2
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Maryland Heights, Missouri 63043
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Fax (314) 434-8706

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☐ Center 4
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Hazelwood, Missouri 63042
(314) 895-2811
Fax (314) 919-2710

☐ Center 5
1617 South 3rd Street
St. Louis, Missouri 63104
(314) 421-2657
Fax (314) 421-2046

☐ Center 6
1709 Silsinn Lane
Fenton, Missouri 63026
(314) 349-6850
Fax (314) 343-6541

RESULTS OF MEDICAL EXAMINATION

PT/INJ/VST ID No. KEITH CALHOUN

Patient Name _____ SSN: _____ DOB _____

Employer ID No. _____ Employer Name _____

Today's Date 2-11-99

☐ Drug Screen Only ☐ Alcohol Only ☐ Drug Screen and Alcohol

☑ Able ☐ Unable to perform job functions as described by:
- ☑ Employee
- ☐ Written job description

If "unable" is checked, the reason is:
- ☐ Delay in job placement pending:
  - ☐ Further tests to be ordered/information to be reviewed
  - ☐ JCA
  - ☐ Personal physician follow-up
  - ☐ Other
  - ☐ Patient has a medical condition not anticipated to interfere with described job functions
- ☐ Review of outstanding results
  - ☐ Lab
  - ☐ Drug screen
  - ☐ X-ray
- ☐ Unable to perform essential job functions safely

Recommended physical restrictions _____

☐ Based on the Medical Evaluation for fitness to wear respirator:
- ☑ No restrictions on respirator use
- ☐ Some specific use restrictions

Restrictions _____

☐ No respirator use permitted

Time in _____ Physician/Nurse Practitioner _____ Date 2-11-99
Signature

Time out _____ Employee _____ Date 2-11-99
Signature

91071 (7/98)

Claim Number:

Concentra Medical Centers

83 Progress Parkway Maryland Heights, MO 63043
Phone: (314) 434-2233 Fax: (314) 434-8706

Service Date: 09/30/1999

Non-Injury Status Report

Patient: Crump, Orville J.
SSN: 329-74-5862
Address: 124 N. Virginia
BELLEVILLE, IL 62220
Home: (618) 239-6811
Work: ( ) - **Ext.:**

Employer Location: Environmental Restoration
Address: 16333 Westwoods Business
ELLISVILLE, MO 63021
Auth. by:

Contact: Mike Broderick
Role: Safety Manager
Phone: (314) 227-7477 **Ext.:**
Fax: ( ) -

This Visit:

Time In: 08:21 am **Time Out:** 01:05 pm

HazMat Physical - Preplacement

Audiogram
U/A Micro
Pulmonary Fun.Test W/Interp.
Blood Lead
GGT - Gamma Glutyl Transferase
Lipid Panel
CBC w/diff
Hepatic Function
EKG
DOT Pre-Placement
Respitator Fit-Quantative
Chest X-ray 1 view
Hazardous Material Physical (HazMat)
Metabolic Panel

Result Status:

Able to perform essential functions
No medical restrictions
Pending - Results

lab tests, ekg, cxr, drug screen results

Remarks:

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MEDICAL EXAMINER'S CERTIFICATE

I certify that I have examined

C Rville Crump

(Driver's name (Print))

In accordance with the Federal Motor Carrier Safety Regulations (49 CFR 391.41 through 391.49) and with knowledge of his/her duties, I find him/her qualified under the regulations. Expiration date of certificate: 09-30-2001

Qualified only when wearing: ☐ Corrective lenses ☐ Hearing aid

☐ Medically unqualified unless accompanied by a _____ waiver

☐ Medically unqualified unless driving within an exempt intracity zone

☐ Qualified by operation of 49 CFR 391.64

A completed examination form for this person is on file in my office.

314-434-8174 067554 MO

(Area Code/Phone No.) (License/Certificate No.) (State)

M. WARMINGTON, RN CS, ANP MWarmington, RN

(Medical Examiner: (Print Name and Title)) (Signature)

[signature]

(Signature of Driver)

124 N. VIRGINIA / Belleville, IL. 62220

(Address of Driver)

110-BC

Published by J. J. KELLER & ASSOCIATES, INC., Neenah, WI • USA • (800) 327-6868

John Crump

Environmental Restoration L.L.C.
16333 Westwoods Business Park Drive
St. Louis, Missouri 63021
(314) 227-7477
Fax: (314) 227-6447

RESPIRATORY AND PROTECTIVE EQUIPMENT TRAINING

I have received training in the proper usage of the following respirator and protective equipment and in the company's written respiratory program.

Training has included the following:

1. Written Respiratory Program: _____
2. Respirator Selection: _____
3. Respirator Limitation: _____
4. Fit testing methods: _____
5. Cleaning Techniques: _____
6. Inspection Requirements: _____
7. Maintenance: _____
8. Storage Requirements: _____
9. Medical Exams: _____
10. Qualitative Fit Test Used:
    Irritant Smoke: _____
    Isoamyl Acetate: _____
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    ~~B.~~
    ~~C. Overall Fit Factor:~~

I have been trained and fitted with the following respirators:

MANUFACTURER	TYPE	SIZE	APPROVAL	DATE	INITIAL
MSA	Ultra-Twin Full Face	L	DSL	9-22-99	
MSA	Gas Mask Type				
MSA	Model 401 / Ultralite SCBA				
MSA	Cascade 5 Minute Egress System				

I have been provided with a copy of Environmental Restoration's Respiratory Protection Program:

Date: 9/22/99 Signed: _____

I have read and understand the Environmental Restoration Respiratory Protection Procedures and know how to obtain more information.

Signed: 9/22/99 Date: _____

Environmental Restoration Representative: Signed: _____

JIM,

MISSING FIT TEST

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

JIM DAVIS

For Completion of
Annual Training (8 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-007
Certificate #

January 22, 1999
Date Awarded

Debbie Laramie
DEBBIE LARAMIE
Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

JIM DAVIS

For Completion of
Review Training for HM 181/126 Haz Mat Training
in accordance with DOT in 49 CFR 172.700.

S99-001
Certificate #

January 22, 1999
Date Awarded

Debbie Laramie
DEBBIE LARAMIE
Instructor

"Imagineering a Cleaner World"

Riedel Environmental Services Inc.

Certificate of Completion

presented to

JIM DAVIS

in recognition of satisfactory completion
of the course of instruction entitled

HAZARDOUS MATERIALS HANDLING & RESPONSE

February 2-6, 1987

Date(s) of Instruction

Instructor

SMITH

The Smith Corporate Health And Safety Department

Affirms That

JIM DAVIS

Has given satisfactory evidence through experience and examination,
and, is hereby authorized to use the designation

SMITH SITE SAFETY OFFICER

As long as the certificate is renewed annually and not revoked.

Certificate #97-397

Date Awarded - May 5, 1997

Greg Rakus
Regional Health & Safety Manager

Corporate Director of Health and Safety

The Institute of Hazardous Materials Management

INSTITUTE OF HAZARDOUS MATERIALS MANAGEMENT 1984 HMM

Certifies that

James K. Davis

has demonstrated understanding of science, knowledge of regulations, competence in management, and maturity of judgement essential to effectively manage hazardous materials and is hereby designated a

Certified Hazardous Materials Manager

Senior Level

July, 1997	8289	2003	Harold M. Gordon
Date	Number	Expiration Date	Executive Director

International Association

Nitrox & Technical Divers

ENRICHED AIR NITROX DIVER

James Davis

is hereby awarded the Nitrox Diver Certificate
on this 26th day of May, 1994 for completion of
"The Physics and Physiology of Nitrox Diving."

6161
Certification No.

Dick Rutkowski
Instructor

Hyperbarics International
Facility

Key Largo, Florida
Certification Location

Tom Mount
IANTD President

Hyperbarics International, Inc.

Excellence In Undersea Diver Training

Certificate of Training

James Davis

is hereby recognized for successful completion of

Diving Accident Management and Oxygen Adminstration

Dick Rutkowski

PRESIDENT

Jim Patrick

PROGRAM DIRECTOR

May 27, 1994

DATE

Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Scientific Diver Training Program

Certificate of Training

James Davis

Is Hereby Recognized for Successful Completion of

Diving Accident Management / Working Diver

Awarded by US EPA Diver Training Center

Bruce Reynolds
Chairman, Diving Safety Board

May 27, 1994

James M. Patrick
Director, EPA Diver Training

"Imagineering a Cleaner World"

Riedel Environmental Services Inc.

Certificate of Completion

presented to

JIM DAVIS

in recognition of satisfactory completion
of the course of instruction entitled

SITE SAFETY MANAGEMENT

1-14-87
Date(s) of Instruction

Instructor

"Imagineering a Cleaner World"

Riedel Environmental Services Inc.

Certificate of Completion

presented to

JIM DAVIS

in recognition of satisfactory completion
of the course of instruction entitled

EQUIPMENT SAFETY

1/14/87

Date(s) of Instruction

Instructor

PADI

This Is To Certify That

Jim Davis

Has Satisfactorily Completed A Sanctioned Course In

SCUBA DIVING

And Is Hereby Awarded The Rating Of

Open Water Diver

Given This 24 Day Of April 19 94

Instructor

M-12947

Number

President

Certificate of Completion

Awarded to

James K. Davis

FOR COMPLETION OF CLASSROOM STUDY OF BLOODBORNE PATHOGENS

Presented by

U.S. Public Health Service

May 27, 1994

Sandra Keheley

Sandra Keheley R.N. COHN

HEALTHLINE®

NAME: Davis, James Kevin DATE: 9 / 10 / 99

SS#: 493-80-2039 SEX: M

BIRTHDATE: 03 / 27 / 63 LOC#: _____

PHYSICIAN'S WRITEN OPINION REGARDING EMPLOYEE EXPOSED TO HAZARDOUS SUBSTANCES

1.0 Results of medical examination?

Satisfactory [✓] Unsatisfactory [ ]

2.0 Has employee any detected medical condition which would place employee at an increased risk due to exposure to hazardous substances?

Yes [ ] No [✓]

3.0 Are there recommended limitations on the employee's exposure to hazardous substances or on the use of protective clothing and equipment such as respirators?

Yes [ ] No [✓]

4.0 Has employee been informed by the physician of the results of the health examination?

Yes [ ] No [✓] not entirely

5.0 Are there medical conditions which require further examination or treatment?

Yes [✓] No [ ]

Remarks: Referred to ENT for progressive hearing loss. Must wear appropriate hearing protection

DATE: 09 / 16 / 99 SIGNED: [signature] M.D.
M. Warmington RN CS NP

The written opinion has been reviewed and explained to me, and a copy provided.

DATE: ___/___/___ SIGNED: _____ EMPLOYEE

APR 1 0 1991

BOBBY
NEEDS A NEW
FIT TEST

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

ROBERT RANDLE

For Completion of

Annual Training (8 hours) for Hazardous Waste Site Workers

in accordance with OSHA in 29 CFR 1910.120(e)

S99-003

Certificate #

January 6, 1999

Date Awarded

DEBBIE LARAMIE

Instructor

SMITH

ENVIRONMENTAL TECHNOLOGIES CORPORATION

1995

Certificate of Training

Presented To

Bob Randle

For Completion of

Initial Training for Advanced HM181/126F Haz Mat Training

in accordance with DOT in 49 CFR 172.700

95-334

Certificate #

December 28 - 29, 1995

Date Awarded

Dan Wilson

Dan Wilson

Instructor

CERTIFICATE OF TRAINING

Robert Randle

Has Successfully Completed A Course Of Instruction On

NRC Equipment Operation and Maintenance

Friday, September 04, 1998

NATIONAL RESPONSE CORPORATION

446 Edwards Avenue
Calverton, New York 11933-0609

Arokia Cook
Instructor

George Wallace III
Director of Training

urse Number: 98145
rtificate Number: 98145-2887
mpletion Date: 04-Sep-98

HealthLine®
CORPORATE HEALTH SERVICES METRO ST. LOUIS

☐ Center 1
1212 South Grand
St. Louis, Missouri 63104
(314) 577-8060
Fax (314) 776-2793

☒ Center 2
83 Progress Parkway
Maryland Heights, Missouri 63043
(314) 434-8174
Fax (314) 434-8706

☐ Center 3
2626 North Broadway
St. Louis, Missouri 63102
(314) 241-5804
Fax (314) 241-3558

☐ Center 4
801 Hazelwest Drive
Hazelwood, Missouri 63042
(314) 895-2811
Fax (314) 919-2710

☐ Center 5
1617 South 3rd Street
St. Louis, Missouri 63104
(314) 421-2557
Fax (314) 421-2046

☐ Center 6
1709 Gilsinn Lane
Fenton, Missouri 63026
(314) 349-6850
Fax (314) 343-6641

RESULTS OF MEDICAL EXAMINATION

(214242*6*1) RANDLE, ROBERT JOSEPH JR
SSN#: 333-80-7097 D-O-B: 01/05/76
1177001018 ENVIRONMENTAL RESTORATION

SSN: _____ DOB _____

Employer Name _____

Today's Date 6-9-99

☐ Drug Screen Only ☐ Alcohol Only ☐ Drug Screen and Alcohol

☒ Able ☐ Unable to perform job functions as described by:
- ☒ Employee
- ☐ Written job description

If "unable" is checked, the reason is:
- ☐ Delay in job placement pending:
  - ☐ Further tests to be ordered/information to be reviewed
  - ☐ JCA
  - ☐ Personal physician follow-up
  - ☐ Other
  - ☐ Patient has a medical condition not anticipated to interfere with described job functions
- ☐ Review of outstanding results
  - ☒ Lab
  - ☐ Drug screen
  - ☐ X-ray
- ☐ Unable to perform essential job functions safely

Recommended physical restrictions Portacount fit test not performed due to machine malfunction.

☒ Based on the Medical Evaluation for fitness to wear respirator:
- ☒ No restrictions on respirator use
- ☐ Some specific use restrictions

Restrictions _____

☐ No respirator use permitted

Time in _____ Physician/Nurse Practitioner [signature] Date 6-9-99
Signature

Time out 2:21 JUN 99 Employee [signature] Date 6-9-99
Signature

31071 (7/98)

Environmental Restoration L.L.C.
16333 Westwoods Business Park Drive
St. Louis, Missouri 63021
(314) 227-7477
Fax: (314) 227-6447

RESPIRATORY AND PROTECTIVE EQUIPMENT TRAINING

I have received training in the proper usage of the following respirator and protective equipment and in the company's written respiratory program.

Training has included the following:

1. Written Respiratory Program: BR
2. Respirator Selection: BR
3. Respirator Limitation: BR
4. Fit testing methods: BR
5. Cleaning Techniques: BR
6. Inspection Requirements: BR
7. Maintenance: BR
8. Storage Requirements: BR
9. Medical Exams: BR
10. Qualitative Fit Test Used:
    Irritant Smoke: ~~X~~
    Isoamyl Acetate: ~~X~~
11. Quantitative Fit Test: ~~X~~
    A. Porta-Count Model 8015: ~~X~~
    B. ~~X~~
    C. Overall Fit Factor: ~~X~~

I have been trained and fitted with the following respirators:

MANUFACTURER	TYPE	SIZE	APPROVAL	DATE	INITIAL
MSA	Ultra-Twin Full Face	Medium			
MSA	Gas Mask Type				
MSA	Model 401 / Ultralite SCBA				
MSA	Cascade 5 Minute Egress System				

I have been provided with a copy of Environmental Restoration's Respiratory Protection Program:

Date: 9-9-98 Signed: [signature]

I have read and understand the Environmental Restoration Respiratory Protection Procedures and know how to obtain more information.

Signed: [signature] Date: 9-9-98

Environmental Restoration Representative: Signed: _____

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

STEVE DUKE

For Completion of
Review Training for HM 181/126 Haz Mat Training
in accordance with DOT in 49 CFR 172.700.

S99-038
Certificate #

SEPTEMBER 22, 1999
Date Awarded

DEBBIE LARAMIE
Instructor

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

STEVE DUKE

For Completion of
Initial Training (40 hours) for Hazardous Waste Site Workers
in accordance with OSHA in 29 CFR 1910.120(e)

S99-066
Certificate #

September 19-22, 1999
Date Awarded

Debbie S. Laramie

Environmental Restoration, L.L.C.

1999 Certificate of Training

Presented To

STEVE DUKE

For Completion of
Forklift Operator Safety Training
in accordance with OSHA in 29 CFR 1910.178

S99-05
Certificate #

SEPTEMBER 22, 1999
Date Awarded

Debbie Laramie
DEBBIE LARAMIE
Instructor

Date 10-1-99

Name of Traveler: Matt Dule
~~Steve Dule~~

American Express charge $363

Billable/Non-Billable (B or N/B) B

Site Number 1037

	Airport Name	Time	Airlines	Flt. No.
Leave	St. Louis	7:00 A.M.	Southwest	338
Arrive	Chicago	7:55		
Leave	Chicago	9:20	Southwest	814
Arrive	Raleigh	12:00 Noon		
Leave				
Arrive				
Leave				

Ticketless -

Steve Duke

Environmental Restoration L.L.C.
16333 Westwoods Business Park Drive
St. Louis, Missouri 63021
(314) 227-7477
Fax: (314) 227-6447

RESPIRATORY AND PROTECTIVE EQUIPMENT TRAINING

I have received training in the proper usage of the following respirator and protective equipment and in the company's written respiratory program.

Training has included the following:

1. Written Respiratory Program: SD
2. Respirator Selection: SD
3. Respirator Limitation: SD
4. Fit testing methods: SD
5. Cleaning Techniques: SD
6. Inspection Requirements: SD
7. Maintenance: SD
8. Storage Requirements: SD
9. Medical Exams: SD
10. Qualitative Fit Test Used:
    Irritant Smoke: SD
    Isoamyl Acetate:
11. ~~Quantitative Fit Test:~~
    ~~A. Porta-Count Model 8015:~~
    ~~B.~~
    ~~C. Overall Fit Factor:~~

I have been trained and fitted with the following respirators:

MANUFACTURER	TYPE	SIZE	APPROVAL	DATE	INITIAL
MSA	Ultra-Twin Full Face	L	DSC	9-22-99	SD
MSA	Gas Mask Type				
MSA	Model 401 / Ultralite SCBA				
MSA	Cascade 5 Minute Egress System				

I have been provided with a copy of Environmental Restoration's Respiratory Protection Program:

Date: 9/22/99 Signed: Steve Duke Jr.

I have read and understand the Environmental Restoration Respiratory Protection Procedures and know how to obtain more information.

Signed: Steve Duke Jr Date: 9/22/99

Environmental Restoration Representative: Signed: [illegible]